# Guidance on information requirements and chemical safety assessment

## Chapter R.18: Exposure scenario building and environmental release estimation for the waste life stage

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***Guidance on information requirements and chemical safety assessment***
***Chapter R.18: Exposure scenario building and environmental release estimation for the waste life stage***

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# PREFACE

This document describes the information requirements under REACH with regard to substance properties, exposure, use and risk management measures, and the chemical safety assessment. It is part of a series of guidance documents that are aimed to help all stakeholders with their preparation for fulfilling their obligations under the REACH regulation. These documents cover detailed guidance for a range of essential REACH processes as well as for some specific scientific and/or technical methods that industry or authorities need to make use of under REACH.

The first version of the guidance documents were drafted and discussed within the REACH Implementation Projects (RIPs) led by the European Commission services, involving stakeholders from Member States, industry and non-governmental organisations. The European Chemicals Agency (ECHA) updates this and other guidance documents following the Consultation procedure on guidance[1]. These guidance documents can be obtained via the website of the European Chemicals Agency (http://echa.europa.eu/reach_en.asp). Further guidance documents will be published on this website when they are finalised or updated.

This document relates to the REACH Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006[2] and its amendments as of 31 August 2011.

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1 Please note, that this guidance document was updated following the previous guidance consultation procedure

2 Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC (OJ L 396, 30.12.2006).

## DOCUMENT HISTORY

| Version | Comment | Date |
|---|---|---|
| Version 1 | First edition | July 2008 |
| Version 2 | Revised approach for exposure assessment for the waste life stage. The revision includes:<br><br>Modification of the title to be consistent with the scope of the guidance.<br><br>Inclusion of introductory Section R.18.1 to present the new approach and the updated guidance.<br><br>Introduction of the objectives of the guidance: provide advice for exposure assessment of the waste stage of a substance and communication of waste related information down the supply chain.<br><br>Inclusion of reference to Annex VI regarding waste-related information required for CSA in Section R.18.1.<br><br>Developing and providing more information about the workflow for characterising waste streams and new structure of Section R.18.2. Additional subsections for definition and identification of<br>- origins of waste: identification of types of waste<br>- destination of wastes: Introduction of three main waste routes for assessment of the waste stage (Disposal of municipal waste, recycling of municipal waste, hazardous waste treatment)<br>- relevance of waste stage: determination of the scope of the assessment. Provision of examples of criteria for concluding on the potential non-relevance of the waste stage.<br>- type of assessment to be carried out: On a case-by-case basis a qualitative or a quantitative assessment of the waste stage may need to be performed. The list of additional qualitative considerations on risks during the waste life stage from appendix R.13-1 was revised and included in the subsection as part of the qualitative argumentations.<br><br>Creation of dedicated Section R.18.2.4 for information on interface between REACH and Waste Legislation.<br><br>Revision of the quantitative assessment strategy and introduction of a method which considers local and regional releases and link to methodology used in Chapter R.16 for | December 2010 |

| | | |
|---|---|---|
| | environmental exposure assessment. Introduction of a two-fold approach for i) specific and ii) generic quantitative assessment and estimation of release rates.<br><br>Deletion of Section R.18.3.<br><br>Replacement of Section R.18.4 with detailed description of a new approach for tier 1 exposure assessment. Developing of the main determinants for releases estimation and the calculation of release rates for the relevant waste treatment processes.<br><br>Inclusion of information on how to use the result of the exposure assessment for Risk Characterization in additional Section R.18.5.<br><br>Inclusion of Section R.18.6 on the possible outcomes of a qualitative assessment.<br><br>Inclusion of a new Section R.18.7 on how to document and communicate along the supply chain adequate control of risks during the waste life stage.<br><br>Removal of appendices on environmental releases information on 14 waste treatment techniques, waste related information in ES for identified use, waste related information in ES for spray painting and ES format for a waste operation.<br><br>Inclusion of appendix R.18-1listing relevant terminology for waste life cycle stage.<br><br>Provision of default release factor values to the environment for waste treatment process scenarios in Appendix R.18-2 and general refinement considerations:<br><br>- landfill<br>- municipal waste incineration<br>- shredding<br>- road construction<br>- polymer recycling<br>- metal recycling<br>- paper recycling<br>- glass recycling<br>- hazardous waste incineration<br>- distillation<br>- separation<br><br>Inclusion of new waste treatment process list and simplified schemes for the identification of parameters determining the distribution of the substance along the process and the value of release factors Appendix R.18-3. | |

| | | |
|---|---|---|
| | Inclusion into Appendix R.18-4 of default values for ES building for fraction becoming waste, maximum amount used per day and site and maximum amount of substance contained in wastes treated in the region per year.<br><br>Inclusion of Appendix R.18-5 with information on refinement options for release estimates and generic ES.<br><br>Inclusion of two examples for the illustration of the implementation of the method in Appendix R.18- 6 and Appendix R.18- 7. | |
| Version 2.1 | Corrigendum:<br><br>(i) replacing references to the DSD/DPD by references to CLP<br><br>(ii) implementation of minor recommendations concerning nanomaterials arising from RIP-oN3<br><br>(iii) further minor editorial changes/corrections | October 2012 |

**Convention for citing the REACH regulation**

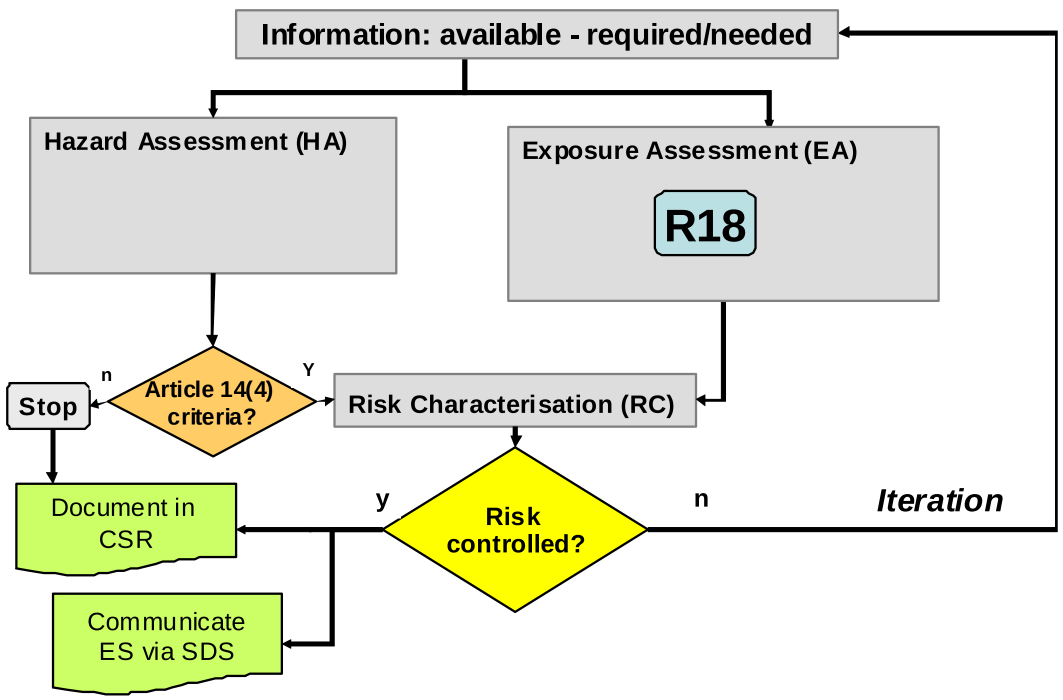
Where the REACH regulation is cited literally, this is indicated by text in italics between quotes.

**Table of Terms and Abbreviations**

See Chapter R.20 for general terms and appendix R.18-1 for terms specifically related to the waste stage.

**Pathfinder**

The figure below indicates the location of Chapter R.18 within the Guidance Document



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**List of abbreviations**

| | |
|---|---|
| BAT | Best available technique |
| BREF | BAT reference document |
| CSA | Chemical safety assessment |
| CSR | Chemical safety report |
| DF | Dispersiveness factor |
| DNEL | Derived no effect level |
| DU | Downstream User |
| EoL | End of life |
| ERC | Environmental release category |
| ES | Exposure scenario |
| ESD | Exposure scenario document |
| HW | Hazardous waste |
| IND | Industrial use setting |
| LoW | European List of Waste |
| M/I | Manufacturer / Importer |
| MCCP | Medium chain chlorinated paraffin |
| MSW | Municipal solid waste |
| MW | Municipal waste |
| OC | Operational condition |

| | |
|---|---|
| PBT | Persistent, Bioaccumulative and Toxic |
| PC | Chemical product category |
| PNEC | Predicted no effect concentration |
| REACH | Registration, evaluation and authorisation of chemicals |
| RF | Release factor |
| RMM | Risk management measure |
| RW | Recycling waste |
| SPERC | Sector specific environmental release category |
| STP | Sewage treatment plant |
| TGD | Technical guidance document |
| TOC | Total organic carbon |
| vPvB | Very Persistent and very Bioaccumulative |
| VOC | Volatile organic carbon |
| WD | Wide dispersive use setting |
| WTO | Waste treatment operation |
| WWTP | Waste water treatment plant |

# R.18 EXPOSURE SCENARIO BUILDING AND ENVIRONMENTAL RELEASE ESTIMATION FOR THE WASTE LIFE STAGE

## R.18.1 Introduction

Article 2.2 of REACH provides that *"waste as defined in Directive 2006/12/EC of the European Parliament and of the Council is not a substance, mixture or article within the meaning of Article 3 of this Regulation."* Therefore, REACH requirements for substances (on their own, in mixtures or in articles) in the waste life stage are limited[3].

General information on types, amounts and composition of waste occurring on manufacture and use of the substance are to be provided in the Technical Dossier (see Annex VI, point 3.6). In addition, manufacturers or importers of a substance as such, in mixtures or in articles[4] subject to registration under REACH are obliged to take the waste life cycle stage of the substance into account when undertaking the appropriate (exposure and risk) assessments under Title II of REACH. In particular, according to Article 3(37) of REACH exposure scenarios are defined as *"set of conditions, including operational conditions and risk management measures, that describe how the substance is manufactured or* ***used during its life-cycle*** *and how the manufacturer or importer controls, or recommends downstream users to control, exposures of humans and the environment. […]"*. The waste stage, as part of the life cycle of a substance, needs to be considered in the exposure scenario.

The waste, in which a substance may be contained, includes waste from manufacture of the substance, waste occurring as a consequence of the use of the substance (on its own or in mixtures) and waste formed at the end of service life of articles in which the substance is contained.

For substances for which a Chemical Safety Assessment (CSA) is required, the waste life stage of the substance needs to be covered by suitable exposure scenarios, the corresponding exposure estimation and the related risk characterisation.

The conditions ensuring control of risk in the waste life stage of the substance need to be documented in the chemical safety report (CSR) and also communicated in the supply chain by means of the extended Safety Data Sheet (extended SDS).

### R.18.1.1 Exposure assessment and Chemical Safety Assessment

The Chemical Safety Assessment is the method that the registrant is required to use in order to assess under which conditions a substance can be safely used. An overview on the CSA process is provided in part A of the Guidance on IR/CSA. A CSA always includes a hazard assessment, which includes classification and labelling, characterisation of PBT/vPvB-related substance properties and the derivation of DN(M)ELs and PNECs. This process, described in parts B and C, is the so-called Hazard Assessment (HA).

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[3] Further explanation on this is given in the guidance on registration (section 1.6.3.4).

[4] If Article 7 (1) of the REACH Regulation applies.

When the substance fulfils the criteria for any of the hazard classes or categories listed in Article 14 (4) of the REACH Regulation, as amended from 1 December 2010 by Article 58(1) of the CLP Regulation, namely:

- hazard classes 2.1 to 2.4, 2.6 and 2.7, 2.8 types A and B, 2.9, 2.10, 2.12, 2.13 categories 1 and 2, 2.14 categories 1 and 2, 2.15 types A to F;
- hazard classes 3.1 to 3.6, 3.7 adverse effects on sexual function and fertility or on development, 3.8 effects other than narcotic effects, 3.9 and 3.10;
- hazard class 4.1;
- hazard class 5.1,
- or is assessed to be a PBT[5] or vPvB[6]

REACH requires an Exposure Assessment (EA) to human and environment to be performed, as described in part D of the Guidance on IR/CSA. The EA has to include the generation of exposure scenario(s) (or the identification of relevant use and exposure categories if appropriate) and exposure estimation. Manufacture and all identified uses of the substance throughout the entire life cycle have to be covered. Furthermore, all the relevant human and environmental exposure routes and populations need to be addressed. The goal of the assessment is the final identification of the conditions of manufacture and use which ensure that risks are controlled. This information is then documented in the exposure scenarios.

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The different steps for exposure scenario building and for the estimation of exposure are detailed in Guidance part D and chapters R.12 to R.18. Chapter R.18 provides information for release estimation during the waste life stage, which will be used for the exposure assessment related to themanufacture or use.

### R.18.1.2 Aim of this chapter

This guidance explains how an environmental exposure assessment for the waste life stage can be carried out, and which information should be communicated down the supply chain.

The guidance includes workflows how to structure information on the waste life stage of a substance and how to calculate release rates in order to show that risks from the waste life cycle stage are controlled. It proposes default values for the parameters determining the exposure assessment: fractions of a substance becoming waste at the different life cycle stage, amount of substance in waste treated at one site and release factors depending on the type of treatment. It explains possibilities and limits for refining such default values if the initial exposure assessment fails to demonstrate control of risk.

At the manufacturing stage, the registrant has detailed knowledge about the amounts and about the treatment of waste. However, further down the supply chain, and in particular when the substance has entered into articles or consumer products the registrant may have difficulties to get information

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[5] Persistent, bioaccumulative, toxic

[6] Very persistent, very bioaccumulative

on the fractions and treatments of waste. Therefore, the guidance outlines two assessment approaches: A generic approach may be suitable for assessing the waste life cycles stage, when the registrant is unable to obtain specific information on what happens to his substance during the waste life cycle stage. A specific approach may be suitable if the registrant has access to more detailed information about the wastes generated on use or at the end-of service life of articles. It is assumed that waste from manufacturing can always be assessed based on the specific approach.

Information on the waste life stage may need to be included in the ES. This is the instrument to describe and communicate use conditions that are suitable to ensure control of risk to the users and information necessary to predict exposure based on these conditions. The guidance suggests which information on waste and waste treatments may be useful for these purposes and for DU's risk management.

The exposure assessment of the waste life cycle stage as well as the documentation and communication in the supply chain is exemplified for two substances (see Appendix R.18- 6 and Appendix R.18- 7).

This chapter of the Guidance on Information Requirements and Chemicals Safety Assessment is closely related to the following other guidance documents:

- Chapter R.16 on environmental exposure estimation provides general guidance on environmental exposure assessment, in particular exposure estimation. Consequently the scope of the current guidance is limited to i) the description of conditions of waste treatment and ii) the generation of corresponding release estimates
- General guidance on how to address risk management measures within a Chemicals Safety Assessment is provided in Chapter R.13.
- General guidance on exposure scenario building is contained in Guidance Part D.
- Guidance on waste and recovered substances, which explains the legal status of substances recovered from waste (and thus not being waste anymore).

A particular methodology for occupational exposure assessment in waste treatment operations has not been worked out due to the following considerations: Seen from the occupational perspective the types of technical processes carried out in waste industries are assumed to be largely the same as in other industries, and thus can be described with the process categories of the use descriptor system (see guidance part 12)[7]. Only if certain categories of processes potentially leading to high exposure have not been assessed for the preceding life-cycle stages, a particular assessment of the waste life stage may be needed. Such an assessment would then be carried out based on the methodology described in the guidance chapter R.14 on occupational exposure. Consequently the aspects of occupational exposure will only be addressed in section 18.2.3 of this guidance (relevance of the waste stage). Regarding the communication down the supply chain the registrant may limit the information to just stating which process categories have not been covered in his assessment.

**Please note: The Technical Appendices to the guidance include various values suggested as default values for waste fractions and release factors. These have been identified and**

[7] The working conditions on landfills and storage places of municipal waste may be an exception here.

**documented in a study prepared by Ökopol, Institut für Ökologie und Politik GmbH, an external service provider commissioned by ECHA. ECHA does not accept any liability with regard to the accuracy of these values.**

## R.18.1.3 Duties of M/I[8] and duties of DU

### R.18.1.3.1 Duties of registrants

The REACH requirements for substances, mixtures and articles do not apply to waste; and waste operations are not downstream uses under REACH. Risks in waste operations are to be primarily controlled based on requirements set by waste legislation. Nevertheless manufacturers and importers of substances, downstream users and potentially recipients of articles have a number of duties under REACH related to substances in waste.

Waste-related information must be included in the registration dossier for all substances, including those for which no CSR and/or SDS is required. Annex VI, section 3.6[9] of REACH requires the registrants to collect *"Information on waste quantities and composition of waste resulting from manufacture of the substance, the use in articles and identified uses"*. M/I are required to specify the types of wastes generated at each step in the supply chain (identified uses) and indicate its composition with regard to the content of the registered substance (and potential degradation products related to the registered substance). Additionally, section 5.8 of the same Annex requires *"disposal considerations"* to be included in the registration dossier if no CSR is required.

Registrants required to carry out a chemicals safety assessment are expected to cover the whole life cycle of the substance in the exposure assessment. Annex I paragraph 5.2.2 of REACH explicitly mentions the waste stage is to be assessed where relevant[10]. In addition, Annex I paragraph 5.1.1 of REACH also makes it clear that the Risk Management Measures of an Exposure Scenario shall include, where relevant, a description of "*waste management measures to reduce or avoid exposure during waste disposal and/or recycling*".

To which extent the waste life cycle stage of a substance is relevant and hence should be explicitly addressed in the CSA depends on a number of considerations further explained in Section R.18.2.3 of this guidance. Such considerations include for example which fraction of the substance amounts arrive at waste treatment stage or whether the conditions at waste treatment differ from the conditions of use already assessed for previous life cycle stages of the substance.

### R.18.1.3.2 Duties of downstream users

As a matter of principle, RMM included in the exposure scenario cannot be used to reduce obligation under waste legislation. Users of the substance need to follow the local waste legislation

[8] Manufacturer/Importer.

[9] In addition, for substances registered in amounts between 1 and 10t/a, an indication of the generation of solid waste is to be given in the context of environmental exposure (Section 6.2.2 of Annex VI of REACH).

[10] Examples of cases when the waste stage can be considered as not relevant are discussed in Section R.18.2.3.

requirements which should be considered when elaborating the ES. The ES should primarily make reference to existing OC and RMM identified by the regulatory framework for waste (e.g. IPPC and Waste Directives). Downstream users receiving waste-related information in an exposure scenario have the duty to implement the advice relevant to their own activity (uses under REACH) and if relevant to forward the information further downstream. The information in the ES should complement the requirements from waste legislation and focus on the specificities of the substance and its risks during the waste stage. The ES information includes i) waste handling at the DU's site, ii) choosing an appropriate route of external disposal and/or recovery and iii) informing customers on any waste-related measures particularly needed to control risks. While REACH cannot overrule the waste legislation, the registrant should indicate in his exposure scenarios which waste treatment techniques have been assessed to be appropriate and which should be avoided. If the recipient of the exposure scenario considers the advice inappropriate (e.g. due to conflicts with local waste requirements), he should communicate this back to his supplier. The downstream user, fulfilling his responsibilities as a waste generator, may also inform the waste service provider on any relevant advice he has received via the ES.

Information related to the waste stage may need to be communicated along the supply chain as part of the Safety Data Sheet (SDS). Any actor in the supply chain supplying substances that are hazardous in accordance with the criteria defined in Regulation (EC) No 1272/2008 or mixtures that are dangerous in accordance with the criteria defined in Directive 1999/45/EC[11] must provide an SDS to his customers. Under Section 13 of the SDS, information on "Disposal considerations" must be given, including (within sub-section 13.1) information on "waste treatment methods". This information should be consistent with the waste-related advice contained in the attached exposure scenarios (if a CSR is required for the substance).

It is important to underline that as waste operations are not identified uses, waste handlers are not downstream users under REACH and they don't receive SDSs and information included in the exposure scenario. Their activities are covered by the waste legislation which, as mentioned, need to be considered when building the ES.

### R.18.1.4 Overview of this guidance

Following the introductory sections, Section R.18.2 is dedicated to characterising the waste streams with a view to the needs under REACH. First the origins and the destinations of waste are explained. The relevance in assessing the waste stage is discussed. Practical advice on how to handle the interface between waste legislation and the REACH Regulation is given.

Section R.18.3 provides the basic workflow and approaches to how Tier 1 release estimates can be derived. In fact, two approaches are presented on how to identify the amount of a substance which is released to the environment during waste treatment. The generic approach is proposed for situations when the registrant has little knowledge about the amounts of waste and the waste streams, and does not have an influence on the waste treatments. This may especially be the case for substances in consumer products and/or articles. The specific approach is meant for cases when the

[11] From 1 June 2015 the criteria for classification of mixtures are also those of "hazardous" according to Regulation (EC) No 1272/2008, replacing of those of "dangerous" according to Directive 1999/45/EC.

registrant has more detailed knowledge about the amounts and destinations of waste, e.g. for own waste from manufacture.

Section R.18.4 explains the input parameters necessary for the exposure assessment at the waste life cycle stage. It presents how to calculate the release rates for the different environmental compartments. It explains the input necessary for the calculation and the algorithm for the calculation itself.

Section R.18.5 is dedicated to the exposure estimation and risk characterisation and it is the link to Chapter R.16 for the calculation of PECs.

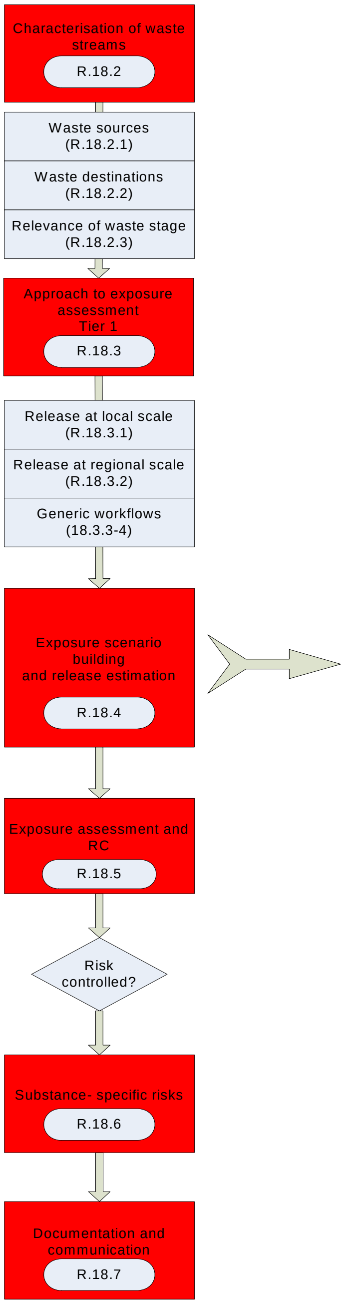
Section R.18.6 provides examples of additional considerations on risks related to the waste life stage which should be checked by the assessor as a last step of the exposure assessment. The M/I may need to consider further actions and communications along the supply chain, if substance specific risks so require.

Section R.18.7 provides an overview of information on the waste stage which may need to be documented and communicated. This section explains how to document the conditions of waste treatment in the CSR, and how to communicate the measures needed to adequately control the identified risk(s) along the supply chain. It shows how the results of the exposure assessment should be extracted for documentation in the registration dossier, in the chemical safety report, in the SDS, and in the exposure scenarios for the different uses.

Detailed and specific information to support the implementation of the approaches presented in the guidance are provided in the appendices. Table R.18- 1 indicates the content of each appendix.

**Table R.18- 1: Appendices and their content.**

| Appendix | Content |
|---|---|
| R.18-1 | Definitions of the relevant terms. |
| R.18-2 | Default release factors for release estimates for different waste treatment processes. This Appendix also gives general information on how to refine the values for more specific estimates. |
| R.18-3 | Schemes reflecting the distribution mechanisms for the substance in different types of waste treatment processes; to be used for iterations or when performing a specific exposure assessment. |
| R.18-4 | Default values for the standard parameters required for building an exposure scenario. This Appendix provides information for the estimation of the amount of substance treated at the waste stage. |
| R.18-5 | This Appendix provides information for refinement options in order to derive more accurate release factors. It also presents generic exposure scenarios for the main waste streams |
| R.18-6/7 | The approach suggested in this guidance is exemplified for two substances. |




| Required parameters | Necessary information | Information source in the guidance | |
|---|---|---|---|
| | | Default assessement | Refinement |
| $F_{waste}$ (fraction becoming waste) | Use conditions | **Appendix 18-4** | **Appendix 18-4** |
| | Waste destination | | |
| $Q_{max}$ (max amount treated d/y at site) | Use quantity | | |
| | Dispersiveness of waste treatment processes | **Appendix 18-4** | |
| RF (release factors) | Waste treatment process | **Appendix 18-2** | **Appendix 18-3** (distributions schemes) **Appendix 18-5** (refinement options) |

**Figure R.18- 1: Illustration of the workflow and location in the guidance of the relevant information**

## R.18.2 Characterising waste streams

As stated above, the M/I is required to describe suitable conditions of waste treatment and assess the related exposure arising from the waste stage of the substance following manufacture and all the identified uses (and subsequent service life) covered by the registration. Where this is applicable, he may assume that waste treatment takes place following the technical standards defined in the relevant waste legislation. To meet the requirements of the exposure assessment for the relevant waste life cycle stage, the registrant has to identify types and quantities of wastes containing the substance. It must be noted that the scope of this guidance is limited to waste legally treated in waste infrastructures. Assessment of waste remaining in the environment has not been included and no particular sections have been proposed for such waste. Waste remaining in the environment is assumed to be covered by the service life assessment[12].

In order to simplify and structure the exposure assessment of the waste stage, the current assessment approach distinguishes three main waste streams, each of which is connected with the most typical waste treatment processes: municipal waste (MW), recycling waste (RW) and hazardous wastes (HW) (see Section R.18.2.2). This simplified approach takes into account the fact that the registrant is not usually able to fully trace the waste treatment processes his substance is finally submitted to. By following the workflow described in this guidance, the registrant will be able to assess releases which are necessary to derive exposure occurring during those processes. In relation to the identified uses, the M/I may find that not all of these three main processes are relevant for assessment.

### R.18.2.1 Origin of wastes

Waste streams may be generated at each stage in the supply chain. The M/I is required to collect the following type of information on operational conditions of waste generation and existing/suitable waste management routes, when relevant considering the substance to be assessed and its specific life cycle:

- Residues from **manufacture** of a substance which are regarded as waste: it can be assumed that the M/I has all necessary knowledge available in-house: Mass balancing calculations (fraction of substance to waste via cleaning and maintenance operations need to be added in any case) which can be taken from the IPPC application or solvent management plans under the VOC Directive[13], and hence this information can be used to determine the amount of a substance in waste. The M/I should also know which waste management route(s) can be used.
- Residues from **formulating** mixtures (e.g. cleaning operations, low quality charges) and transfer of substances from/to containers further downstream, regarded as waste: the waste operations may need risk management comparable to that applied to the mixture. The M/I may contact downstream users and their sector organizations to obtain information on usually applied and most appropriate waste treatment routes. Also, information on the fraction of substances remaining in empty containers and the losses to waste occurring during cleaning operations of

[12] In this regard it should be noted that other waste sources like e.g. littering are not considered as waste streams.

[13] Council Directive 1999/13/EC on Volatile Organic Compounds, amended via Article 13 of Directive 2004/42/EC (Paint Directive).

mixing equipment are likely to be available at formulators' level. For the purpose of clearly identifying the wastes, it may be considered desirable to use waste codes, preferably those of the European List of Waste (LoW). Legislation on (hazardous) wastes[14] and the list of waste[15] can support the identification of types of waste from downstream uses. Furthermore, types of waste and approximations of the substance contents therein can be derived from the use descriptors or general knowledge of the use of a substance in mixtures.

- Residues from **use of mixtures** (e.g. spent lubricants, overspray from spray painting, exhausted baths), regarded as waste: The composition and the physical state of such waste may or may not largely differ from that of the applied substance. Residual liquids from dying/finishing textiles or surplus of printing inks or coatings may be similar in composition to the mixture initially applied. In other cases, like for example spent lubricants or metal cutting fluids, the chemical applied in the process will have largely changed its composition. This also applies to substances contained in residues from air purification or on-site waste water treatment. The risks of handling the waste (and the corresponding risk management) may be driven by these changes in composition rather than the registered substances in the waste. The M/I may contact downstream users and their sector organizations to obtain information on usually applied and most appropriate waste treatment routes. For the purpose of clearly identifying the wastes, may be considered desirable to use suitable codes, preferably those of the European LoW for typical waste types (e.g. spray paint sludge). Also, information on the fraction of a mixture entering into the waste stream is likely to be available at DU level, e.g. from IPPC applications or solvent management plans under the VOC Directive. Public information on types and composition of wastes from downstream uses can be found in sector specific publications, from associations in BREF documents[16] for specific sectors or waste specific publications. These publications may also specify recommended or legally required waste treatment processes. The BREF on waste incineration and the BREF on waste treatment describes which types of wastes can be treated in different waste treatment processes.
- Residues from **processing articles** (in which the substance has been incorporated) in the production of articles, regarded as waste. The M/I has no direct access to information through the supply chain (processing of articles is not a downstream use under REACH), and thus he needs to work with default assumptions from literature or obtained from specialised waste companies or their associations. However such waste (e.g. paper scrap, plastic scrap, metal scrap) is principally recycled along the same routes as corresponding waste from articles at the end of service life.
- Articles at the **end of their service life** (post-consumer waste). The M/I has no direct access to information through the supply chain (use of articles is not a downstream use under REACH), and thus he needs to work with default assumptions from literature or obtained from specialised waste companies or their associations. These are for example companies dismantling cars,

14 An overview of waste legislation as well as links to specific directives and regulations can be found at http://ec.europa.eu/environment/waste/index.htm

15 Last version to be consulted on the Eur Lex website ( http://eur-lex.europa.eu/en/index.htm).

16 Best available techniques reference documents. Apart from the BREFs on the waste management sector, which provides associated emission levels related to the use of BAT, other documents are available for several industrial sectors, describing processes, emission limits as well as providing information on typical wastes generated. They can be obtained at http://eippcb.jrc.es/reference/

household appliances, or electronic articles, companies collecting and processing waste paper or packaging material, or companies dismantling buildings.

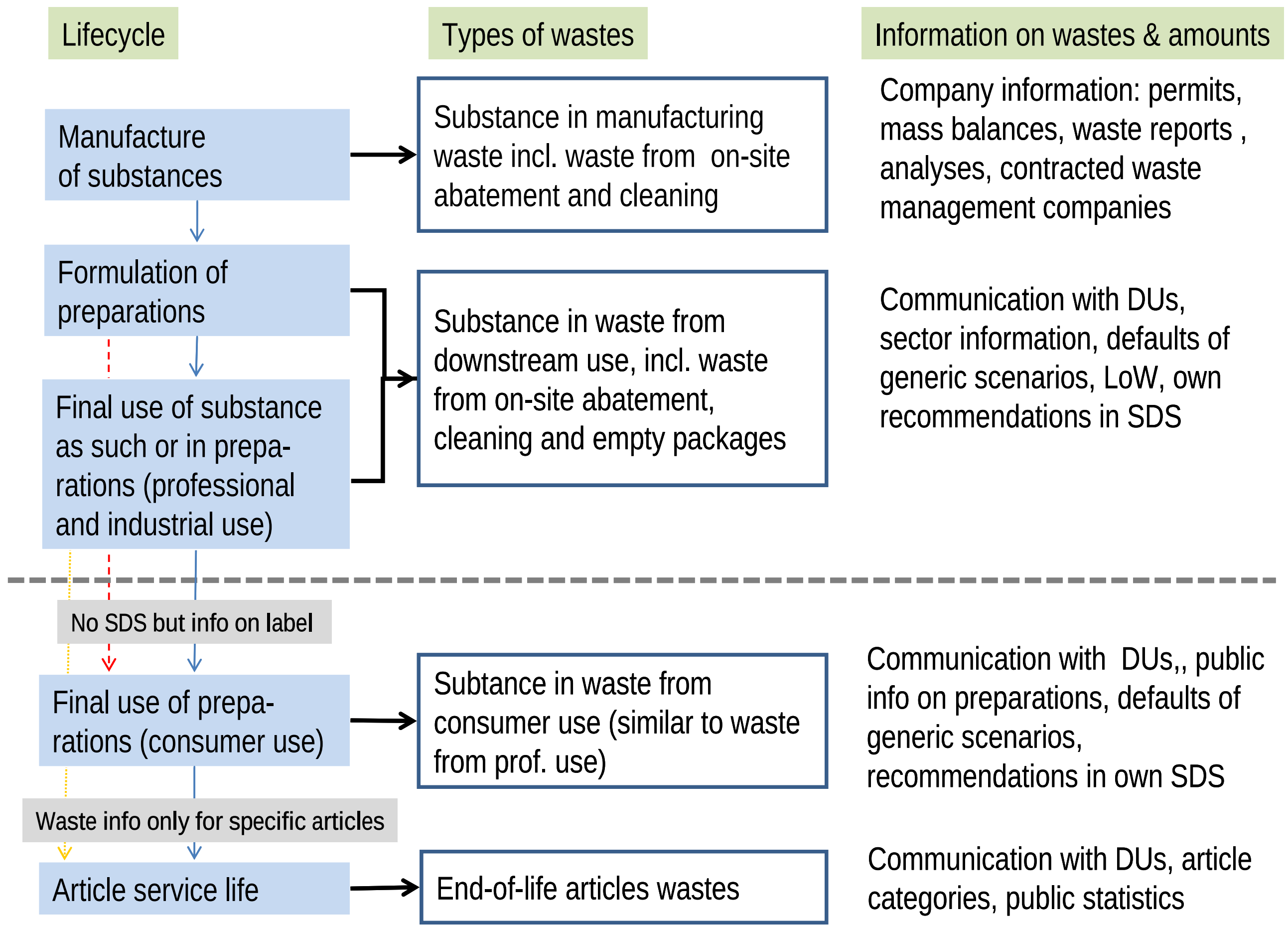
- Residues from treatment in dedicated **waste treatment** facilities which are still regarded as waste. Residues such as slags or filter dust from waste incineration, residues from re-distillation of solvents, dust fractions from milling end-of life articles may need to be covered by the assessment of the waste life stage on a case-by-case basis. The registrant may conclude that the conditions of treatment of such materials have already been assessed under previous life stages or that the quantity of substance in secondary waste is not relevant for exposure assessment purposes (see Section R.18.2.3). The M/I has no access to information through the supply chain and thus, when the assessment is to be performed, he will need to work with default assumptions from literature or obtained from specialised companies or their associations.

It should be noted that "residues", which have here the meaning of unintended output of a process, are not always to be considered as waste and thus may not have to be covered by the assessment of the waste life stage. On a case-by-case basis, such substances may be considered as internal residues and thus to be covered as part of the ES for the manufacture or downstream uses.

**The Outputs** of this initial analysis are:

- Types of chemical products and articles that may become waste during the life cycle of the substance. Based on this, the appropriate entries in the European LoW may be identified.
- Identification of residues from environmental risk management (onsite abatement) measures applied during the life cycle that will be disposed of as waste.

Figure R.18- 2 provides an overview of waste generation during the life-cycle of a substance and examples of related possible sources of information.




LoW = List of Waste (established by Commission Decision 2000/532/EC), DU = downstream user, SDS = Safety Data Sheet

**Figure R.18- 2: Types of waste generated along the life cycle of a substance**

### R.18.2.2 Destinations of wastes

The waste sector consists of a large variety of actors, and wastes usually undergo several treatment steps before they are either disposed of or recovered. These steps may be performed at one or several sites, frequently involving separation or mixing of different waste fractions. In this regard, the waste treatment chains are similarly complex to supply chains.

The registrant possesses full information on his own manufacturing waste and in certain cases also on the waste of downstream use concerning the waste's nature and composition, as well as the applicable waste treatment process into which it enters. However information on the amounts of substance becoming waste later in the supply chain or after the consumer stage (interruption of the information chain) may be complicated to obtain and the assessment becomes more difficult.

With the aim of simplifying the assessment of the waste destination, the guidance proposes three main waste treatment destinations which the registrant may consider for the assessment of the waste stage related to the identified uses. In this Section a general description of the three main waste destinations is provided.

#### R.18.2.2.1 Municipal Wastes (MW)

According to the Landfill Directive (1999/31/EC, as amended), municipal waste is defined as:

*"…waste from households, as well as other waste, which, because of its nature or composition, is similar to waste from households."*

According to this definition, substances contained in municipal wastes could originate from any activity or article. Municipal wastes originate not only from private households, but could also stem from manufacturing and downstream uses (non-hazardous wastes[17]) of the substance as such, in mixtures or in articles. This category also includes processing aids because they may contaminate other materials during their use, which are later disposed of as municipal waste, e.g. packaging materials, clothes or rags.

The approach suggested in the guidance is to consider municipal waste as destined for two main waste treatment processes: landfill and thermal treatment. Certain (fractions of) municipal wastes could also enter recycling processes. This is not reflected in the assessment of the waste entering the main waste stream MW, but rather in the waste stream "recycling wastes" (see Section 18.2.2.2 below). However, the municipal waste stream covers recovery[18] mainly related to heat energy recovery from thermal treatment of wastes. This is not explicitly addressed, as recovery is regarded as part of "thermal treatment" and hence covered by that.

#### R.18.2.2.2 Article waste for recycling (RW)

This waste stream comprises **solid non-hazardous wastes** that contain substances or materials which are to be recycled from article waste[19].

Origins of wastes for recycling can be materials or articles used by consumers, industrial or professional users which are collected via special collection systems. Furthermore, off-specifications from downstream users (solid materials) could enter this waste stream. Substances could either be recycled as such or be attached to (e.g. as component in a coating) or contained in materials (e.g. additives) which are recycled.

Materials likely to be recycled are either of high value (e.g. precious metals) or those which remain unchanged and scarcely diluted during use (e.g. glass). Under the recycling process the main fractions paper, glass, ferrous and non ferrous metals, rubber, mineral construction materials and plastics will be distinguished and further discussed. Furthermore the shredding scenario for

[17] "Hazardous waste" is to be understood to as defined in Directive 2008/98/EC. Hazardous waste is defined in article 3(2) and hazardous properties are listed in Annex III of that Directive.

[18] Note that under REACH, recovery is understood as recovery of substances from wastes, either as such or as part of a material / mixture. This understanding differs from that under waste legislation (see also appendix R.18-1).

[19] "Non hazardous waste" is here defined according the waste legislation. It may nevertheless contain hazardous substances. In some cases parts of the waste may be classified as hazardous and separated. For example if End-of-Life Vehicles (ELVs) are collected and dismantled, braking fluids or hydraulic oils are hazardous liquid wastes, which would occur in the recycling waste stream. The assessment of treatment of these components would be carried out in the context of the third waste stream (hazardous wastes) and would not be considered as entering the RW stream.

recycling waste is addressed since its assessment may be relevant for all substance contained in recycling waste[20].

In addition, recycling wastes include complex articles and end-of-life article wastes for which specific legal requirements and/or voluntary regimes exist to support separate collection and waste treatment. This includes complex articles like vehicles, electric and electronic equipment and batteries possibly containing hazardous substances, as well as packaging consisting of several materials. Table R.18-2 correlates the use descriptors for article categories with the most likely recycling processes. As shown in the table, some of the waste streams are classified as hazardous according the Waste Directive and are not to be included in the general destination "Recycling Waste". These are instead to be considered as entering the waste destination "Hazardous Waste" described in the next section.

**Table R.18-2: Correlation of article categories with recycling waste streams**

| Article categories | Waste treatment for recycling wastes |
|---|---|
| AC 1 Vehicles | End-of-life vehicles =><br>metal recycling, plastic recycling, glass recycling (oils and brake fluids are treated as hazardous waste (HW) |
| AC 2 Machinery, mechanical appliances, electrical/electronic articles | Waste electronic and electric equipment (WEEE) =><br>metal recycling, plastic recycling, glass recycling (TV and PC monitor) |
| AC 3 Electrical batteries and accumulators | Metal recycling |
| AC 4 Stone, plaster, cement, glass and ceramic articles | Glass recycling, recycling of construction materials |
| AC 7 Metal articles | Metal recycling |
| AC 8 Paper articles | Paper recycling |
| AC 10 Rubber articles | Rubber recycling |
| AC 13 Plastic articles | Plastics recycling |

The destination of wastes for recycling are the specific recycling processes applicable either to the substance or the material in which it is contained.

### R.18.2.2.3 Hazardous Wastes (HW)

According to legislation, waste has to be classified as hazardous if it fulfils the criteria defined by the Hazardous Waste Directive[21]. A waste could be classified as hazardous because of the contents

[20] "Shredding" scenario in particular may represent important source of exposure for the waste life stage but, as for "Road construction" scenario, is scarcely covered by Community legislation. Considerations for assessment and option for refinement are provided, as for the other scenarios, in the appendices.

[21] Directive 2008/98/EC on waste (Waste Framework Directive), defines, in article 3(2) the term hazardous waste as "waste which displays one or more of the hazardous properties listed in Annex III.

of the assessed (hazardous) substance, but also because of the presence of other hazardous components. According to waste legislation, hazardous wastes are to be subjected to more specific waste treatment processes. Although some wastes from consumer uses (e.g. paints residues, light bulbs, packages of biocides, …) may be hazardous, most of the hazardous wastes are generated in manufacturing and downstream uses of the substance concerned.

The assessed substance could be contained in hazardous wastes from:

- manufacturing (residues and off-specifications, cleaning of equipment),
- downstream uses of mixtures, e.g. cleaning solvents, metal cutting fluids, treatment baths (e.g. metal plating, textile dying), paints, lubricants. In general the waste could occur in the form of unused left-overs of the original mixture, residues of the mixture lost from the application process (e.g. when cleaning equipment), contaminated packaging, exhausted processing aids;
- risk management measures applied by manufacturers or downstream users, e.g. filters of exhaust gas cleaning devices, sludge from on-site waste water treatment, removal of particles from the ground but also clothing of workers, gloves or face masks,
- consumer uses of classified mixtures (residuals, packaging, contaminated equipment).

In the hazardous waste stream also waste oils will be addressed, despite the fact that specific legislation[22] is in place requiring separate collection and promoting material recovery/recycling. The same applies e.g. to solvents. This is due to waste oils being hazardous and the fact that specific treatment processes for liquid wastes are provided in more detail in Appendix R.18-2.

## R.18.2.3 Relevance of the waste stage and definition of the assessment to be carried out

The M/I should determine the scope of his assessment by defining the relevant lifecycle stages. Waste may be generated from any manufacturing or use of a substance. However, there may be cases where the registrant can conclude that the assessment of the waste stage is of no relevance for the outcome of the CSA. Whenever the waste stage has to be assessed, the type of assessment (qualitative or quantitative release/exposure considerations) and the resulting communication needs via exposure scenario should be determined.

### R.18.2.3.1 Assessment of the relevance of the waste life cycle stage

The relevance of the waste stage within the exposure assessment for a substance is to be understood as the outcome of an overall consideration which takes into account different qualitative and quantitative elements, such as type of substance becoming waste, type of waste, amounts of substance in waste or conditions at the waste stage. An up-front conclusion that there is no need to carry out a more detailed exposure assessment for the waste stage should be well documented and justified in the CSR.

The following criteria are examples of bases for concluding on the potential non-relevance of the waste stage. They should be used within an overall analysis on relevance of the waste stage within the exposure assessment, and not in isolation from each other.

[22] Directive 98/2008/EEC (WFD).

- The substance is used as an intermediate under strictly controlled conditions: Waste is generated only during manufacture of the intermediate and its use for manufacture of another substance. Waste from use of intermediates under strictly controlled conditions is not to be covered in a CSA, since such intermediates are exempted from the CSA requirement under REACH[23]. Please note: If the residues (or by-products) from manufacture are placed on the marked as non-waste, registration as a substance under REACH is required.

- The substance reacts upon end use: After reaction, the substance as such no longer exists and therefore no further lifecycle stages exist[24]. In such cases the quantitative assessment can be limited to the waste amounts which occurred before reaction[25]. Please note: In order to draw such a conclusion, the M/I needs to consider the extent to which the reaction occurs on end-use conditions, i.e. whether 100% of the substance reacts or a fraction remains; furthermore it should be considered whether reaction products other than those intended occur or not.

- The substance is used in fuels[26]: The use as fuel implies the destruction of the substance in that process. Hence, only wastes from the lifecycle stages before the use as fuel could contain the substance. Please note: The reaction products of inorganic substances or constituents (impurities) of substances within the fuel may still exist after incineration. The M/I would need to take this into account before concluding that the waste stage of a substance is not relevant.

- The substance is used as a processing aid, and is fully emitted to air or waste water on end-use. These fractions are no longer relevant for subsequent waste life stages.

- Only small fractions of the mass flow of the substance end up in the waste stage. This consideration should take into account the initial quantities of the substance placed on the market and the outcome of the assessment for the previous life stages.

- The conditions in the waste stage are already covered in the exposure assessment for other life cycle stages, and it can be concluded that the expected releases to the environment from the waste stage are significantly lower than those from the previous life cycle stages.

- The conditions in the waste stage are already covered in the exposure assessment for other life cycle stages, and it can be concluded that the anticipated waste treatment does not include processes that could lead to higher occupational exposure than already assessed for other life cycle stages. For example, dust forming processes may not be relevant for the downstream uses of a substance, and thus they are not covered in the exposure assessment. However during the

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[23] Note that waste related information may need to be included in the dossier for registration purposes (section 3.6 of Annex VI and Articles 17(2)(f) and 18(2)(f) to the extent that the manufacturer is able to submit it without any additional testing).

[24] If the substance is used in excess to its co-reactant, relevant and particularly hazardous wastes may be generated. This is often the case in two-component packages, which are mixed (manually) directly before use. Here, wastes from the non-reacted substance remaining in packaging, from cleaning or from other residues should be regarded as relevant and assessed.

[25] Nevertheless the risk from the disposal of the reacted product should be considered by M/I. Also downstream users supplying substances for reaction upon end-use should consider wastes from the reacted product.

[26] When assessing substance used as fuels Directive 98/70/EC should be considered as well as further uses exempted from authorisation under Article 56(4) REACH.

waste stage milling processes (e.g. for electronic articles) may be carried out, potentially leading to respiratory or dermal exposure. In such cases the registrant would be expected to additionally include the conditions at waste stage into his exposure assessment.

- The expected concentration of the substance at waste stage falls below the cut-off concentrations laid down in article 14(2) of REACH, and the overall amount of substance in waste is sufficiently low so that no relevant release rates to the environment could occur.

If the waste stage of a substance includes or exclusively consists of recovery processes, this may be the end of the lifecycle of the substance, if the end of waste life is reached during the process. At the same time a new life-cycle starts. The waste entering the recovery process is part of the first life cycle and to be assessed by the registrant. The recovered substance as such or in a mixture or an article is however placed on the market under the responsibility of the company undertaking the recovery[27]. The substance manufacturers and the legal entity performing the final recovery may co-operate by sharing their knowledge – the manufacturer of the substance needs information on the recycling process for his CSA, and the recycler needs to know details on the manufactured substance in order to potentially benefit from the exemptions for recovered substances (Article 2.7(d) of REACH).

The description of use (see descriptor system in Chapter R.12[28]) may help to identify i) suitable waste categories from the European LoW and ii) waste categories with special EU requirements under waste regulations. Where no information is available the registrant may choose to contact representative customers.

### R.18.2.3.2 Type of exposure assessment required

Once the relevant waste stages have been identified, the registrant should determine the type of assessment suitable for the CSR and the related recommendations/assumptions to be communicated down the chain. The following matrix provides an overview on the generic assessment cases that may occur.

**Table R.18- 3: Generic assessment cases and related information to be communicated**

| | Exposure estimation and risk characterisation | Exposure scenario information for communication |
|---|---|---|
| Technical standard for waste treatment technique laid down in EU legislation (including emission limits and required process parameters). | Qualitative argumentation why the suggested treatment technique is suitable to prevent/minimise releases of the substance to the environment | • fraction of substance becoming waste<br>• suitable waste codes<br>• specification of suitable waste management measure or treatment technique<br>• any behavioural advice to waste generator |
| The suggested waste treatment | Quantitative release estimation | • fraction of substance becoming waste |

[27] The Guidance on waste and recovered substances explains in detail the requirements for recovered substances and for exemption under Article .2(7) of REACH and the information to be collected by the recycler.

[28] Guidance on IR/CSA which is available on the ECHA Guidance website.

| | | |
|---|---|---|
| technique can be legally carried out under a wide range of conditions impacting on the expected release rate. | and quantitative risk characterisation | • suitable waste codes<br>• specification of suitable waste management measure or treatment technique<br>• specific requirements for the treatment technique including effectiveness<br>• any behavioural advice to waste generator |
| The substance properties suggest that the conditions of treatment do not lead to destruction or immobilisation of the substance (e.g. metals in incineration or volatile/water soluble substances in landfills). | Quantitative release estimation and quantitative risk characterisation | • fraction of substance becoming waste<br>• suitable waste codes<br>• specification of suitable waste management measure or treatment technique<br>• specific requirements for the treatment technique including effectiveness<br>• any behavioural advice to waste generator |

A qualitative assessment on release and potential risks should be based on:

- physico-chemical properties of the substance,
- hazard properties of the substance,
- potential degradation products
- amount of waste,
- conditions of treatment operations in disposal and recovery.

When a defined standard does not exist or the substance is not eliminated (destruction or immobilisation) during the process, a release estimation and quantitative risk characterisation is necessary to support the conclusion on waste process and conditions for safe handling of waste.

A particular approach is needed regarding landfills for mixed municipal waste or construction waste. Since no good models exist to predict the releases from landfills, the registrant should demonstrate control of risk based on a qualitative argumentation as to why the substance is unlikely to be released under landfill conditions. This argumentation may be based on volatility, water solubility, degradability and adsorption behaviour.

In addition a number of further risk aspects should be considered in the assessment of the waste life stage: The following list gives examples of such risks:

- Substances with PBT properties would in any case require an accurate qualitative assessment according to the specific requirements resulting from the inherent fact that no safe levels (PNECs) can be defined;
- Formation of break-down products during thermal treatment: Certain substances could form toxic, persistent and bioaccumulative breakdown products under thermal stress during waste treatment (e.g. halogenated flame retardants in plastic/copper composite material);
    - The M/I should quote available information in the CSA;
    - Relevant information is to be forwarded to DUs via the SDS and the ES;

- Compliant incineration plants should not lead to unacceptable releases of dioxins or other newly formed substances of specific concerns;

- Occurrence of the substance in products/articles made from recycling materials: substances which are likely to be recycled should be assessed with regard to their potential of "contaminating" products made from secondary raw materials (e.g. flame retarded plastics should be prevented from being used in children's toys);

  - To be qualitatively assessed in the CSA;

  - Prevention of occurrence by preventing the material from entering relevant waste streams in significant amounts.

### R.18.2.4 Advice on how to handle the interface between REACH and Waste Legislation

The registrant must always consider the possible borderline between the REACH regime (from manufacturer to final downstream user) and the waste regime (from waste generator to final disposal or recovery operation). Thus companies may have two roles at the same time: Downstream user and waste generator; waste-recycler and placer on the market of a (recycled) substance.

In order to handle the interface between the two legislative systems in a proper way the M/I and DU should take note of the following:

Internal handling of substances in waste: the DU is still responsible for applying the operational conditions (OC) and risk management measures (RMM) identified in the exposure scenario, although the waste regime may already apply. This relates for example to occupational and environmental measures to prevent exposure from internal collection and storage of waste, and onsite pre-treatment of residues regarded as waste, for example by extracting water. The DU is also responsible for sending the waste to appropriate waste treatment as identified in the ES and in line with waste management legislation. The duties of the DU under REACH *end* when the residues have been transferred to the responsibility of an authorised waste management company.

Cleaning and regeneration of empty/contaminated/used processing aids or product aids (e.g. re-distillation of cleaners, washing of cleaning wipes) outside waste legislation is regarded a downstream use under REACH. Such operations will not be covered in this guidance.

Residues that may occur in onsite pre-treatment of waste-water and exhaust air (as a result of environmental risk management measures) and which are to be disposed of in waste treatment facilities should be covered in the waste management section of the relevant exposure scenarios. Hence, this guidance suggests considering the status of residues generated by any process: whenever they are regarded as waste, these may need to be covered in the assessment of the waste life cycle stage.

## R.18.3 Tier 1 Quantitative exposure assessment for the waste life stage

Environmental exposure as described in Guidance R.16 includes two steps.

*Step 1:* Determination of releases to the environment at local and at regional scale, driven by the operational conditions and risk management measures relevant for the different uses.

*Step 2:* Assessment of distribution and fate of the substance in the environment leading to certain concentrations of the substance in the different environmental compartments. Distribution and fate are mainly driven by substance properties, once the substance has been released to the environment.

The first step is addressed in this guidance, however focusing exclusively on the waste life stage. The second step is only addressed in Guidance R.16 and the assessment is independent of the life cycle stage at which the releases occur.

Two scenarios are to be assessed regarding the releases to the environment (step 1). The local scenario covers releases from point sources in a local environment. The regional scenario covers all releases taking place at regional scale (including those from point sources). The "regional scenario" does not refer to a specific region in the EU but is a standardised calculation model. The regional scenario is needed to derive "background" values for the local scenario in order to take account of the fact that the exposure in a local environment is also influenced by releases that take place elsewhere.

### R.18.3.1 Releases at local scale

The guidance focuses on the calculation of the release rates ($Elocal_{, air}$; $Elocal_{, water}$; $Elocal_{, soil}$) of the substance during the waste stage. From these releases exposure estimation for the different environmental compartments can be derived, as described in the guidance chapter R.16.

The suggested approaches in this guidance allow the identification and derivation of the input parameters of the release assessment: fraction becoming waste ($f_{waste}$), amount of substance treated per installation per day ($Q_{max,local}$)[29], and the release factor (RF) necessary for the derivation of the release estimates. The latter depend on, e.g., physical-chemical properties of the substance and the operational conditions (OC) and risk management measures (RMM) implemented in the waste treatment installation. These three parameters are described in Section R.18.4 and detailed in Appendix R.18-2 and Appendix R.18-4.

For the determination of the amount of substance per waste treatment installation ($Q_{max,local}$), two generic cases have to be distinguished:

- Manufacturing and use of the substance in the industrial setting. In a default conservative assessment it would be assumed that the manufacture takes place in one installation only, and also that the waste types originating from that manufacturing process are disposed of in one installation per required treatment type only. The same assumptions are made for uses at industrial sites. Additives for very particular rolling oils in the steel industry may be an example here. Thus the total volume of the substance in a waste stream resulting from manufacture or from use would be concentrated in one treatment site in the region. Based on higher amount of or more detailed information the registrant may refine the assumptions in the default assessment.

[29] This determinant is comparable to the daily use at site ($D_{daily}$) for an industrial setting in environmental exposure assessment (see Chapter R.16, section R.16.3.2.1).

- Wide dispersive use of the substance and service life in articles. In a default conservative assessment it would be assumed that the use takes place evenly distributed over the EU by many single users. Consequently the total volume of the substance in a waste stream resulting from dispersive uses or from article service life would be distributed across various waste treatment sites in the region. The number of sites to be assumed may vary, depending on the structure of the waste treatment type.

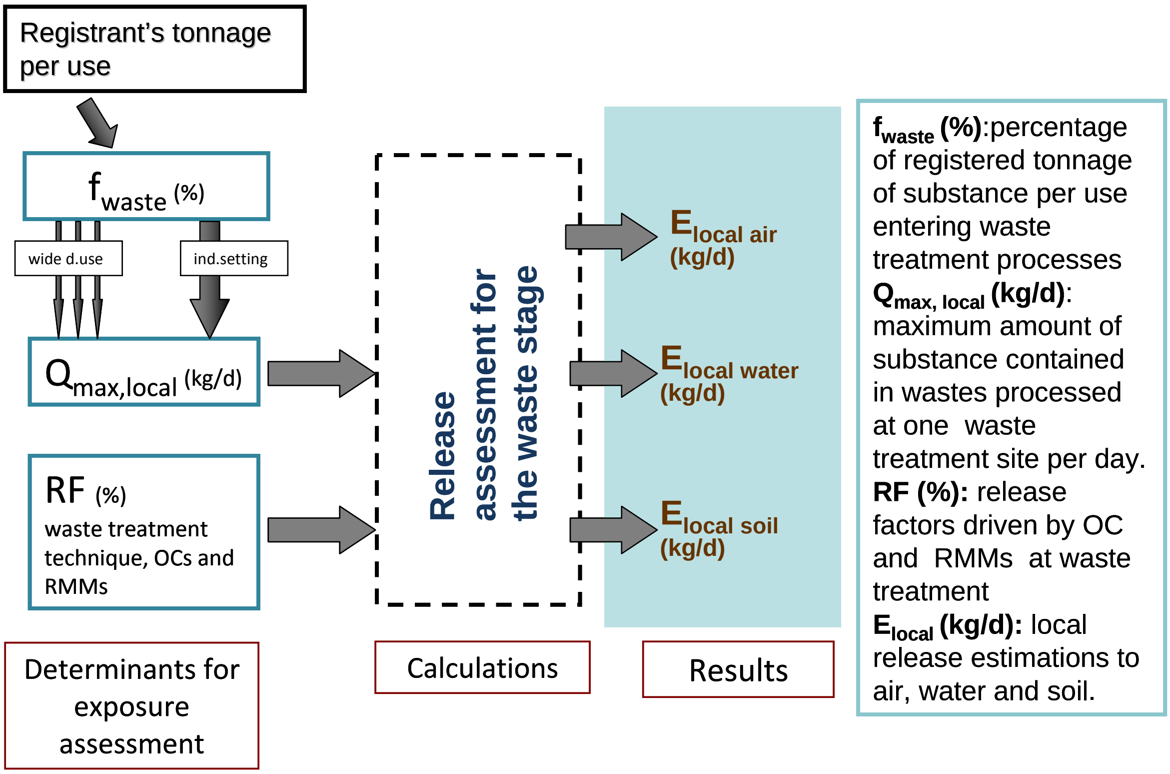


**Figure R.18-3: Determinants and results of local release assessment for the waste stage.**

As shown in

Figure **R.18-3** the results of the release assessment are release rates (estimates) to the relevant environmental compartments which occur during the waste stage of the assessed substance.

This guidance provides two approaches for exposure scenario building for the waste life stage. On the basis of the amount of available information on uses, wastes and waste treatment processes, registrants and other actors may chose between:

- a generic assessment, or
- a specific assessment based on more specific information on wastes and waste treatment processes.

The generic approach is useful when the available information on waste and waste treatments is not sufficient to allow use of the specific approach. In the generic approach, default parameters are provided to estimate, for each exposure scenario, the fractions of substance ending up in one of the main waste streams (MW, RW, HW) and general release rates will be calculated based on worst case release factors. Different assumptions need to be made between industrial uses generating waste (substance amount in waste may concentrate in fewer treatment sites) and wide dispersive uses generating waste (substance amount in waste is likely to be treated in a more dispersive waste treatment infrastructure).

The specific assessment is especially useful for wastes from manufacturing, because all information is available to derive release to the environment. The same may apply to well-defined industrial uses of substances, where the corresponding industry sectors may have most of the required information available.

In any case it should be considered that use of the specific approach may be better for hazardous substances, since the results of the generic approach may be too conservative.

Also, downstream users conducting a DU CSR may choose to make a specific assessment as they, like the substance manufacturer, have access to all information needed for a specific assessment of their waste.

In Sections R.18.3.3 and R.18.3.4 the generic and specific approach are briefly presented to enable the registrant to decide which approach is better applied in the specific case. Determinants and algorithms used in the exposure assessment are provided in Section R.18.4. Detailed information for implementation of the approach and necessary calculations are provided in Appendix R.18-2, Appendix R.18-3 and Appendix R.18-4. The approach is exemplified in Appendix R.18- 6 and Appendix R.18- 7 for two different substances.

### R.18.3.2 Releases at regional scale

As with other life cycle stages, the waste life stage contributes to releases of the substance at regional scale. In the context of Guidance R.16, this is a standard model of a European region with about 20 Millions inhabitants[30] and defined parameters (e.g. size, volume of water, soil, sediments and biota, etc…). In order to calculate the regional releases from waste treatment in the default conservative approach (Tier 1), again two cases are distinguished: i) Waste from manufacture and industrial uses and ii) waste from dispersive uses and article service life. The fraction of the registrant’s total amount per use assumed to be treated in the region ($Q_{max,regional}$) is different for the

[30] The model assumptions are still based on the original 15 EU Member States. For EU 27 the region represents 5% of the EU and thus the current model may slightly over-predict the true regional releases.

two cases: For manufacture and industrial uses the total use and related waste amount is assumed to occur in one region. For dispersive use and article service life, it is assumed that 10% of the registrant's total volume occurs in the region for use and related waste treatment.

At regional scale all the releases occurring at the different life cycle stages are summed up.

Figure R.18- 4 shows the input parameters and the results of the release assessment at regional scale. The outputs are the annual amounts of substance released to the different environmental compartments.

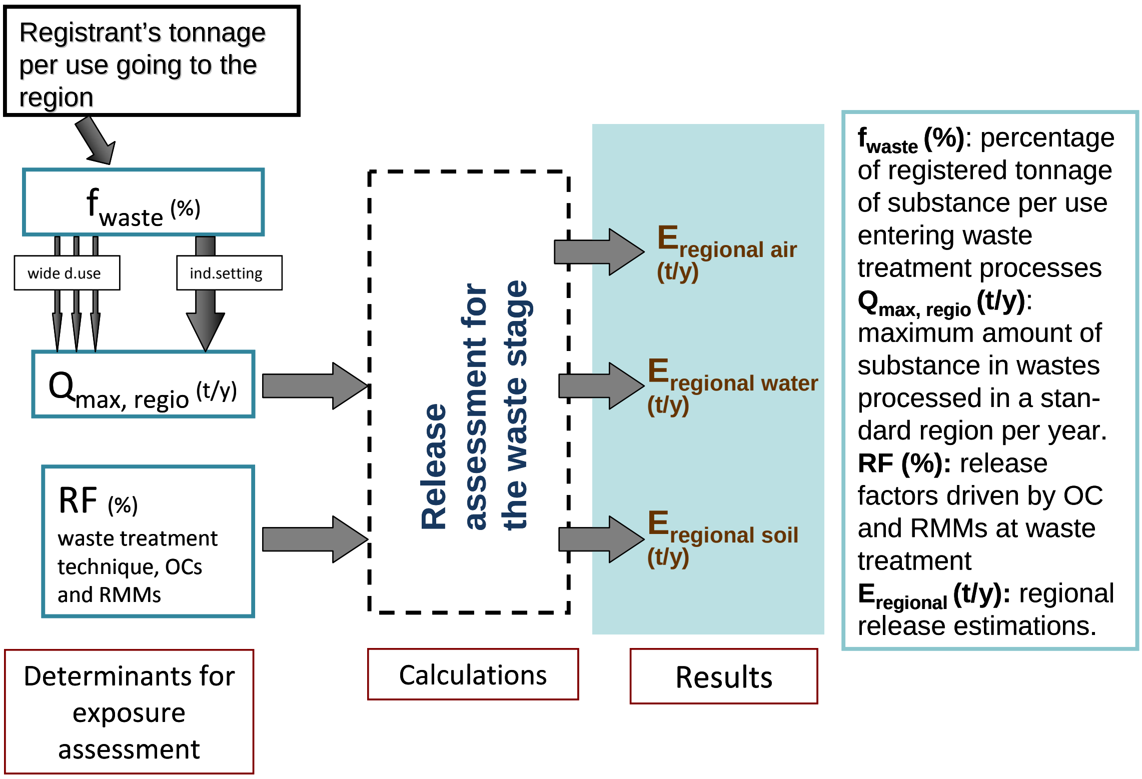


**Figure R.18- 4: Determinants and results of regional release estimation for the waste stage.**

### R.18.3.3 Workflow for the generic approach

If the registrant chooses to make a generic assessment, he should follow the steps indicated in the workflow in Figure R.18-5.

The generic release estimate uses conservative default values for identifying waste amounts and fractions entering into the three main waste streams. Furthermore, generic exposure scenarios can be selected containing default release factors and assumptions on implemented risk management in the processes.

The workflow aims to assist the M/I in structuring the origins and types of wastes containing his substance, as well as related waste treatment processes. Based on this structure, a tiered assessment is described in Section R.18.4, for which default values are provided for a first tier assessment in

Appendix R.18-2 and Appendix R.18-4 and information for refining scenarios is proposed in Appendix R.18-5.

The approach only covers the identification of releases of the substance from the different waste treatment processes to the environmental compartments water, air and soil (release estimation). Any fate modelling, i.e. the behaviour of the substance in the environment (e.g. biodegradation, adsorption to organic matter) is not included as it is assumed that fate modelling with e.g. EUSES[31] is carried out on a routine basis.

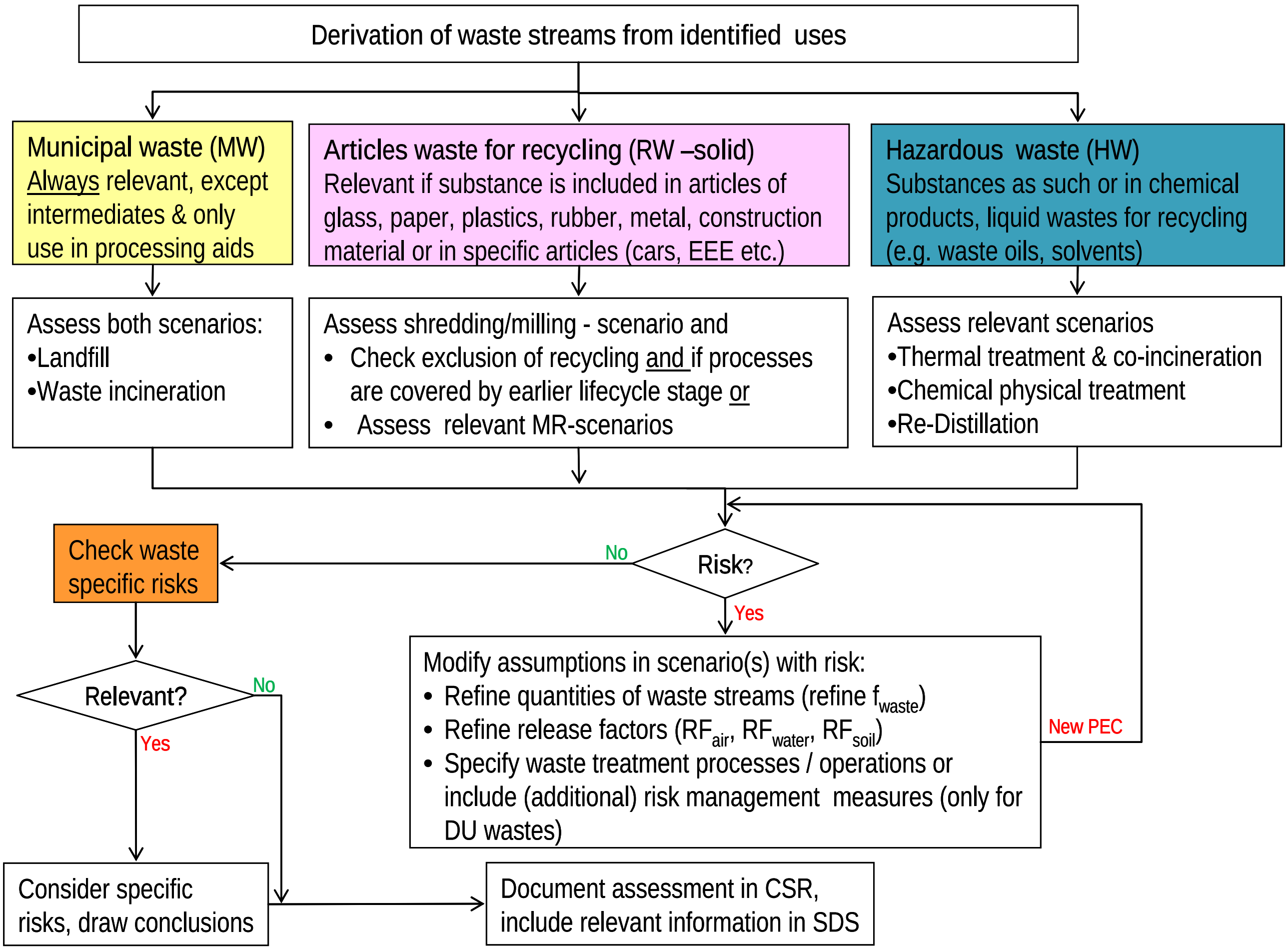


**Figure R.18-5: Workflow for generic approach**

The approach suggests grouping of wastes into three waste streams (municipal waste, recycling waste and hazardous waste) in order to structure and simplify the assessment. Based on information on types and composition of wastes and uses generating these wastes, the M/I can estimate the amounts of the substance contained in wastes entering each stream. The assessment has to be

[31] EUSES is a software which has been developed in the course of the assessment of risks from existing substances. Among other, EUSES can be used to predict how the substance behaves in the environment, based on information on its properties, it calculates concentrations of the substance in different environmental media.

performed differently for industrial setting uses and wide dispersive uses. The release estimate can be performed using the defaults proposed for the various waste treatment processes (see Appendix R.18-2 and Appendix R.18-4).

In the scenarios for assessment it is assumed that any handling and pre-treatment of waste occurs at the same site as the main treatment process (in order to provide a more conservative assessment) whilst being aware that these processes may also take place at different sites. If a risk is identified, the logics and information sources can be used to refine the assumptions in the generic scenarios.

The approach takes into account that in most cases the M/I cannot influence which waste streams and waste treatment process a mixture or article containing the substance ends up in. Hence, the registrant has no influence on the type and effectiveness of RMMs applied by the operators of waste treatment installations, as exposure scenarios and recommendations in the SDS do not reach them and are not binding for the waste sector. However, the registrant can inform the DUs on waste management measures, including the decision on which waste treatment route/process should be selected or may raise concerns for a specific waste. The registrant could therefore refine his assessment by limiting the suggested waste treatment processes and/or prescribing specific operational conditions or risk management measures. He is then to include the information into the exposure scenario communicated down the supply chain and recommend that waste be treated in accordance with these recommendations. Such information may be obtained from CEFIC's risk management library[32], EU BAT reference documents, SPERC[33]-fact sheets provided by the waste management sector, or by communication with respective waste treatment operators. The amount and type of specific information which can be communicated to complement the standard requirements of waste legislation depend on the addressee. The DU may be able to make choices regarding treatment of waste from industrial and professional uses by separately send waste to waste treatment operators, but he will have very limited possibilities to influence the destination of waste from article service life.

### R.18.3.4 Workflow for the specific approach

If the registrant chooses to make a specific assessment from the start, he should follow the steps indicated in

[32] The RMMs library is available on the CEFIC website.

[33] Sector Specific Environmental Release Categories, developed by industrial sector organisations.

Figure R.18-6.

The derivation of waste streams can be more specific in this approach compared to the generic approach, as in-house information and information from DUs can be used to more precisely identify types and amounts of wastes during manufacturing and downstream uses. This would result in more realistic amounts of the substance entering a particular waste treatment process (daily treated amount).

The types of waste treatment can be obtained from the supply chain and the registrant can build specific and more detailed exposure scenarios applicable to specific waste treatment operations. Then, information compilation may be supported by prescriptions on waste treatment routes from national laws. For defined treatment operations the operating conditions can be determined quite precisely as well as normally applied risk management measures. This information can be used to derive specific release factors. If, for example, the temperature of a thermal, non-oxidative treatment of wastes is precisely known, the degree of mineralisation of the substance can be assumed by comparing it with its decomposition temperature. The derivation of release factors could/should be supported by information from operators of respective waste treatment installations (process knowledge, measurements, monitoring etc.) on legal requirements or literature information. In case site-specific data are available, these should be supported as far as possible by references or measurements.

An overview of waste treatment processes and corresponding distribution schemes are presented in Appendix R.18-3.

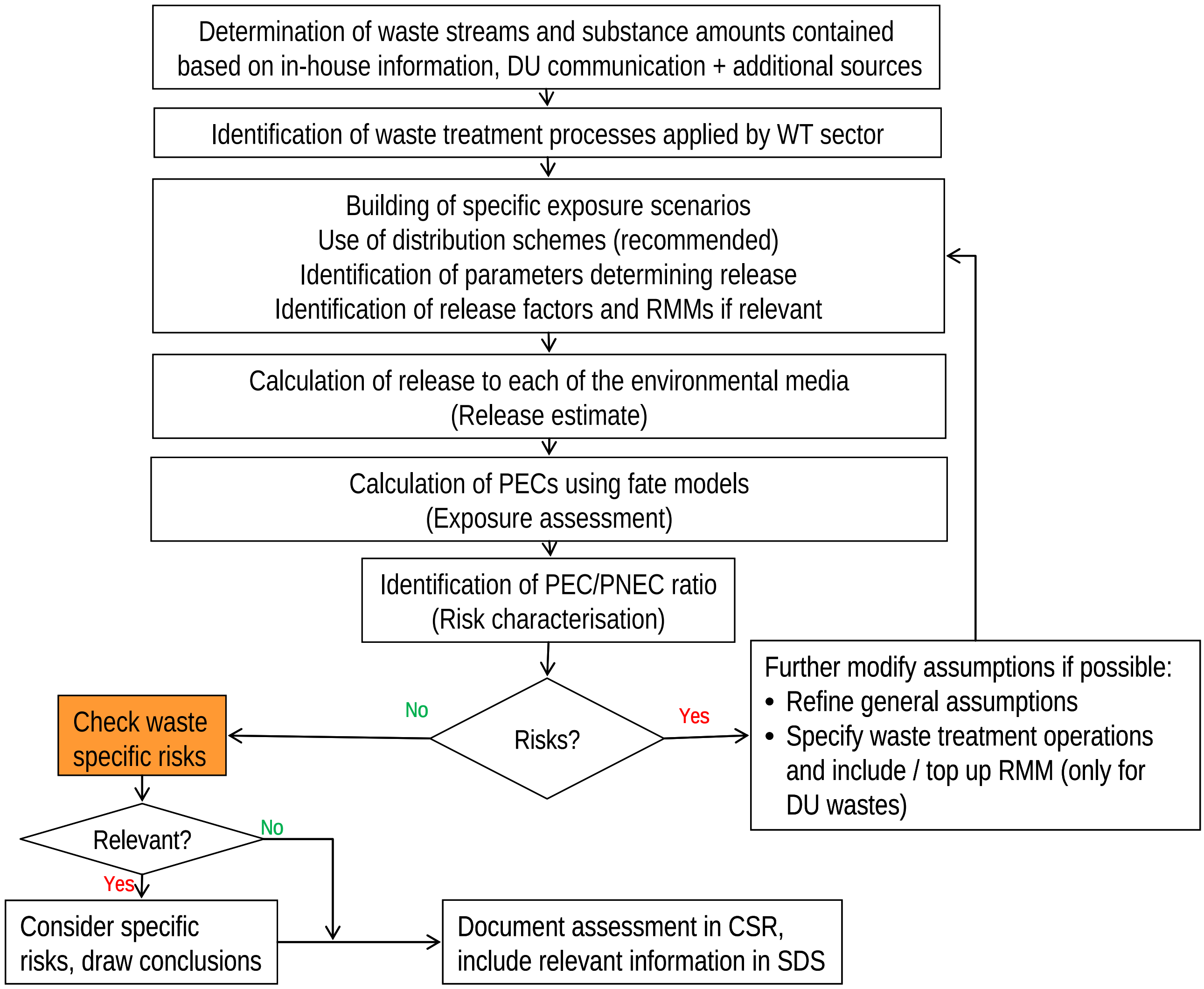


**Figure R.18-6: Workflow for specific approach.**

## R.18.4 Determinants and generic Algorithm

As introduced in Section R.18.3, this guidance suggests two options to assess releases and exposures from the waste stage:

- **generic assessment**: using default values and making refinements if risks are identified;
- **specific assessment**: using available specific information on waste amounts, waste treatment processes applied and related environmental releases; make refinements if risk are identified.

The method for building exposure scenarios and deriving release estimations is described briefly in this section.

Information to perform the generic approach is given in Appendix R.18-2 and Appendix R.18-4 where default values are provided. For making the release estimation with the specific approach an overview of waste treatment processes and corresponding distribution schemes is presented in Appendix R.18-3. The Appendices will help the registrant (and DU, if applicable) to collect and structure the information and to develop specific exposure scenarios, if needed.

### R.18.4.1 Method for building exposure scenarios

The exposure assessment for the waste life cycle stage described in this guidance requires the quantification of specific determinants for the development of generic scenarios and release estimations.

The entire assessment is to be carried out for the full registration volume of the substance per use. It is expressed in [t/y] and represented in equations by the capital letter "Q". The other relevant determinants, already introduced at the beginning of Section 18.3 and illustrated in

Figure **R.18-3** and Figure R.18- 4 are:

- the fraction of total amount per use becoming waste and entering into a specific (or generic) waste treatment process ($f_{waste}$) expressed in [% of amount per use];
- the maximum processed daily amount of the substance contained in wastes at one waste treatment site per day ($Q_{max,\ local}$) expressed in [kg/d];
- the annual amount of the substance contained in wastes treated in the region ($Q_{max,\ regional}$) expressed in [t/y];
- the release factors to the environment, which can be expressed either as %-value or as factor without a unit (i.e. 5% or 0.05):
  - $RF_{air}$ : fraction of the amount of the substance entering a waste treatment process that is emitted to the air during the waste treatment.
  - $RF_{water}$: fraction of the amount of the substance entering a waste treatment process that is emitted to the water during the waste treatment.
  - $RF_{soil}$: fraction of the amount of the substance entering a waste treatment process that is emitted to soil during the waste treatment.

The results of the release estimation are local daily releases to three different environmental compartments: air, water and soil. The local daily releases from a waste treatment process are expressed in [kg/d] and indicated with "$Elocal_{air/water/soil}$".

When developing the exposure scenario the M/I needs to take into account that releases from the waste life stage may occur several decades after manufacture and downstream use of the substance under assessment. These delays are determined, e.g. by:

- the residence time of the substance as such, or mixture or article in the society;
- temporary storage after service life before waste collection (e.g. exhausted batteries);
- articles "left" in the environment after service life (e.g. buried cables);
- exposure of residues (secondary waste) from waste incineration. This source could be of particular relevance if the residues are re-introduced into the market as products (e.g. building material) or if exposed to water;
- exposure of waste in landfills to water.

Thus, when carrying out the CSA, the registrant needs to consider the time pattern of releases. This should be done by applying the following rules:

- Project the releases from the waste life stage into the year when marketing of the substance takes place, in order to take account of the stocking up processes (see Chapter R.17). Assume steady state: when the chemical flow in the society has reached an overall equilibrium and the stock building of the substance in the waste fraction has reached its maximum.

- If applicable, include building material produced from residues of waste incineration into the release estimates from the waste life stage (e.g. for metals);
- Assume a landfill situation typical for construction waste (no capture of fugitive emissions, rain water and radiation access to the waste, waste water collection). Assume that the conditions are similar to outdoor use of construction material;
- M/I may need to consider other landfill situations as well (e.g. for manufacturing waste; or bio-reacting municipal landfills as long as existing in the EU).

### R.18.4.2 Release estimation, generic approach

***LOCAL release estimation***

The generic approach to estimate release rates uses conservative default values for identifying waste amounts and fractions entering into the three main waste streams. Furthermore, generic exposure scenarios can be selected containing default release factors and assumptions on implemented risk management measures (RMM) in the processes.

The release rates are calculated using the following equation:

$$Elocal_{env} = Q_{max,local} * RF_{env}$$

Where $Elocal_{env}$ is the local release rate from waste treatment process [kg/d] to different environmental compartments (indices air, water or soil).

For a generic approach, default release factor values ($RF_{env}$) are provided in Appendix R.18-2.

The equation requires the estimate of the $Q_{max,local}$ values which represents the highest total amount of the registered substance contained in wastes which are treated per day at one site. This value reflects the amount of substance contained in wastes entering each waste stream, the dispersion of use and treatment across the EU and the number of installations in the EU where such a waste is treated.

$Q_{max}$ is calculated using the following formula, which is explained in details in Appendix R.18-4:

$$Q_{max,local}\ [kg/d] = (Q\ [t/a] * f_{waste} * 1000 * DF) / T_{emission}$$

*Q = registered volume of substance per use [t/a]*

$f_{waste}$ *= fraction of registered volume per use becoming waste and entering a specific waste stream (indices MW, RW, HW).* Table R.18- 19 provides default values which reflect the type of use and the life cycle stage the substance comes from.

*DF: Factor characterising the dispersiveness of use and corresponding treatment.* As for any other life cycle stage, the release of the substance to the environment during the waste stage depends on the number and distribution of the installations where the treatment takes place. Different assumptions are to be made in case of i) an industrial setting use or ii) a wide dispersive use, and when the number of installations can be more precisely defined[34]. In general, the following approach is taken for wide dispersive uses and corresponding waste generation structure. The locally used amount of a substance resulting in air and water emissions (0.2% from regional amount) is taken over from the existing Guidance R.16. Based on the assumption that the municipal waste water treatment structure in the EU is more dispersive than the municipal and industrial waste treatment structure, a concentration factor is applied, derived from the number of waste treatment installations compared to the number of municipal sewage treatment installations which are considered to serve each standard town (Population of 10,000 equivalent).

$T_{emission}$ = *days of operation of a waste treatment installation [d/a]*. Table R.18- 21 proposes default values and justifications for the main waste treatment processes.

The local releases from waste-stage per use will need to be summed up according to the following rules:

- For all uses: The releases from the waste treatment processes are to be added to the releases from use in order to derive an exposure estimate consistent with the related exposure scenario.
- For dispersive uses: The releases of the same waste treatment process resulting from waste, generated in different dispersive uses are to be summed up. This is to take into account that waste from dispersive uses will locally feed into the same treatment installation[35].

### *REGIONAL release estimation*

The release estimation will have to be calculated also at regional scale. The same formula as before has to be used to calculate the release rate to different environmental compartments but using the annual amount of the substance contained in wastes treated in the region ($Q_{max,\ regional}$).

$$ERegional_{env}\ [t/y] = Q_{max,regional}[t/y] * RF_{env}$$

The value $Q_{max,\ regional}$ is to be calculated separately for each waste treatment process as they have different release rates. Furthermore, the following default fractions which reflect the type of use should be used [36]:

- 100% for manufacturing and industrial setting uses
- 10% for wide dispersive uses

For each of the waste types and the related waste treatment processes the regional releases have to be assessed separately. Whereas in the local assessment, M/I may have divided the amount of a type of waste in different scenarios (corresponding to different sub-processes), in the regional

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[34] Appendix R.18-4 provides a detailed description of the approach and the possible assumptions. In the appendix a table with average number of installation and days of operation is also provided.

[35] To be further considered whether the same applies for waste from industrial uses. However, here the consistency with the current assessment approach waste water treatment from industrial uses is to be taken into account.

[36] This is the approach elaborated and implemented in the Chapter R.16 (Environmental Exposure Estimation).

assessment one single waste treatment process with the most conservative emission factors may be assessed for the whole amount of the waste type (as a worst case).

If, for example, municipal wastes are generated, the waste treatment processes incineration and landfill should be assessed at local scale (each being 95% of the total amount of MW). In the regional assessment, M/I could use the total volume as $Q_{max,regional,MW}$ and assume the total amount is disposed of in landfills. This would be the most conservative approach, as the default release rates are higher than rates for incineration.

Alternatively the M/I could also collect further information on the local situation and national legal requirements in order to justify the decision in the splitting of waste amounts to different treatment processes.

The annual quantity of substance treated in a waste treatment process per year is therefore calculated as follow:

$$Q_{max,regional}\ [t/y] = Q\ [t/a] * f_{waste} * 1 \qquad \text{(industrial settings)}$$

$$Q_{max,regional}\ [t/y] = Q\ [t/a] * f_{waste} * 0{,}1 \qquad \text{(dispersive uses)}$$

A proposed step by step workflow for the generic approach to estimate release rates is shown in Figure R.18- 7.

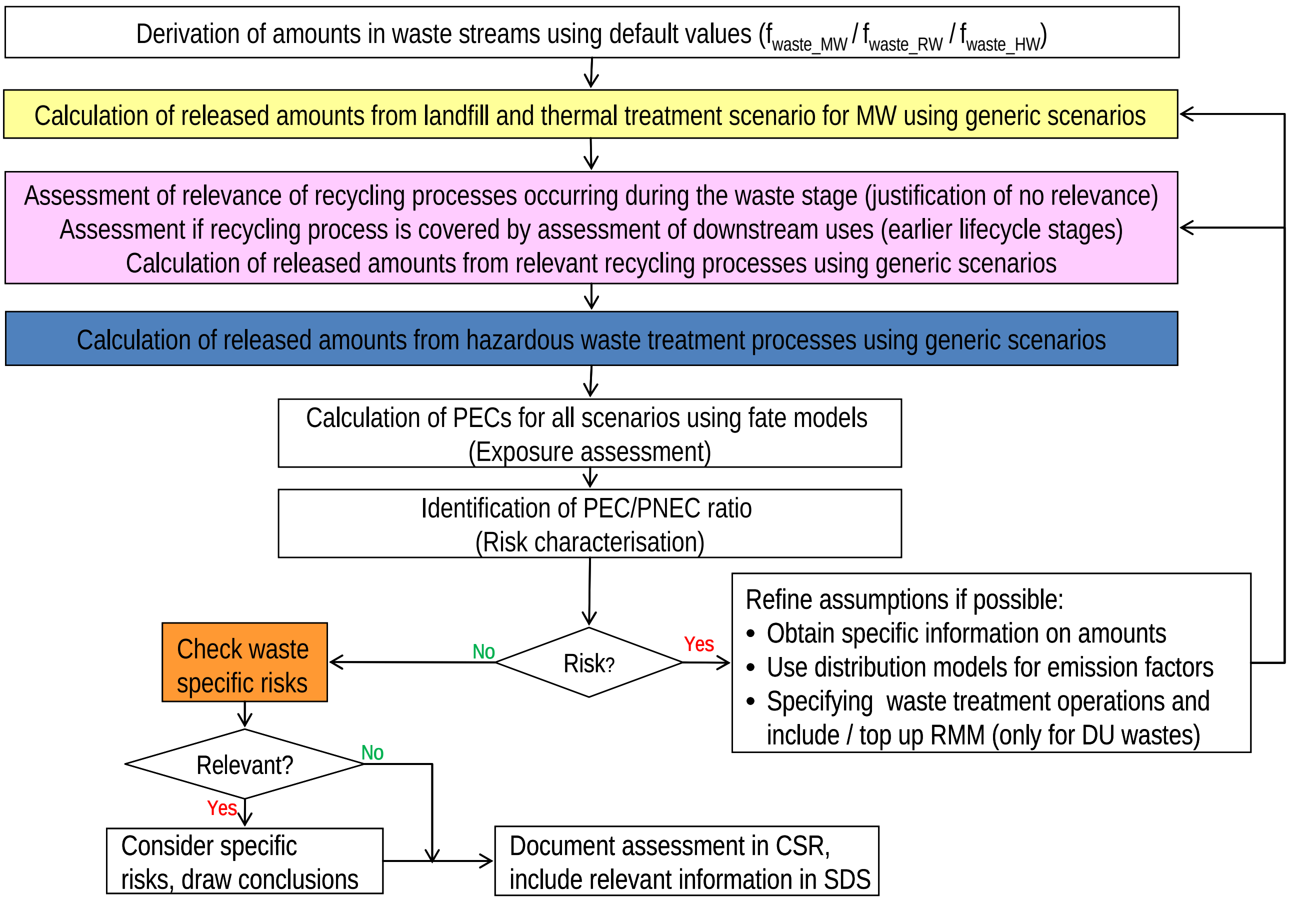


**Figure R.18- 7: Step by step Workflow for generic assessments of the waste stage**

As a first approach, the three main waste streams described in Section R.18.2 (municipal waste (MW), recycling waste (RW) and hazardous wastes (HW)) should be checked for relevance and described (e.g. related to the use descriptors and/or based on knowledge of downstream uses).

## R.18.5 Quantitative exposure assessment and risk characterisation

The identified daily releases to the different environmental media have to be entered into fate models such as EUSES to model local predicted environmental concentrations. In order to ensure transparency of the assessment of the waste life stage and consistency with the assessment approach used in chapter R.16, the releases from waste treatment sites should be considered before municipal STP. However, if waste water is treated on-site (hence before discharge from the treatment process), this is to be taken into account in the release estimation and therefore integrated as RMM into the derivation of release factors to water or air. Together with the background concentrations which have been calculated from the regional releases to the environment for each use, they are summed up to the predicted environmental concentrations (PECs)[37]. These PECs are to be compared to the respective PNEC values of the substance. If the PEC/PNEC ratio is below 1, the risks are controlled and the assessment is finished. The standard ESs provided in the annex can be used for documentation in the CSR and, if any refinements are made, these should be included therein and justification should be provided.

Please note that this approach has not been validated for use with nanomaterials. As such, any estimates obtained from this approach should be scientifically justified. Consideration should be given to the use of simulation studies to generate additional data on emissions. If the output is used to estimate exposure for NMs, this should preferably be supported by measured data, including the consideration of the most appropriate metric. There should be a clear description in the CSR of the uncertainties associated with the estimated values and the consequences for the risk characterisation

## R.18.6 Outcome of the qualitative assessment

Exposure and risks that had been addressed by qualitative considerations are also to be documented in the CSR. Such documentation may include the following elements:

- Qualitative justification as to why no releases of the substance from a specified waste treatment process are to be expected.
- Qualitative justification as to why the conditions in the specified treatment will prevent formation of dangerous degradation products.
- A statement that the uses (and the related conditions of use) assessed for manufacture, downstream uses and service life also cover the type of processes (by PROC) and conditions of use likely to occur in the specified waste operations, and hence no additional risks are to be expected for workers carrying out waste treatment operations with the substance.

[37] Section R.16.6.6 describes in detail the PEC calculation and the estimation of the background concentration. It may be useful to remind that released amounts for the waste life stage can be entered into EUSES and used as for other life cycle stages described in the IR/CSA guidance.

## R.18.7 Documentation and communication

### R.18.7.1 Documentation in the registration dossier

Article 10 specifies the requirements for data submission in the registration dossier. For the waste life cycle stage, Article 10(a) (iii) is relevant making reference to Annex VI, Section 3.6 of REACH (information on waste). For substances for which a CSA is required, the information in the Technical Dossier is to be consistent with the information on manufacture and use in Section 2 of the CSR.

#### R.18.7.1.1 Section 3.6 of Annex VI

The manufacturer or importer (M/I) shall document information on the amount of waste resulting, where relevant, from manufacture of the substance, from the identified uses and from the use in articles, including composition of the waste streams.

Information on the amount, type and composition of wastes from the manufacture of a substance is directly available to the manufacturer and should be included as such in the registration dossier. It should be reported separately from the information related to all other identified uses.

The derivation of amounts, types and compositions of wastes from identified uses (as such or in mixtures) is described in Appendix R.18-4. For the technical dossier, similar types of waste from different downstream uses can be summarized or grouped. Information on the composition may be limited to a rough indication of the content of the substance to be registered in the waste stream. Also the extent of recycling should be characterised.

Information on types, amounts and composition of wastes from articles is to be given separately. This can be done by listing the most important types of EoL-article waste and an indication of the amount of the registered substance in each of these streams. Also the extent of recycling should be characterised. For the purpose of clearly identifying waste categories/types, suitable waste codes may be used. This is current practice for the compilation of SDSs. The use descriptors may be used to generically identify the types of waste and related waste codes from the European LoW. Furthermore, M/I could communicate with downstream users to identify the appropriate waste codes from the waste generators or to verify assumptions.

### R.18.7.2 Documentation in the CSR

In the chemical safety report, the M/I should document the results of his assessment. According to the type of assessment chosen as outcome of the upfront considerations (see Section R.18.2.3), the information to be reported in the CSR should support the quantitative or qualitative conclusions on the suitable waste treatment(s).

Waste related information is required according to sections 5.1.1 and 5.2 of Annex I (as mentioned in Section R.18.1.3). This should cover the identification of waste streams resulting from manufacture and the identified uses, describing the condition of internal and external waste management in the relevant exposure scenarios, carrying out release estimates (when quantitative assessment needs to be carried out) for the waste life stage and characterising related risks. This documentation is to be provided according to the same rules and guidelines as for the assessment of downstream uses (as laid down in Annex 1 of REACH). Since waste treatment is not regarded as "a use" under REACH, no separate exposure scenarios for the waste life stage are needed. The conditions of waste management regarding downstream uses and subsequent service life in articles are to be described in section 9.x.1.1 of the corresponding exposure scenarios.

In this section the relevant parts of CSR, where waste related information has to be included, are presented.

#### R.18.7.2.1 Part B of the CSR: Manufacture and uses

**Section 2.1: Manufacture**

The description of the manufacturing process

"*should also support the derivation of information for exposure scenario building in chapter 9, e.g. description of activities and processes covered in the exposure scenario or fraction of substance lost from process via waste, waste water or air.*"[38]

The manufacturer should describe sources of manufacturing wastes of the substance and the general disposal pathway for each type of waste. This information should be consistent with the information provided in the technical dossier (amount, type, composition).

**Section 2.2: Identified uses**

The information on identified uses in this section may also contain information on types and amounts of waste generated, as described in the Technical Dossier. The M/I should justify any use or lifecycle stage he excludes from his assessment of the waste stage of the substance as not relevant (e.g. intermediates or specific uses like consumer uses of substances leading to full evaporation, or discharge to waste water and subsequent biodegradation). Indications regarding the relevance of the waste stage are given in Section R.18.2.3.

Wastes occurring at subsequent life stages, in particular from end-of-life articles (EoL-articles) should be included in this section as well. Information can be provided in aggregated form (amounts and main waste streams the articles end up in) or could be provided for single identified uses or article categories.

**Section 2.3: Uses advised against**

Any use advised against because resulting wastes cannot be ensured to be disposed of in safe waste treatment processes should be specified and justified in this section.

**Section 9: Exposure assessment**

The exposure assessment for the waste stage does not need to be documented in the form of stand-alone exposure scenarios, but should be integrated into the exposure scenarios for downstream uses or subsequent article service life.

[38] Part F of Guidance on Information requirements and Chemical Safety Assessment.

The conditions of internal treatment of residues which are regarded as waste at the downstream users site are to be covered under the following headlines of the standard exposure scenario format (see draft update of Guidance Part D and F).

| **Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil** |
|---|
| *Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aimed at reducing releases to air, sewage system, surface water or soils. The description of the measures should also cover removal, collection, storage and possibly onsite pre-treatment of the substance removed from waste air and waste water by these techniques.* |
| **Organizational measures to prevent/limit release from site** |
| *Specific organisational measures or measures needed to support the functioning of particular technical measures. This may also include particular measures for internal waste handling.* |

For external treatment, the type of suitable external waste treatment process(es) is to be specified. The information to be reported will depend on the type of assessment the registrant has decided to carry out for the specific case.

When well defined EU standards exist (in waste legislation, IPPC BREF) for the considered waste treatment and qualitative argumentations have been made, reference to the standard may be sufficient.

When standards are not available or releases cannot be excluded, more specific information and technical details are required. Information on the type of treatment, particular operational conditions (if relevant for the substance) and risk management measures (if relevant for the substance) need to be specific enough to justify the assumed effectiveness of the treatment (respectively the relevant release factors). Please note: The release factors from waste treatment are usually driven by the condition of treatment and the substance properties.

All the four ES standard formats (see draft update Guidance Part D and F) include two sections meant to provide information on the conditions of external waste treatment and/or recycling.

*Exposure scenario sections related to the uses of the substance as carried out by workers*:

| **Conditions and measures related to external treatment of waste for disposal** |
|---|
| *Quantify fraction of used amount entering into external waste treatment; specify type of suitable treatment for waste generated by workers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste; specify particular conditions (if relevant) and required effectiveness of treatment (in case of quantitative exposure assessment)* |
| **Conditions and measures related to external recovery of waste** |
| *Quantify fraction of used amount entering into external waste treatment; specify type of suitable recovery operations for waste generated by workers uses, e.g. re-distillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery outside waste incinerators; specify particular conditions (if relevant) and required effectiveness of treatment (in case of quantitative exposure assessment);* |

*Exposure scenario sections related to uses of substance as carried out by consumers*:

| **Conditions and measures related to external treatment of waste for disposal** |
|---|
| *Quantify fraction of used amount entering into external waste treatment; specify type of suitable treatment for waste generated by consumer uses, e.g. municipal waste incineration, hazardous waste incineration: specify particular conditions (if relevant) and required effectiveness of treatment (in case of quantitative* |

| |
|---|
| *exposure assessment); provide corresponding instructions regarding separation of waste to be communicated to consumers* |
| **Conditions and measures related to external recovery of waste** |
| *Quantify fraction of used amount entering into external waste treatment; specify type of suitable recovery operations for waste generated by consumer uses, e.g. refinery process for lubricant waste; specify particular conditions (if relevant) and required effectiveness of treatment (in case of quantitative exposure assessment); provide corresponding instructions regarding separation of waste to be communicated to consumers.* |

*Exposure scenario section related to the service life of substance in articles (handling of article by worker)*:

| **Conditions and measures related to disposal of articles used/processed by workers** |
|---|
| *Quantify fraction of used amount entering into external waste treatment; specify type of suitable treatment for waste generated during processing of articles by workers, e.g. municipal waste incineration, hazardous waste incineration, land-filling; specify particular conditions (if relevant) and required effectiveness of treatment (in case of quantitative exposure assessment);* |
| **Conditions and measures related to recovery of articles used/processed by workers** |
| *Quantify fraction of used amount entering into external waste treatment; specify type of collection system and suitable recovery operation for waste generated during processing of article by workers, e.g. recycling schemes for substances in batteries from professional applications , vehicles other than cars, household appliances, electronic articles, paper articles, metal articles; specify particular conditions (if relevant) and required effectiveness of treatment (in case of quantitative exposure assessment),, including re-collection rate; provide corresponding instructions regarding separation of waste to be communicated to consumers* |

*Exposure scenario section related to service life of substances in articles (handling of article by consumers)*:

| **Conditions and measures related to disposal of consumer articles at end of service life** |
|---|
| *Quantify fraction of used amount entering into external waste treatment; specify type of suitable treatment for waste generated by consumer uses, e.g. municipal waste incineration; specify particular conditions (if relevant) and required effectiveness of treatment (in case of quantitative exposure assessment);* |
| **Conditions and measures related to recovery of consumer articles at the end of service life** |
| *Quantify fraction of used amount entering into external waste treatment; specify type of collection system and suitable recovery operation for waste generated by consumer uses, e.g. recycling schemes for substances in batteries, vehicles, household appliances, electronic articles, paper articles, metal articles; specify particular conditions (if relevant) and required effectiveness of treatment (in case of quantitative exposure assessment),, including re-collection rate; provide corresponding instructions regarding separation of waste to be communicated to consumers;* |

When a quantitative assessment is carried out, in order to derive an exposure estimate corresponding to the conditions described in the exposure scenarios, the following information must be included in the exposure scenario:

- Fraction of waste: Fraction of the daily and annual use amount per substance disposed of externally, to be potentially broken down in different waste streams, depending on the foreseen disposal route , and

- Effectiveness of waste treatment operation: In order to derive a release estimate, the registrant needs to make assumptions on the effectiveness of treatment with the view on preventing/minimising releases of the substances from waste treatment to air, water and soil.

The assumed waste fractions and the assumed effectiveness of treatment are to be briefly justified (e.g. reference to BREF document, sector information e.g. in form of SPERCs for waste treatment operations).

The local release rates from the waste treatment processes corresponding to an exposure scenario are derived based on the following information:

- Daily and annual amount of substance covered in an exposure scenario
- Fractions of waste and effectiveness of treatment.

Based on these release rates, the exposure estimates can be derived and documented as described in Chapter R.16.

Where uses are regarded as wide dispersive, two additional assessment steps have to be performed and documented:

- The fraction of 0.2% from the regional amount that is usually applied to calculate the amount used in a municipality with 10,000 inhabitants[39] may need to be corrected for a municipal waste treatment infrastructure: Usually more than one standard municipality is connected to 1 bigger treatment plant. Thus, a concentration factor may be applied (Appendix R.18-4 provides more details and suggests conservative concentration factors), and
- All the local releases from treatment of waste from dispersive uses are to be summed up in order to account for a situation, in which all these treatments may take place in the same municipality.

*Section 10: risk characterisation*

Risk characterization ratios are to be documented for each of the exposure scenarios assessed and conclusions regarding the adequacy of control of risks.

### R.18.7.3 Inclusion of information in the ESs on downstream uses and for consumers communicated within the SDS

#### R.18.7.3.1 General Principles

The M/I must include all relevant information into the safety data sheet and attached ESs that is needed by the DU to safely manage and dispose of wastes containing the assessed substance. Relevant information refers to any information the DU needs in order to safely handle wastes on-

[39] The 10,000 person equivalent of a substance in wide dispersive use in the EU has been determined with a view to the municipal waste water system. The size of the system is closely related to the number of person living in the municipality where the waste water treatment takes place. Due to the road, rail and ship transport of waste over longer distance this correlation is not that close for waste treatment, and thus a higher fraction may be needed.

site, to choose an appropriate waste treatment process or disposal route and to communicate information further down the supply chain or to the consumers.

The registrant will have to consider that the DU may not have possibilities to make their own choices regarding the disposal/recovery route and/or the effectiveness of the treatment. As a general rule:

- For waste from the use of a substance as such or in a mixtures, information communicated to the DU should include advice on:
    - Type(s) of waste treatment techniques suitable for the waste generated during the uses covered by an exposure scenario.
    - Any behavioral advice to downstream user or consumers (e.g. separate collection).
    - Any specific advice or information relating from the qualitative considerations, including occupational aspects, that should (as good practice) be forwarded to the waste service provider.

It may be considered desirable to specify the relevant names/codes derived from the European LoW.

- The registrant should consider on a case by case basis when the effectiveness of the waste treatment is to be communicated to the DUs. Depending on the type of assessment carried out, on the waste treatment process and the addressee, this information may or may not be relevant to be included in the ES. As an example, information on effectiveness of the waste treatment may be useful for chemical-physical processes which is very case-dependent. Compared to that, such information may be of no relevance for incineration of organic substances or treatment of consumer products. Thus the effectiveness data may be kept by the registrant without being communicated.
- For end-of-service-life-articles and other waste occurring during the article life cycle stage of a substance, the possible choices of a downstream user are more limited. They usually do not have direct contact to the article users and to waste service providers. However they can influence the waste related design of their products and may communicate some information with the article.

M/Is must attach ESs to their SDSs for all identified uses and distinguish between ESs that relate to the use of a substance as such or in a mixture or the use of articles containing the substance. They should also distinguish between industrial users, professional users and consumers in the ESs they attach to the extended Safety Data Sheet.

In the following section, it is explained in more detail which information regarding the conditions of waste management and waste treatment is to be included into the ES formats[40] and how this can be done. This guidance is relevant for all types of exposure scenarios.

[40] Reference to ES format for the extended Safety Data Sheet included in the updated Part D of the Guidance on Information Requirements and Chemical Safety Assessment available on the ECHA Guidance website.

#### R.18.7.3.2 Information relevant for exposure scenarios for uses of a substance as such or in mixtures by workers

*Section 2.1: Control of environmental exposures*

**Information to be included under "Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil"**

In this Section of the ES, information on measures for any waste treatment process carried out onsite should be included. This information is to be identified during the assessment of a downstream use. If M/I have assessed a waste treatment process for external waste treatment which could also be applied as an onsite measure, they may include related recommendations or reflect earlier recommendations in this section.

Information on onsite waste treatment operations could relate to the operational conditions e.g. specify minimum temperatures and oxygen supply for incineration of waste gases or specify efficiencies of the waste treatment process (e.g. degree of sedimentation of substances in chemical-physical treatment of liquid wastes). This section should also be used to recommend any OCs or RMMs for recovery processes from wastes carried out onsite.

**Information to be included under "Organizational measures to prevent / limit release from site"**

Organizational measures are part of the assessment of a use rather than of the waste stage. Nevertheless, some information may be identified as relevant for inclusion into this section such as:

If different types of wastes containing the substance are generated by the activities covered in the exposure scenario and if these wastes are to be treated using different waste treatment processes, a separate collection onsite is necessary.

**Information to be included in the ES section "Conditions and measures related to external treatment of waste for disposal"**

- Information on the type of waste treatment processes suitable to waste generated by the uses of the substance which are covered in the exposure scenario. If the M/I assessed that all possible waste treatment processes the substance could end up (considering the identified waste types) in are safe (assuming standard conditions and realistic worst case), they may indicate that any waste treatment process is acceptable for DU wastes.

- If only certain treatment processes have been assessed as adequately controlling the risks, the M/I must clearly state that the DU has to ensure that his waste is handed over to a waste management company treating the waste as recommended[41]. Other waste treatment processes may be explicitly mentioned as outside the conditions of the ES.

- If the M/I has not assessed a certain relevant waste treatment process, they should state that treatment of waste in the respective processes has not been assessed.

[41] It must be underlined that the recommendations in the ES should not contradict the local waste legislation requirements and should primarily refer to them.

Information on the operational conditions in the external waste treatment installation may include operating temperatures, indoor/outdoor treatment, water contact, abrasive processes etc...

If the M/I assumed "normal operational conditions" in his assessment, e.g. as specified in the waste legislation or BREFs or as described in literature as state-of-the art, no specific information needs to be included, apart from the reference to the established standard. The same applies to risk management measures.

If the M/I identify operational conditions in their assessment that differ from "normal conditions" or where no standard conditions are specified in legislation, BREFs or any other valid source of information, these conditions are to be specified and described in the exposure scenario. Furthermore, in order to derive release rates and exposure estimates from the waste life stage, the registrant needs to document (and sometimes also communicate) reasonable assumptions on the effectiveness of the treatment operation. Based on these assumptions the M/I will derive residual emissions of the substance from the waste treatment via air, water or soil. The same applies to risk management measures, including, if relevant for the substance to be assessed, conditions of treatment of secondary wastes (waste from waste treatment) are also to be documented in the exposure scenario. This could be, for example, sludge from physical-chemical treatment of wastes, air filters, incineration slags, etc.).

Any waste specific risks that have been identified in the qualitative assessment (c.f. Section R.18.2.3.1) should be specified here, including recommendations on how to avoid them.

**Information to be included in the ES section "Conditions and measures related to external recovery of waste"**

The types of information and the conditions for including it in this section are analogous to the section on external treatment of waste for disposal. Thus the section in the ES is expected to describe the conditions in a waste treatment aimed at recovery of material or heat from the waste. The conditions are to be described in a way that emission factors via air, water and soil can be derived. Please note: The CSA needs to cover the conditions of treatment of waste in which the substance is contained. As soon as the substance is recovered from waste (and thus is not waste anymore), the life cycle of the substance ends.

#### R.18.7.3.3 Information relevant for exposure scenarios related to service life of articles (handling by workers)

Articles handled by workers includes i) machines and equipment, ii) material which is used "one-time-only" (disposable), e.g. cleaning rags, sanding paper or iii) articles processed for finishing or maintenance. This may result in i) waste from processing (e.g. stripped-off paints) or ii) articles at the end of their service life (e.g. machinery/vehicles or batteries, processing aids). A considerable portion of a marketed substance, having been processed into an article during downstream use, may end up in such waste. There is however, no regular communication mechanism foreseen under REACH between downstream users producing an article, further producers of more complex articles and the users of articles (except for substances included in the candidate list for authorisation according to Article 7(2)). Thus, the downstream user can provide safety information on the articles he has produced only with the technical information on the article.

**Section 2.1: Control of environmental exposures**

**Information to be included under "Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil"**

In this section of the ES, measures for any onsite (pre-) treatment should be included. This may include for example floor and equipment cleaning regarding residues from mechanical paint stripping or sanding or collection of cleaning rags.

**Information to be included under "Organizational measures to prevent / limit release"**

If different types of waste articles containing the substance are generated by the activities covered in the exposure scenario and if these wastes should be treated using different waste treatment processes, a separate collection onsite is necessary.

Specific measures to ensure that risks are controlled during storage and transport should be indicated here as well.

**Information to be included in the ES section "Conditions and measures related to external treatment of waste for disposal"**

The information to be included here is analogous to the information in the exposure scenario for uses of substances as such or in mixtures.

**Information to be included in the ES section "Conditions and measures related to external recovery of waste"**

The information and the conditions for including it in this section are comparable to the section on external treatment of waste for disposal.

#### R.18.7.3.4 Information relevant for exposure scenarios related to uses of substances carried out by consumers and the handling of articles by consumers

Mixtures used by consumers potentially leading to waste in consumers' hands include for example, paints and adhesives. The resulting waste may include empty packages, full packages of non used mixtures, equipment like brushes etc.

Articles handled by consumers include i) machines and equipment, ii) material which is used "one-time-only" (consumables), e.g. cleaning rags, sanding paper or iii) articles processed for maintenance. This may result in i) waste from processing (e.g. stripped of paints) or ii) articles at the end of their service life. A considerable fraction of a marketed substance having been processed into an article during downstream use may end up in such waste.

The main measures to be implemented by consumers are the separate collection and feeding of waste into the different municipal waste schemes, including a take-back system by distributors. If relevant for control of risk, the registrant of a substance meant to become part of an article is expected to specify in the exposure scenario the required re-collection rates and the associated measures to achieve this.

### R.18.7.4 Extended Safety Data Sheet

Advice related to waste management and treatment (aimed at disposal and/or recovery) is to be included into Section 13 (especially sub-section 13.1 "waste treatment methods") of the safety data sheet. Such information is also part of the exposure scenarios attached to the safety data sheet. The information at both places should be consistent with each other.

The information in the extended SDS is meant to make downstream users aware of the substance related risks in waste treatment and to suggest appropriate waste treatment techniques/routes. Furthermore, any particular conditions of treatment on these routes are to be communicated to the downstream users. Thus, the DUs are expected to take this information into account when they organise waste collection and potentially any pre-treatment at their site, and when they make their choice on the appropriate external waste disposal route. Regarding the condition at the waste treatment facilities, DUs can communicate the information received from their suppliers, however there is no mechanism foreseen in REACH that the companies treating the waste take this information into account, or feedback on it.

If relevant, a downstream user may need to communicate waste related measures further down the chain, for example:

- A downstream user (e.g. paint formulator) may receive exposure scenarios for consumer uses of a substance, containing waste related advice (e.g. substance should not be disposed of via waste water). The downstream user is strongly recommended to consider technical means to support minimisation of waste (e.g. design of package), separate disposal (e.g. one-way brushes for paint) and/or to forward behavioural advice to the consumers.
- A downstream user (e.g. plastic converter) may receive exposure scenarios for article service life, containing waste related advice (e.g. do not process into articles where no separate collection of waste after service life is expected). The downstream user is strongly recommended to consider whether his products are supplied to markets where separate collection exists or does not exist.

#### R.18.7.4.1 Section 13: disposal considerations

This section (especially sub-section 13.1 “waste treatment methods) may typically contain the following pieces of information, which should be consistent with the information provided in the exposure scenarios attached to the extended SDS:

- Types of waste (e.g. it may be considered desirable to identify the European LoW code(s)) typically generated during the uses covered in the attached exposure scenarios.
- Reference to technical waste treatment/disposal/recovery requirements defined in European legislation, BREF documents or any published standards and applicable to one or more of the waste types generated.
- If needed, further advice on waste treatment techniques, operational conditions and risk management measures suitable to control risks related to the waste generated during the uses covered in the attached exposure scenarios.

## R.18.8 Appendices

# APPENDIX R.18-1: RELEVANT TERMS RELATED TO WASTE LIFE CYCLE STAGE

| | |
|---|---|
| Disposal[42] | means any operation which is not recovery even where the operation has as a secondary consequence the reclamation[43] of substances or energy. |
| Disposal considerations[44] | this term includes any information relating to waste management measures. In the registration dossier, a differentiation should be made between considerations directed to industrial or professional actors and those directed to the general public. Disposal considerations may include waste management directed at disposal or recovery. |
| Hazardous waste[45] | means waste that displays one or more of the hazardous properties listed in Annex III of Directive 2008/98/EC. |
| Recycling[46] | means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations. Under REACH, substances as such or contained in mixtures which are obtained from recycling processes are so called “recovered substances”. |
| Recovery[47] | means any operation the principle result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfill a particular function, or waste being prepared to fulfill that function, in the plant or in the wider economy. |
| Service-life | residence time of a material/article in the society. |
| Stock building in society | cumulative quantity of a chemical in a society which can be considered as equal to the annual quantity added into the society multiplied by the residence time of the chemical (in years). |
| Waste | means any substance or object which the holder discards or intends or is required to discard[48]. |

[42] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on wastes and repealing certain directives, Article 3(19), abbreviated to “Waste Framework Directive” in the following.

[43] In this context, reclamation means that either substances / materials are extracted or heat is generated from waste during its processing, however the difference from recovery is that this gain in materials or energy is not the primary purpose of the waste treatment process but a secondary benefit.

[44] “Disposal considerations” are to be included in information for registration in accordance with REACH Annex VI, Section 5.

[45] Article 3(2) Waste Framework Directive.

[46] Waste Framework Directive, Article 3(17).

[47] Waste Framework Directive, Article 3(15).

[48] Waste Framework Directive., Article 3(1).

## Appendix R.18-1: Relevant terms related to waste life cycle stage

| | |
|---|---|
| Waste management measures | mean any measures related to the management of waste. They include activities of all supply chain actors related to communication, storage, handling, treatment and disposal of waste.<br>Waste management measures are also implemented by operators of waste treatment installations. They may include recommendations on specific disposal pathways, forwarding of waste related information or communication needs down the supply chain or to consumers and operators of waste treatment installations. In contrast to risk management measures, waste management measures cover a broader range of activities. Risk management is one of several aspects of waste management. |
| (Waste) treatment[49] | means recovery or disposal operations, including mixture prior to recovery or disposal. In this document, the term is used to address any type of handling and processing of wastes, regardless of the technology or intention of the activity. It covers landfilling and waste incineration (substance is destroyed or finally removed from the technosphere) as well as recovery of substances. |
| Waste treatment operation (WTO) | this term is used in the guidance for specific treatment technologies. Several treatment operations may be grouped into one type of waste treatment process. |
| Waste treatment process | the term waste treatment process does not apply to a specific technical operation, but to a group of operations, with similar release patterns. They can be regarded in analogy to PROCs describing the use of a substance at an abstract level. |

[49] Article 3(14) Waste Framework Directive.

# APPENDIX R.18-2: DEFAULT RELEASE FACTORS FOR WASTE TREATMENT PROCESSES

## 1 Release factors to the environment

The release factors to air, water and soil quantify the fraction of the substance (contained in waste) which enter into the waste treatment process and is released to the environmental media. Furthermore, the substance could distribute to secondary wastes during the waste treatment process, such as risk management devices or ashes and sludge. These secondary wastes are further processed potentially resulting in releases to air, water and soil. These releases need to be taken into account in the release estimation from the process.

Guidance on the identification of release pathways and deriving release rates from waste treatment processes is provided in Appendix R.18-3 where distribution schemes are explained. These indicate how a substance is supposed to behave in the process, depending on its properties and the operational conditions determining release. The distribution schemes can also support any specific assessment of waste treatment processes.

Release factors are dimensionless.

**Note**: Release estimates based on the release factors for mercury, lead and cadmium should not be used for exposure quantification and/or quantitative risk characterisation. A qualitative assessment is more appropriate here. Such qualitative assessment is needed to take into account the uncertainties around the environmental behaviour of the metal (for mercury) and/or the hazard profile of the substances related to human health (carcinogenic and reproductive toxicity with regard to cadmium and lead).

## 2 Release estimates for municipal wastes

The assessment of municipal wastes should be performed for all substances, regardless of the types of mixtures, articles and uses they end up in, except for intermediates and substances exclusively used in processing aids. In the following, basic information on landfilling and incineration and default settings for the first generic assessment are provided.

Options to refine the assumptions and derive more specific release factors, other than the methods explained in relation to the distribution schemes in Appendix R.18-3, are discussed in Appendix R.18-5. Standard ES to collect and summarize information on safe conditions during waste treatment are also suggested in the appendices.

The results of this step are released amounts of the substance from landfill and incineration to air, water and soil at local and regional scale:

- $Elocal_{air}$ [kg/d], $Elocal_{water}$ [kg/d], $Elocal_{soil}$ [kg/d] and
- $Eregional_{air}$ [t/y], $Eregional_{water}$ [t/y] , $Eregional_{soil}$ [t/y].

***Transport and storage of municipal wastes***

For municipal wastes it can be assumed that releases from transport are negligible compared to the main waste treatment processes. Therefore, no separate transport and storage scenario needs to be calculated for municipal wastes.

### *Landfill for municipal waste (No model)*

From 2009 at the latest, landfills should be operated according to the Landfill Directive and well defined standards exist. Landfills exist for non hazardous wastes and hazardous wastes. According to legislation, the permeability of bottom layers and liners is lowest for hazardous wastes and highest for inert wastes. As it cannot be excluded that hazardous wastes end up in municipal waste landfills, no differentiation is made and the assumptions for release estimates are based on a regular municipal waste landfill. This implies:

- Pre-treatment by mechanical methods[50] to reduce volumes[51].
- Moisture content, pH and compaction/density in landfill are controlled
- Surface water run-off and leachate from drainage is collected and treated on-site[52] before discharge to surface waters.
- Existing artificial and mineral liners, preventing to a large extent leachate permeating and reaching the soil (in theory no release to soil)
- Coverage of landfill parts preventing release of dust (wind-borne particulates).
- No capture of landfill gas because collection systems start operation only after full coverage. As the majority of the substance would directly emit after disposal in the landfill (when it is not covered), no risk management measures preventing or reducing releases to air are assumed.

The release estimation from landfill, needs to consider the residence time of the substance in the landfill body. The substance is continuously entered and accumulates into the landfill body until its closure. In the derivation of the default RF proposed in the Table R.18- 4, it is assumed that the average residence time is 20 years. Hence, the annual release factor of the substance during service life is multiplied by the residence time of 20 years to obtain the RFs for the landfill. It must be noted that when refinements are required this assumption and factors from ERC cannot be used. Refinements shall have to be based on measured data (where accumulation is integrated) or modelling from leachate testing[53].

[50] Sorting or volume reduction measures with low release potential, therefore this is not specifically addressed.

[51] Municipal wastes may be incinerated and the ashes be landfilled. This is covered, as the incineration scenario is also assessed, if municipal waste occurs. The risks from landfilling of ashes will not exceed that of landfilling untreated wastes.

[52] According to the Landfill Directive (99/31/EC), Annex I section 2, collected leachate is to be treated according to local standards before discharges. As it can be assumed that legal requirements are implemented in waste treatment processes, an on-site treatment of waste water is assumed.

[53] More information on refinement options are provided in Appendix R.18-5.

## Appendix R.18-2: Default release factors for waste treatment processes

**Table R.18- 4: Defaults for the landfill scenario**

| Parameter | Default | Reasoning |
|---|---|---|
| # of landfills | 8400[54] | Approximate number of landfills in EU-27 |
| Emission days | 365 | Releases from landfill are continuous |
| WWTP (%) | 100 | All leachate is collected and treated on site. |
| Release factor to air ($F_{air}$) | Non-VOCs: 0<br>VOCs 0.0005 | Releases of non-VOC are regarded as negligible.<br>Volatile substances can be released via landfill gas. No release factors were found or derived from measured data. The proposed factor corresponds to releases of substances to air during service life (ERC 10a). |
| Release factor to water ($F_{water}$) | 0.032 | Highest release factor of plastic additives to water during service life of articles proposed in OECD ESD for plastic additives. Release is estimated over a lifetime of 20 years.<br>This release factor relates to the service life or articles and there is NO WWT foreseen. As worst-case assumption an efficacy of 50% for the on-site WWTP as average and applicable for all substances may be used. |
| Release factor to soil ($F_{soil}$) | 0.0016 | Release factor of ERC 10a |

Please note: There is no commonly accepted model available to predict substance specific releases from landfills. Thus characterisation of exposure and risk due to releases from landfill should therefore include a qualitative argumentation regarding the mechanisms expected to prevent release of the substance from a landfill. Release quantification may be used to support that argumentation. However, in most cases release quantification from landfills will be very uncertain.

*Incineration of municipal waste (Model "Thermal treatment-oxidising")*

Waste incineration is regulated by Directives 2008/1/EC concerning integrated pollution prevention and control (hereinafter referred to as "IPPC Directive") and 2000/76/EC on incineration of waste (hereinafter referred to as "Waste Incineration Directive"). Main activities with relevance for environmental emissions are:

- Storage: air emissions (evaporation, dust) are negligible[55] compared to emissions from the actual incineration and are covered by the default emission factors.
- Pre-treatment: For municipal waste incineration, pre-treatment is done only for bulky waste. Air emissions (evaporation, dust) from crushing or shredding of bulky waste are negligible

[54] Data bases inter alia: Helmut Maurer, European Commission Unit ENV G4, Sustainable Production and Consumption, 7 December 2006; Jorge DIAZ DEL CASTILLO, DG Environment, European Commission, 13 May 2008. Figures should be used with caution: Landfills for hazardous waste: ~400, Landfills for non-hazardous waste: ~5000, Landfills for inert waste: ~3000.

[55] Emissions may occur mainly for substances which are normally not intentionally collected with household waste like e.g. mercury from fluorescent light bulbs or organic solvents. As these are exceptions, they are not specifically addressed. It is best practice to avoid emissions from storage by extracting bunker air to be used as combustion air in the furnace.

compared to the emissions from the actual incineration process. They are regarded as covered by the default release factors.

- Incineration process (different techniques). For municipal waste and at the generic stage, no differentiation is made between different techniques. Co-incineration and thermal recovery processes (e.g. recycling of glass, steel, and copper) are covered by the scenario developed for municipal waste incineration.
- Management of secondary wastes and residues from incineration:
  - flue-gas cleaning: it is assumed that any waste incinerator is equipped with a flue-gas treatment device. This is already considered in the release rates to air in the default values.
    - Wet flue-gas cleaning is carried out in about half of the existing waste incineration plants, giving rise to waste water emissions from subsequent waste water treatment. The incineration process as such is water free. It is assumed that 100% of the waste water is treated in an on-site WWTP or re-injected and evaporated in the plant.
    - Dry and semi-dry flue-gas cleaning is used by the other half of existing waste incineration plants: Dry or semi-dry absorbents (e.g. lime) are injected and collected in the dust filter. No waste water is produced.
    - The injection of additional adsorbents (e.g. coke) produces solid waste that is collected in the dust filter.
    - Electrostatic or fabric dust filters produce solid waste. This solid waste is disposed of in underground landfills which are designed to fully contain wastes and emissions thereof. Therefore, no separate assessment needs to be performed for this pathway.

  - Slag/bottom ash and fly ash[56]: in general, substances entering thermal processes may distribute to slag/bottom ash and fly ash, if they are not destroyed. Into which of these substances distribute depends on their physic-chemical properties and the processing conditions during the thermal process. Substances that could be found in such incineration residues may be metals with very high or very low boiling point and minerals. The exact composition and nature of slag and ashes depends on the site specific operational conditions of the thermal process. Therefore a worst case should be assumed if detailed information is missing. Slag and ashes are either disposed of in landfills (covered by the assessment of the landfill scenario) or reused in road construction. The related emissions are integrated in the default emission factors.

The Waste Incineration Directive (2000/76/EC) describes conditions of use and emission limit values which are regarded as compliant with the IPPC Directive (2008/1/EC). They apply to incineration and co-incineration: Plants shall be operated under the conditions set in the permit and designed, equipped and operated in such a manner that the Directive is complied with. After the last injection of combustion air, temperatures in municipal waste incinerators are to be raised to 850°C for 2 seconds. Co-incineration plants are to fulfil the same operating conditions. Emission limit values to air and water are set in the Annexes of the Waste Incineration Directive.

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[56] In the entire document, slag and bottom/fly ash are addressed in general terms, in order to make sure they are considered in the assessment. In a thermal process this relates to ash and slag of a waste incinerator or co-incinerator and metal melting plant, but they are also used in the scenario for metal recycling.

## Appendix R.18-2: Default release factors for waste treatment processes

According to EUROSTAT[57]:

- Around 20 % of the municipal solid waste (MSW) produced in the EU-27 is treated by incineration (total MSW production was about 522 kg per person in 2007); the percentage of MSW treated by incineration in individual Member States of the EU-27 varies from 0 % to 53 %[58]
- In 2007, 258 million tons of municipal wastes were generated in the EU 27, which makes up approximately 14% of the total waste amount[59].

According to the BREF document on waste incineration (2006[60]):

- Annual MSW incineration capacity in individual European countries varies from 0 kg to over 550 kg per capita and the average MSW incinerator capacity is about 200,000 tonnes per year.
- The average throughput capacity of the MSW installations in each MS also varies. The smallest plant size average seen is 60,000 tonnes per year and the largest close to 500,000 tonnes per year.

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[57] EUROSTAT News Release, 9 March 2009.

[58] 48% of municipal waste is recycled or composted, the remaining share is landfilled (about 2/3) and incinerated (about 1/3).

[59] 2008 ENVIRONMENT POLICY REVIEW - pressure indicator municipal waste, primary data source: EUROSTAT.

[60] BREF documents can be found on JRC website at http://eippcb.jrc.ec.europa.eu/reference.

**Table R.18- 5: Defaults for the municipal waste incineration scenario**

| Parameter | Default | Reasoning |
|---|---|---|
| # of installations | 600[61] | Medium number of approximated number of installations in EU-27 |
| Emission days | 330 | Incinerators are operated approximately on 330 d/a, corresponds to large installations (TGD) and information in BREFs, as well as own expert knowledge |
| WWTP (%) | 100 | It is assumed that 100% of waste water from flue-gas cleaning is collected and either treated on-site. Wastewater is assumed to be discharged directly to surface waters (no STP in EUSES). |
| Release rate to air[62] | 0.0001<br>0.05<br>0.001<br>0.0003 | Organic substances<br>Mercury<br>Cadmium, thallium, antimony, tin<br>Other Metals<br>Organic substances are destroyed due to high incineration temperatures.<br>Metals are not destroyed and could be emitted to a rather high extent to air, even if flue gas is cleaned. |
| Release rate to water[63] | 0.0001<br>0.0002 | Organic substances<br>Metals<br>As organic substances are mostly destroyed, their content in flue-gas cleaning water is expected to be low.<br>Metals are expected to emit to a low extent during incineration, due to high boiling points. Hence, their concentration in flue-gas cleaning water is expected to be low as well but higher than organic substances, as they are not destroyed. |
| Release rate to soil | 0 | No direct releases to soil occur from incineration. |

Secondary wastes, such as ashes or solid wastes from flue gas treatment[64] are disposed of underground or by inertisation and disposal in respective landfills. Related emissions to the environment can be disregarded as they are negligible compared to the emissions from the main process.

## 3 Release estimates for recycling wastes

Material recycling processes aim to recover substances or materials from waste in order to start a new service life. The assessment of material recycling processes should be performed for all substances, which may be included into or onto articles made of

- Paper
- Glass

[61] See Table R.18- 21 for data source.

[62] Based on Transfer factors published by Reimann, in: Thomé-Kozmiensky “Ersatzbrennstoffe 2”, TK Verlag, 2002.

[63] Expert judgment, based on emissions to air and old CSR guidance on waste, in which the same factors were assumed.

[64] To be noted that some residues from flue gas treatment are not regarded as waste but internal residues.

- Plastics
- Construction material
- Metal
- Rubber

In addition all substances which are included in articles for which specific waste regimes exist, such as vehicles, electric and electronic equipment, batteries and accumulators etc. should be included here. Recycling wastes are normally not hazardous wastes[65] but, especially in the case of complex articles, may contain hazardous components.

The assessment consists of three steps:

1) Assessment of relevance of recycling and justification of no relevance

2) Checking if recycling process is already covered by earlier assessments

3) Estimation of released amounts from relevant recycling processes

The results of these steps are released amounts from the relevant recycling processes to air, water and soil at local and regional:

- $Elocal_{air}$ [kg/d], $Elocal_{water}$ [kg/d] and $Elocal_{soil}$ [kg/d] and
- $Eregional_{air}$ [t/y], $Eregional_{water}$ [t/y] , $Eregional_{soil}$ [t/y].

For recycling processes, only those default settings for exposure scenarios or assessments which differ from conditions in the primary production processes are described here. For the assessment of waste treatment processes which are run in a similar or the same way as in primary production, information and exposure scenario building corresponds to the methods and defaults proposed in the respective Sections of the IR/CSA guidance[66].

***Step 1: Relevance of recycling processes***

As default, M/I are to assume all six material wastes as relevant. Because the input waste to most of the recycling processes are material mixtures (e.g. complete circuit boards could be shredded and enter the metal recycling process (melting) in a secondary metal processing plant) recycling processes should only be excluded after careful consideration. If it can be justified that processes are not relevant, respective justification should be provided and no quantitative assessment is needed.

Possible reasons why a material recycling process may be of no relevance could be:

- A substance is specifically designed to perform in a specific material which is normally not contained in recycling waste

[65] "Hazardous waste" is to be intended as defined in the Waste Framework Directive.

[66] Overview and different chapter of the IR/SCA guidance can be found on the ECHA website, guidance section.

- Substance properties suggest that use in a specific material is unlikely, as it would not be stable under operating conditions (e.g. organic substances as part of metals – however they could be applied as finishing)
- Substance is a main component of only one material (e.g. $SiO_2$ in glass) and very seldom found in other materials so only the specific type of material recycling is likely to be applied
- Uses are limited to specific materials by M/I and/or uses are advised against
- Information is available from the supply chain, which enables the exclusion of use of the substance in materials

Examples of reasons why it could be difficult to exclude material recycling processes:

- Substance is used in a wide range of processing aids or coatings (could be applied to any material and enter recycling process as "contamination")
- Uses in all types of materials are known
- There is very little knowledge of the uses of the substance
- Substance may only be part of one material but this material is entering the recycling process of another material because of limited separation (e.g. plastic additives going with plastic parts to metal recycling)

***Step 2: Assessment if recycling process is already assessed***

The recycling processes of glass, paper, plastics and metals correspond to manufacturing and downstream user processes. If the lifecycle of the substance includes these processes before they become wastes, the registrant may omit an additional assessment for recycling wastes, if:

- The input amount ($Q_{max}$, see Appendix R.18-4 for details) is equal to or smaller than the primary process. If the amount is higher in the recycling process, a short cut assessment using rule of proportion could be performed to derive a related exposure level and PEC/PNEC ratio in comparison to the assessment of primary processes.
- The operational conditions are comparable in recycling processes and primary production (e.g. could the feeding process be different, giving rise to different releases to the environment).
- The (efficiency of) risk management measures are comparable in recycling and primary production processes.

Comparable conditions can for example be assumed for additives in plastics. However, before recycling, a mechanical size reduction is performed, which would have to be assessed in any case (see "Shredding of recycling wastes" described in Step 3).

Substances which are introduced into or onto a material at a late lifecycle stage may be contained in the recycling waste but their lifecycle may not include the respective process. This is the case for example for substances in printing ink (printing occurs after pulping, which would correspond to the recycling process) or substances used in paints applied to metal articles. In these cases, an assessment of the recycling process is necessary.

***Step 3: Release estimate for recycling processes***

*Transfer and storage*

For all recycling wastes relevant releases, which might occur due to storage and transport of wastes ("transfer and storage model"), should be calculated. This could be the case for material wastes which are transported in dusty form (substance could be released in the form of dust particles), which are stored outdoors (substance could leach out) or which are stored for long periods of time (evaporation). The derivation of release factors should be based on the model "transfer and storage".

*Shredding of recycling wastes (Model "Mixing/Milling")*

For all substances contained in recycling waste, the mixing / milling scenario should be assessed in addition to the main relevant recycling processes, because any recycling process involves some type of mechanical destruction in form of breaking the material and/or shredding.

The collection of waste before being treated does not lead to relevant releases to the environment. Breaking and shredding of materials result in the formation of dusts and consequently in releases to air of the substance contained in or attached to the dust particles.

**Table R.18- 6: Defaults for shredding**

| **Parameter** | **Default** | **Reasoning** |
|---|---|---|
| # of installations | 210[67] | Amount of installations in EU-27 |
| Emission days | 330 | Normal operating days |
| WWTP | not relevant | It is assumed that no onsite wastewater treatment plant exists. |
| Release factor to air ($F_{air}$) | 0.1 | Paper and plastics, minerals: material has low weight and/or dust is likely to occur – expert judgement[68] |
| | 0.05 | Rubber: material has medium weight, some release likely - expert judgement |
| | 0.01 | Metals,: emitted dust is heavy and the majority of the release settles shortly after emission – expert judgement |
| Release factor to water ($F_{water}$) | 0 | No water contact |
| Release factor to soil ($F_{soil}$) | 0 | Processing does not give rise to releases to soil |

*Recycling of construction materials (Model "Road construction")*

The use of shredded construction materials in road construction is the most likely destination route, complemented by landfilling in inert waste landfills. The scenario "road construction", covers both cases.

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[67] See Table R.18- 21 for data source. The estimation doesn't include mobile shredders. As they would contribute to dispersive emissions, the number is not relevant. Nevertheless the registrant should consider the option to assess the emission as diffuse emission from mobile shredders.

[68] In this guidance expert judgement has been used as source to derive default values when necessary due to lack of basic data in literature. Experience and sector knowledge have been used to derive default values when available information does not allow to correlate emissions of single substances to the amount of that substance entered into a waste treatment process.

This destination route means in principle "open use in the environment with low release promotion" and hence corresponds to the ERC 10a for wide dispersive use of articles.

**Table R.18- 7: Defaults for the road construction scenario**

| Parameter | Default | Reasoning |
|---|---|---|
| Emission days | 365 | Continuous releases due to outdoor use of waste |
| WWTP | not relevant | Releases are directly to the environment. |
| Release factor to air | 0.00005 | Emissions to air are assumed to be 10 times lower than those of the service life of an article in outdoor uses with low release promotion (ERC 10a), because of evaporation slowing down towards the end of the service life and due to the fact that materials are below the road surface (sealed surface) |
| Release factor to water | 0.0016 | Emissions to water are assumed to resemble those of the service life of an article in outdoor uses with low release promotion (ERC 10a).<br>For exposure assessments, connection to an STP should be assumed. |
| Release factor to soil | 0.0016 | Emissions to soil would occur due to leaching from the construction material the substance is contained in. The release factor corresponds to ERC 10a. |

*Recycling of rubber (Model "Mixing/Milling")*

Rubber tyres are the largest sources of rubber waste and due to their high resilience and durability are mostly reused, rather than recycled. The majority of waste tyres are "repaired" and used as retreads. Tyres and non-tyre rubber can also be reused in other products after shredding it to a material known as "crumb".

Some chemical recycling of rubber also takes place, including ultrasound techniques, and pyrolysis or microwave treatment. All of these processes result either in mineralisation or in the manufacture of new substances (beginning of a new supply chain). As these processes are applied to a rather low extent, no default values are given for this process. Pyrolysis could be assessed based on the model "thermal treatment – non-oxidising" and for other techniques specific models would have to be built, taking account of rather specific operational conditions. The assessment of the shredding scenario is relevant in any case (see "Shredding of recycling wastes" previously described).

*Recycling of plastics*

Substances which are included in plastic materials or have been added as a finishing to a plastic article (e.g. coating, firm attachment of other materials onto the surface of an article), need to be assessed with regard to the recycling scenario. They are normally not intentionally recovered but are a contaminant in the plastic material.

**Table R.18- 8: Defaults for the polymer recycling scenario**

| Parameter | Default | Reasoning |
|---|---|---|
| # of installations | 50,000 | Number of companies represented by EU plastics converters association. Figures will be revised based on association information in next draft. |
| Emission days | 220 | Standard operation days |
| WWTP (%) | not relevant | No on-site wastewater treatment is assumed to exist in polymer recycling installations. |
| Release factor to air | 0.025 | Highest release factors in OECD ESD for plastic additives |
| Release factor to water | 0.0025 | For the exposure assessment, discharge of wastewater to the local sewage system should be assumed. |
| Release factor to soil | 0 | |

Refinement options and iteration can be performed according to the IR/CSA guidance. The OECD emission scenario document provides information for refining release factors, depending on additive types, volatilities and water solubility.

*Recycling of metals (Model "Thermal treatment – oxidising")*

If the substance is added to the metal after the forming process in the primary production, (e.g. substances in coatings), an assessment of recycling is necessary. In the recycling process the metal is melted and fed into a forming process. Substances with low decomposition temperatures would most likely be destroyed and released in low amounts, which would justify the refinement of respective release factors.

**Table R.18- 9: Defaults for metals recycling**

| Parameter | Default | Reasoning |
|---|---|---|
| # of installations | 231 | Number of secondary steel producing installations |
| Emission days | 330 | Operating time of industrial installations of the metals industry |
| WWTP (%) | not relevant | No on-site wastewater treatment is assumed to exist in metal recycling installations. |
| Release factor to air[69] | 0.005 metals<br>0.015 Mercury<br>0.001 organic substances | These values are based on expert judgment, considering available data from single plants[70] |
| Release factor to water | 0.00005 metals | Expert judgment. Water free process (including abatement), only indirect via landfill (disposal of slags) |
| Release factor to soil | 0 | |

Disposal of secondary wastes, ashes and slag would occur in landfill. This is accounted for in the release factors and no additional assessment is needed.

*Recycling of paper*

Substances which have been added to a paper article in the course of finishing or other uses of paper (coating, printing etc.) are contained in the material as contamination. For the assessment of risks from these contaminants, the following information and scenarios can be used.

[69] The factor relates to dust and the concentration of the substance in the dust should be taken into account to determine the total release.

[70] Annual loads and approximate annual processed volumes.

## Appendix R.18-2: Default release factors for waste treatment processes

**Table R.18- 10: Defaults for the paper scenario**

| Parameter | Default | Reasoning |
|---|---|---|
| # of installations | 335 | Number of paper mills in EU 27 using recovered paper[71] |
| Emission days | 330 | Information source: 340 days from OECD ESD recovered paper mills |
| WWTP (%) | 100 % | In the European Union, the wastewater generated from paper mills is generally discharged directly to surface water upon primary and biological treatment. |
| Release factor to air | 0.15 | Substances in recycled paper are unlikely to be volatile (should have evaporated earlier). Operating conditions don't involve high temperatures. 0.15[72] corresponds to a release factor from water for substances with a LogH of < 1, which are not degradable. |
| Release factor to water | Worst case: 0.9014 | The defaults reflect the worst case[73]<br>Mineral oil based inks 0.901<br>Flexographic inks 0.3005<br>Toners 0.3005<br>Dyes 0.5<br>For the exposure assessment, direct discharge to surface water should be assumed. |
| Release factor to soil | 0.00144 | No direct releases to soil, but from secondary wastes. |
| *Additional release from sludge* | | |
| *Release to secondary wastes / sludge* | *0.9* | *It is the intention of the process to remove most of the substances contained as contamination on the old paper. The releases distribute between water and sludge. The default reflects the worst case (substance fully absorbs to sludge). The worst case scenario would involve use of this sludge in construction or agriculture. The release factor to soil is calculated by multiplying 0.9 (removal rate) with the release rates to water and soil (c.f. above).* |

*Recycling of glass*

Glass recycling starts with the breaking of collected glass. It can be assumed that no releases occur to air and water and hence, for this material recycling, no shredding scenario needs to be assessed.

Substances which are added to the glass article (e.g. coating, attachments of metals) are contained in the material as contamination and for them an assessment of the process is necessary.

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[71] See Table R.18- 21 for data source.

[72] Source: simple treat model.

[73] The DEHP RAR specifies for paper recycling that printing inks can be removed in a range between 6 and 90%. As a worst case, the full amount is soluble in water and contained in the aqueous phase.

**Table R.18- 11: Defaults for the glass recycling scenario**

| Parameter | Default | Reasoning |
|---|---|---|
| # of installations | 140 | Number of glass producing installations |
| Emission days | 330 | Normal operating time of continuous processes |
| WWTP | Not relevant | No onsite wastewater treatment is assumed to exist in glass recycling installations. |
| Release factor to air | 0,006 metals<br>0.05 Mercury<br>0.0001 organic substances | Values taken from ongoing discussion about revision of glass BREF[74] |
| Release factor to water | 0.0005 | Only very limited waste water emissions, due to internal circulation. Value derived by expert judgment, worst case assumption on residual releases.<br>For the exposure assessment, discharge of wastewater to the local sewage system should be assumed. |
| Release factor to soil | 0 | |

*Specific article wastes (Models "Solid-solid separation" and "Milling/ Mixing")*

Articles, for which specific waste regimes exist, undergo a series of processing steps before materials are actually recycled. The first step is a dismantling process, resulting in a separation of non-hazardous parts from hazardous parts (frequently operating fluids, e.g. battery acids). Furthermore, main types of materials are separated mechanically. These steps normally do not lead to any significant release of substances.

The second step is where the main solid materials are broken into smaller parts via shredding and other breaking techniques. To assess respective release to air or water, the shredding scenario previously described should be used. In the next step the shredded waste fractions are separated, which should be assessed using the solid/solid separation model.

And the third step is where the main material is subjected to the respective recycling processes. Therefore, it is important to identify in which material streams the substance ends up in order to assess the suitable treatment process described before.

## 4 Release estimates for hazardous wastes

The development of scenarios to assess releases from hazardous wastes should take particular account of the type of wastes, e.g. whether it is liquid or solid or whether it mainly consists of mixtures (e.g. galvanic baths) or it contains substances and mixtures as contamination (e.g. cutting fluids).

[74] BREF documents are available on the JRC website.

### Appendix R.18-2: Default release factors for waste treatment processes

The waste stream "hazardous wastes" is relevant for wastes from risk management measures (air filters, sludge from waste water treatment etc.) as well as for wastes from manufacturing and downstream uses, as the assessed substance could be contained in high concentrations. Wastes from substances used in classified consumer mixtures should also be assessed within this waste stream, as they should be collected as hazardous consumer wastes.

The results of the assessment step are released amounts from the relevant processes to air, water and soil at local and regional scale:

- $Elocal_{air}$ [kg/d], $Elocal_{water}$ [kg/d] and $Elocal_{soil}$ [kg/d] and
- $Eregional_{air}$ [t/y], $Eregional_{water}$ [t/y] , $Eregional_{soil}$ [t/y].

The waste treatment processes relevant for the different types of waste can be identified for the first tier assessment based on the following table.

**Table R.18- 12: Correlation of PC[75]s and other wastes to most likely waste treatment processes**

| Waste treatment scenario | Types of wastes / relevant product categories |
|---|---|
| Incineration / co-incineration of hazardous wastes | Solid wastes from risk management measures, e.g. spent air filters, filter cakes and dried sludge from waste water treatment<br>Leftovers of classified mixtures (industrial, professional and consumers) disposed of inside its original packaging or as production wastes (e.g. solid paint overspray, remaining residuals in machinery or waste occurring during cleaning operations)<br>Spent processing aids and other types of liquid production wastes, however mostly they are first or only treated in chemical physical treatment installations.<br>Almost all PCs could be relevant |
| Distillation<br>Silver recovery | Waste oils<br>PC30 (photo-chemicals)<br>PC35 (Washing and Cleaning Products (including solvent based products)<br>PC40 (extraction agents) |
| Separation and further waste treatment processes | Liquid wastes, such as spent processing aids or processing chemicals (e.g. galvanizing or textile finishing baths)<br>End-of service life mixtures, such as hydraulic fluids<br>Secondary wastes from risk management measures (e.g. sludge from paint overspray or onsite wastewater treatment, washers)<br>Of particular relevance[76]: PC9a, PC14, PC 15, PC16, PC17, PC20, PC 21, PC23, PC24, PC25, PC26, PC34, PC36, PC37 |

*Incineration of hazardous waste (model "Thermal treatment-oxidising")*

The process of incineration of hazardous waste is in principle the same as the incineration of municipal wastes. The same European-wide emission limit values are set by the Waste Incineration Directive and a great part of the BAT conclusions is valid for both types of waste incinerators. The main difference regarding the extent and type of emissions to the environment is a higher degree of destruction of organic substances (in particular PCP, PCBs and other halogenated waste) where the minimum temperature of 1100°C has to be guaranteed according to the Waste Incineration Directive.

[75] Product Categories.

[76] PC9a: coatings, paints, thinners, paint removers, PC14: metal surface treatment products, PC15 non-metal-surface treatment products, PC16 heat transfer fluids, PC17 Hydraulic Fluids, PC20 Products such as pH-regulators, flocculants, precipitants, neutralization agents, PC21 Laboratory Chemicals, PC23 Leather tanning, dye, finishing, impregnation & care products, PC24 Lubricants, Greases & Release agents, PC25 Metal Working Fluids, PC26 Paper and board dye, finishing & impregnation products, PC34 Textile dyes, finishing & impregnating products, PC36 water softeners PC37 water treatment chemicals.

**Table R.18- 13: Defaults for the hazardous waste incineration**

| Parameter | Default | Reasoning |
|---|---|---|
| # of installations | < 200 | Average approximate number of installations in EU-27+CH+NO (BREF Waste Incineration 2006: EU-15+CH+NO: 93, new EU Member States: 96 including 74 very small installations with capacity < 10 t/d) |
| Emission days | 330 | Incinerators are operated on approximately 330 d/a |
| WWTP | 100 % | Wastewater from flue-gas cleaning is collected and submitted to on-site waste water treatment. |
| Release rate to air[77] | 0.0001<br>0.05<br>0.001<br>0.0003 | Organic substances<br>Mercury<br>Cadmium, thallium, antimony, tin<br>Other Metals<br>Organic substances are destroyed due to high incineration temperatures.<br>Metals are not destroyed and could be emitted to a rather high extent to air, even if flue gas is cleaned. |
| Release rate to water[78] | 0.0001<br>0.0002 | Organic substances<br>Metals<br>As organic substances are mostly destroyed, their content in flue-gas cleaning water is expected to be low.<br>Metals are expected to emit to a low extent during incineration, due to high boiling points. Hence, their concentration in flue-gas cleaning water is expected to be low as well.<br>For the exposure assessment, the wastewater is assumed to be discharged to surface waters. |
| Release rate to soil | 0 | No direct releases to soil occur from incineration. |

Waste water treatment efficiencies are calculated based on maximum waste water emissions of municipal and hazardous waste incineration plants before treatment[79] compared with emission limit values of the Waste Incineration Directive and (for the COD value) with the upper range concentration of the BAT associated emission level[80].

PCDD/F (11.71-> 0.3 ng/l): 97%.
Mercury (19.025-> 0.03 mg/l): 99,5%.
Other metals (calculated with lead peak level of 24 -> 0.2 mg/l): 99%
Minerals (COD 390 -> 250 mg/l): 35%

Secondary wastes from hazardous waste incineration (filter dust, ashes or slag) are to be disposed of in underground landfills. No emissions occur from these.

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[77] Based on Transfer factors published by Reimann, in: Thomé-Kozmiensky “Ersatzbrennstoffe 2”, TK Verlag, 2002.

[78] Expert judgement based on emissions to air.

[79] BREF Waste Incineration, p. 176.

[80] BREF Waste Incineration, page 446.

*Distillation of liquid wastes (Model "Distillation")*

This waste treatment process can be applied to distillation of waste oils, solvents, cleaning agents or similar mixtures, aimed at recovering substances from the waste mixture. The process covers the filling of waste material into the distillery (low releases) and heating up of the mixture to extract distillation fractions of the main material with higher purities. The assessed substance could either be recovered or distributed to distillation sludge or fractions which are further treated as waste (e.g. distillation fractions with higher or lower boiling points than the main recycled product) or be included in the waste gas incinerated in the off gas abatement.

The fraction of a substance included in a lubricant or a solvent possibly going to a (re-)distillation process depends on the volatility of those solvents or oils and on the specific use patterns. Table R.18- 14 shows respective figures where part of the different lubricant mixtures reaches the waste status as a separate collectable waste fraction.

**Table R.18- 14: Average fraction of collectable waste[81]**

| Type of lubricant | Collectable share |
|---|---|
| engine oil | 59. 5% |
| hydraulic oil | 75.0% |
| gearbox oil | 64.0% |
| Metal cutting fluids | 45.0% |
| Base oil | 50.0% |
| machine oil | 40.0% |
| compressor oil | 50.0% |
| insulating oil | 90.0% |
| Turbine oil | 70.0% |

Less than the total amount of these "collectable" waste fractions is directed into the distillation process. Thus e.g. for lubricants assessments show that for the EU 27 only about 13% of the market volume is distilled again[82].

Substance is distributed between air (and consequently destroyed in the of gas abatement unit), distillation sludge (which is then further processed) and the recovered fraction (substance could be main component or contamination).

In a proposal for an emission scenario document for the chemical industry[83], generic release factors for different types of equipment used in the chemical industry are proposed. For distillation, a

[81] Jepsen, D., Drachenberg, I.: Altölströme in Deutschland, Müll-Handbuch, Kennzahl 8222, Lieferung 1/2008, Erich Schmidt Verlag.

[82] GEIR 2008; market surveillance – waste oil collection an waste oil use in EU 27 in 2006, not published.

[83] P. van der Poel and J. Bakker: RIVM report 601200004/2004 Proposal for the development of Emission Scenario Documents on the Chemical Industry.

release factor to air of 0.07 kg TOC[84] / tonne is proposed. This results in a release factor to air of 0.00007 for the main constituent / solvent. For substances contained as contaminants, the release factor to air should be multiplied by the concentration in the solvent.

Aqueous wastes from distillation, within which substances could reach surface water, may be aqueous condensates and aqueous bottom residues from the distillation. Both are assumed to be submitted to further waste treatment processes, e.g. waste water treatment or thermal treatment (non-oxidising and oxidising). Due to low concentrations of contaminants and solvents in the residues releases can be neglected in the assessment.

**Table R.18- 15: Defaults for the distillation scenario**

| Parameter | Default | Reasoning |
|---|---|---|
| # of installations | 140 | Approximate number of installations in EU-27 |
| Emission days | 220 | Normal operating days for non-continuous installation |
| WWTP | Not relevant | It is assumed that no onsite wastewater treatment plant exists. |
| Release factor to air | 0.007 | Applicable to the substance, if it is the main component to be recovered in the process.<br>The default value of the ESD has been multiplied by 100 as it has been derived for the chemical industry and primary processing. |
| | 0.007 * average concentration (%) | Volatile contaminations of distilled product (boiling point around or higher than distillation temperatures)<br>Default release factor derived from ESD proposal multiplied by 100 (see above) |
| | 0.00007 * average concentration (%) | Metals, inorganic substances and substances with boiling points well below distillation temperature.<br>Default release factor from ESD proposal is used for almost non-volatile substances. |
| Release to water | c.f. equation below | Emissions to water pathway depend on various factors according to ESD proposal for chemical industry, which are difficult to condense into one factor. The equation has been modified to adapt to conditions of waste treatment and derive a daily instead of an annual local release.<br>For the exposure assessment, discharge to the local sewage system is to be assumed. |
| Release factor to soil | 0 | Processing does not give rise to releases to soil, no secondary wastes which would reach the soil. |

Emissions to water result from cleaning of the distillation installation. Therefore, they do not mainly depend on the volume of the substance, but rather more on the number of cleaning events, the size of the reaction vessel and the density of the substance.

The daily released amount to water (before wastewater or sewage treatment) from a distillation plant can be calculated[85] with the following equation:

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[84] Total organic carbon.

$$Elocal_{water} = Volume_{vessel} * RHO_{material} * RF_{resid} * \#clean * conc_{dist} / T_{emission}$$

$Elocal_{water}$ = daily local release to water [kg/d]

$Volume_{vessel}$ = Volume of distillation installation = 200 [$m^3$][86]

$RHO_{material}$ = density of substance [$kg/m^3$]

$RF_{resid}$ = residual amount in the distillation installation before cleaning = 3.28 [%][87]

#clean = number of cleaning events

assuming that the vessel is cleaned after each batch, the number of cleaning events can be derived by dividing the amount entering the distillation process (Q [t/a] * $f_{waste\_HW\_distill}$) by the vessel volume (200$m^3$) multiplied by the concentration in the waste to be distilled[88].

$Conc_{dist}$ = concentration of the substance in the waste to be distilled

$T_{emission}$ = operation days of the distillation plant

*Treatment of liquid wastes (models "Liquid-liquid separation" and "Solid-liquid separation")*

Aqueous wastes treated by chemical physical treatment could be for example:

- inorganic acids and alkalis and their rinse-waters, together with cleaning, washing and interceptor wastes from a range of processes;
- aqueous alcohol/glycol streams and process wash-waters from chemical industry, including cleaning wastes with low levels of chlorinated compounds such as dichloromethane or phenolic compounds;
- cyanide wastes - typically this waste will consist of solid or liquid cyanide salts, for example, sodium cyanide from surface metal treatments. They may also be present in printing wastes, usually as silver cyanide. Examples of cyanide based plating solutions include copper, zinc and cadmium cyanides;
- developer waste (photographic wastes) typically includes a solution with a high percentage of ammonia salts, predominantly thiosulphate;
- waste waters from shaping; oil wastes; organic chemical processes; and water and steam degreasing processes;
- Sludge from water based cleaning of paint overspray;
- Used galvanic baths from galvanic industry;
- Used / contaminated processing aids, such as metal cutting fluids;

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[85] Using the information from the ESD proposal.

[86] Average volume used for assessments in the proposal for an ESD for the chemical industry.

[87] Highest value for residues in vessels applied in the ESD proposal for the chemical industry.

[88] If e.g. a solvent is registered in amounts of 5000 t/a, and approximately 20% of that end up in waste for distillation and the solvent is contained in that waste in a concentration of max. 30%, the number of cleaning events would be 1.5.

- Sludge from on-site or municipal waste water treatment processes or other processes of different industries;
- residues from the metallurgical industry (dusts, sludge, slags). These may have high contents of Cr(VI), spent catalysts, paint residues, mineral residues from chemical processing.

Several processes are applied depending on the type of aqueous wastes, which in principle aim at separating the fractions contained in the aqueous wastes and concentrating the contaminants / unwanted components in the solid phase for further treatment. Substances in the waste could distribute during the process to:

- sludge (due to precipitation or adsorption), which is usually disposed of after drying in incineration plants or used in road construction;
- oil/organic phase of the waste (lipophilic substances, would be skimmed or decanted);
- water phase (filtrate of the aqueous wastes from solid-liquid separation), which is usually specifically treated on-site;
- air (mainly from scrubbing of exhaust air from the reactor).

Air releases may be associated with rapid pH changes, rapid temperature rises and with vigorous agitation. Emissions include mostly volatile organic compounds (VOCs), which are identified through their vapour pressure (0.01 kPa or more[89]) but also non-volatile compounds and metals. Furthermore some installations plants are operated under higher temperature (50-90 °C) so increase of vapour pressure might occur.

Emissions to water occur from the filtrate of the water phase of the aqueous wastes. The processing of waste waters mixed with organic material generates around 836 kg of waste water per tonne of waste and 5.5 kg of sludge per tonne of waste[90]. Substances to a large extent are part of the sludge generated from the process or are contained in the oil phase, which both are either recycled or disposed of in waste incineration plants.

*Generic model aqueous waste treatment by separation*

In the following, generic defaults are proposed covering the liquid/liquid and solid/liquid separation processes. The release factors to the environmental media relate to releases from the separation process to the environment. The distribution factors to the organic phase and to sludge provide for the derivation of amounts of the substance in secondary wastes. Depending on the separation technique and related resulting phases, releases from secondary wastes (e.g. treatment by incineration and/or landfilling) have to be assessed separately.

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[89] Corresponds to the definition of VOCs of the Solvent Emission Directive (1999/13/EC). Alternatively, a boiling point of 250°C or less could be used.

[90] OECD ESD series n.10 on lubricants.

**Table R.18- 16: Default values for generic assessment of separation processes of aqueous wastes**

| Parameter | Default | Reasoning |
|---|---|---|
| # of installations | 780 | Approximate number of installations in the EU-27 |
| Emission days | 220 | Normal operating days for non-continuous installation |
| WWTP | 100% | Onsite wastewater treatment is assumed to exist. The efficacy should be determined for each substance separately. |
| Release factor to air | 1 | Expert judgement: volatile compounds would evaporate or be stripped out during the process |
| | 0.15 | Expert judgement: Non-volatile compounds: Operating conditions seldom involve high temperatures. 0.15 corresponds to a release factor from water for substances with a LogH of < 1, which are not degradable (derived from simplified release factors of simple treat). |
| Release factor to water | Solubility > $C_{waste}$ → $RF_{water}$ = solubility [mg/l] / 100,000<br>Solubility < $C_{waste}$ → $RF_{water}$ = solubility [mg/l] / concentration [mg/l] | Expert judgement: Worst case assumption that only the excess to the dissolvable amount of the substance is removed from the water phase.<br>If solubility is higher than the concentration in aqueous waste, then the entire amount would be dissolved and released. The release factor results from division of the solubility by 100,000 (100% = 1g/l)<br>If the solubility is lower than the concentration in aqueous waste, the release factor can be derived from the quotient of solubility and concentration |
| Distribution factor to sludge | 1 | Expert judgement: worst case assumption: the total amount of the substance entering the process distributes to sludge. The sludge would have to be assessed as secondary waste. |
| Distribution factor to organic phase | 1 | Expert judgement: worst case: 100% of substance to oil phase |
| Release factor to soil | 0 | Expert judgement: Processing does not give rise to releases to soil, sludge is incinerated not resulting in releases to soil |

## 5 Refinement and more specific estimations

*Treatment of aqueous cooling lubricant solutions*

The following more specific derivation of released amounts to water per day builds on the assumptions of the generic model (liquid/liquid separation). The releases of substances in cooling lubricant emulsions entering the waste treatment process can be estimated using the following formula[91]:

$$C_{wastewater} = C_{subst} * (Dilution_{oil\_to\_water} + 1) / (Dilution_{oil\_to\_water} * Kow + 1)$$

[91] The equation has been extracted from the OECD ESD on lubricants: OECD series on emission scenario documents – number 10, Emission scenario document on lubricants and lubricant additives, JT00174617, November 2004.

$C_{wastewater}$ = Concentration in the wastewater
$C_{subst}$ = Concentration of the substance in the waste lubricant
$Dilution_{oil\_to\_water}$ = Oil/water ratio = 20
Kow = octanol water partitioning quotient

The resulting daily local release is obtained by multiplying the concentration in wastewater by the amount of wastewater generated per day (default = 200 $m^3$ / day)

$$E_{water}\ [kg/d] = C_{wastewater}\ [mg/l] * 200\ [m^3/d] / 1000$$

<u>*Treatment of synthetic cutting fluids*</u>

For synthetic cutting fluids (and only these), the release of substances to water would be calculated as[92]:

$$E_{water}\ [kg/d] = C_{subst} * 200 m^3/d * (1 - F_{addelim}) / 1000 = C_{subst} * 0.04$$

$F_{addelim}$ is the elimination factor of additives or other substances from the water phase during the separation process of used synthetic cutting fluids. It is set to 0.8 as default. Hence, 80% of the substance would end up in sludge / the oil phase of the system. Sludge is most likely incinerated in hazardous waste incineration plants not giving rise to relevant releases to the environment.

<u>*Photographic chemicals*</u>

The recycling of baths from photographic films is a rather specific process, which will apply only for some substances. It can be assumed that the return rates of photo chemicals are between 20 and 90%. With respect to waste assessment for the release estimate, 90% of the substances would enter the waste stage. The remaining fraction is already released during service life or is discharged to the sewer by the user of the chemicals. Silver is the only component recovered during the process.

[92] The equation has been extracted from the OECD ESD on lubricants: OECD series on emission scenario documents – number 10, Emission scenario document on lubricant additives, JT00174617, November 2004.

**Table R.18- 17: Defaults for the treatment of photographic baths**

| Parameter | Default | Reasoning |
|---|---|---|
| Fraction becoming waste | 0.9 | OECD ESD for photographic industry |
| # of installations | Missing information | |
| Emission days | 220 | Normal operating days for non-continuous installation (250 TGD part 4) |
| WWTP | 100% | Onsite wastewater treatment is to be assumed. In this case the efficacy should be determined for each substance separately and integrated into the default release factor. |
| Release factor to air | 0 | TGD part 4 |
| Release factor to water | 1 | TGD part 4<br>For the exposure assessment, direct discharge to surface water should be assumed. |
| Release factor to soil | 0 | TGD part 4 |

## 6 Iteration: general refinement options

The default values for release factors proposed in the generic release estimation models are conservative and reflect the worst case. The default factors are in most cases independent of substance properties and of specific operational conditions. If risks are identified in the first assessment, M/I have several options to proceed:

- The daily amounts of the substance treated at one site can be refined by making more precise assumptions on the main waste streams and related applicable processes (Appendix R.18-3 and Appendix R.18-4);
- The default release factors can be refined based on substance properties and operational conditions of the waste treatment process and/or based on information on the distribution of the substance in the process (refinement of distribution models);
- The default release factors can be refined based on legally defined emission limit values and/or measured values or based on release factors derived from literature (e.g. ESDs, IPPC BREFs, permits etc.) applicable to the same or similar substances (read across);
- When the composition of wastes is known, release factors may be derived more easily from emission limit values or measured data, if the treated amount is also available.
- For wastes from manufacturing and downstream uses, the types of waste treatment can be limited to those not posing a risk (to be communicated in the safety data sheet/ES);
- For wastes from manufacturing and downstream uses, risk management measures can be assumed for the waste treatment processes (to be communicated in the safety data sheet/ES).

The concept of refinement of release factors for the waste life stage does not differ from refinements done on release factors for other life cycle stages. However, in the waste sector the knowledge on inputs to specific treatment processes is in most cases incomplete, which frequently makes it impossible to relate a measured release to an input amount of a substance.

In this section generic indication for refinement is discussed. More specific details are provided in Appendix R.18-5.

## 6.1 Refinement of release factors to air

Substances with very high volatilities are likely to already evaporate during use/service life. Hence, a justification for a lower release factor from waste treatment than that given in the default scenarios could be based on respective argumentation. Substances with very low volatilities are likely to evaporate in lower amounts from the waste treatment than those specified in the generic scenarios.

Substances which are chemically bound in a product or an article may not evaporate, although the volatility may suggest this, as they are fixed in the matrix. If M/I can exclude the destruction or dissolution of that chemical bond in the product or article, he may justify a lower release factor to air.

Modification of release using measured data or emission limit values for releases to air for a specific waste treatment operation is rather difficult, as these can normally not be related to the input amount of the substance.

## 6.2 Refinement of release factors to water

Substances with a very low solubility are not likely to be contained in water discharge from waste treatment processes. Hence, a justification for lower release factors than the defaults could be based on respective argumentation.

Substances which are chemically bound in a chemical product or an article may not be dissolved and enter the water pathway, although the solubility may suggest this, as they are fixed in the matrix. If M/I can exclude the destruction or dissolution of that chemical bond, he may justify lower release factors.

Another option to modify release factors is to provide measured data for emissions to water or to base the argumentation on emission limit values for a specific waste treatment operation. In both cases, the derivation of refined release factors needs to be related to the amount of the substance entering the waste treatment process as part of wastes. Furthermore, the amount of waste water produced should be considered.

## 6.3 Refinement of release factors to soil

Direct releases to soil occur only for some to the waste treatment and disposal processes. Furthermore, the assessment of risks to soil is relevant only at regional level.

## APPENDIX R.18-3: FATE OF SUBSTANCE IN WASTE TREATMENT PROCESSES

This Appendix is aimed at supporting the structuring of the information on waste and waste treatments.

The list of waste treatment processes (Table 18-17[93]) aims at systemising technical solutions applied for the treatment of waste. The processes are grouped in major categories ("process groups") "transfer/storage", "mechanical treatment", "chemical treatment", "biological treatment", "thermal treatment", and "landfill". On a secondary level, individual waste treatment processes are shown and further differentiated in waste treatment operations (columns 3 and 4 of the table). In an additional column, the WT processes/-sub processes are assigned to a limited number of distribution models.

Each individual operation can be applied to different waste treatment activities, since it is not combined with a specific type of waste to be treated (e.g. "incineration of municipal waste") nor a description of the treatment target (e.g. "inertisation of waste").

For each of the waste treatment processes a distribution scheme is provided. These enable the registrant to make an exposure assessment based on the specific approach. At the end of this Appendix an example is provided on how the distribution models support the release rate estimation.

**Table R.18- 18: List of waste treatment processes**

| Level 1<br>WT process groups | Level 2<br>WT Processes | Level 3<br>sub-processes | Level 4<br>WT Operations |
|---|---|---|---|
| **Transfer/storage** | | | |
| Model "Transfer and Storage" | Transport/Storage | Transport | Machines |
| | | | Belts |
| | | Storage | Outdoor |
| | | | Indoor |
| **Mechanical treatment** | | | |
| Model "Mixing" | Mixing | | |
| | Size reduction | Shredding | |
| | | Crushing | |
| | | Milling | |
| Model "Solid/solid separation" | Separating | Solid/Solid separation | Sieving |
| | | | Washing |
| | | | Air separation |
| | | | Eddy current |
| | | | Magnetic |

[93] The list has been developed based on literature and internet research on waste treatment activities in Europe as well as personal experience of the involved experts. Major sources have been the reference document on best available techniques for treatment of waste (WT BREF document) 93 and the BAT background documents collected by the IPTS (Seville, available in the Members Area at: http://eippcb.jrc.es). The source has been complemented for operations that have not been covered by the IPPC Directive.

## Appendix R.18-3: Fate of substance in waste treatment processes

| Level 1<br>WT process groups | Level 2<br>WT Processes | Level 3<br>sub-processes | Level 4<br>WT Operations |
|---|---|---|---|
| Model “Solid/liquid separation” | | Solid/Liquid separation | Filtration |
| | | | Sorption |
| | | | Flotation |
| | | | Sedimentation |
| | | | Centrifugation |
| Model “Liquid/liquid separation” | | Liquid/Liquid separation | Decanting |
| | | | Stripping |
| | | | Ultra Filtration |
| | | | Ion Exchanger |
| | | | Sorption |
| Model “Gas/solid separation” | | Gas/Solid separation | Scrapping |
| **Chemical treatment** | | | |
| Treatment is normally done in mixture of a separation step. The equilibrium of (mostly liquid/liquid) separations is influenced by the listed treatments. Further information is provided in this Appendix. | Chemical Treatment | Neutralisation | |
| | | Flocculation | |
| | | Extraction | |
| | | Splitting | |
| | | Solidification | |
| | | Ageing | |
| | | Immobilisation | |
| | | Oxidisation | |
| | | Reduction | |
| | | Dechlorination with metallic alkali | |
| | | Hydrogenation | |
| | | Electrolysis | |
| | | Stabilisation | |
| **Biological treatment** | | | |
| Not relevant for chemicals | Decomposition | Composting | |
| Simple treat model for STP, specific scenarios for specific WWT to be developed, if necessary | | Biological water treatment | Aerobic |
| | | | Anaerobe |
| | | | Fermentation |
| **Thermal treatment** | | | |
| Model “Thermal treatment – oxidising” | Fully oxidising | Dedicated incineration | Grate |
| | | | Fluidised bed |
| | | | Rotary kiln |
| | Fully oxidising | Co-Incineration | Grate |
| | | | Fluidised bed |
| | | | Rotary kiln |
| | Partly oxidising | Pyrolysis | |
| | | Gasification | |
| Model “Thermal treatment – non oxidising” | Non oxidising | Solid waste | Thermal drying |
| | | | Thermal desorption |
| | | Liquid waste | Distillation |
| | | | Evaporation |
| **Landfill** | | | |
| No general distribution model available | Landfill | Inert waste disposal site | |
| | | Non-hazardous waste | |
| | | Hazardous waste disposal | |

## Appendix R.18-3: Fate of substance in waste treatment processes

| Level 1<br>WT process groups | Level 2<br>WT Processes | Level 3<br>sub-processes | Level 4<br>WT Operations |
|---|---|---|---|
| Model "Road construction" | Construction waste | Use in road construction | |

## 1 Distribution schemes of the main waste treatment processes

The aim of this Annex is to describe, with simplified schemes, the mechanisms of waste treatment processes. It will facilitate the identification of the most important parameters (operational conditions (OC), risk management measures (RMM) and substance or waste properties) which determine the distribution of the substance along with the processes and the value of release factors to the different environmental pathways.

The models can be used to facilitate the identification of options to refine release factors and support related qualitative argumentation or measured results. Secondly, the models can be used to develop specific exposure scenarios, e.g. by registrants assessing their manufacturing wastes and wastes of which they have specific information.

The distribution models for the different waste treatment process are explained by text and using graphical illustrations. In both cases the influence of substance properties and operational conditions on release factors is indicated. Furthermore, examples of RMMs are provided.

### 1.1 Scheme "Transfer and Storage"

Before treatment, waste is stored either out in open air spaces or indoors. Releases of dusts may occur as well as releases to water from rain water or sprinkling against dusts.

For treatment, waste is transferred e.g. from trucks to storages, from storages to treatment processes or from previous treatment processes to the following ones. The transfer may be done with machines or with belts, or in case of liquids by means of pipes. Movement with machines can lead to dust emissions as well as transport via belts if these are not covered. Furthermore, wastes stored outside may release substances with rainwater run-off to water and to soil.

Release factors to water, air and soil from transfer and storage of wastes containing the assessed substances can be added to the release factors for further processing (e.g. incineration, shredding etc.), as normally transfer and storage is most relevant at the site of waste processing.

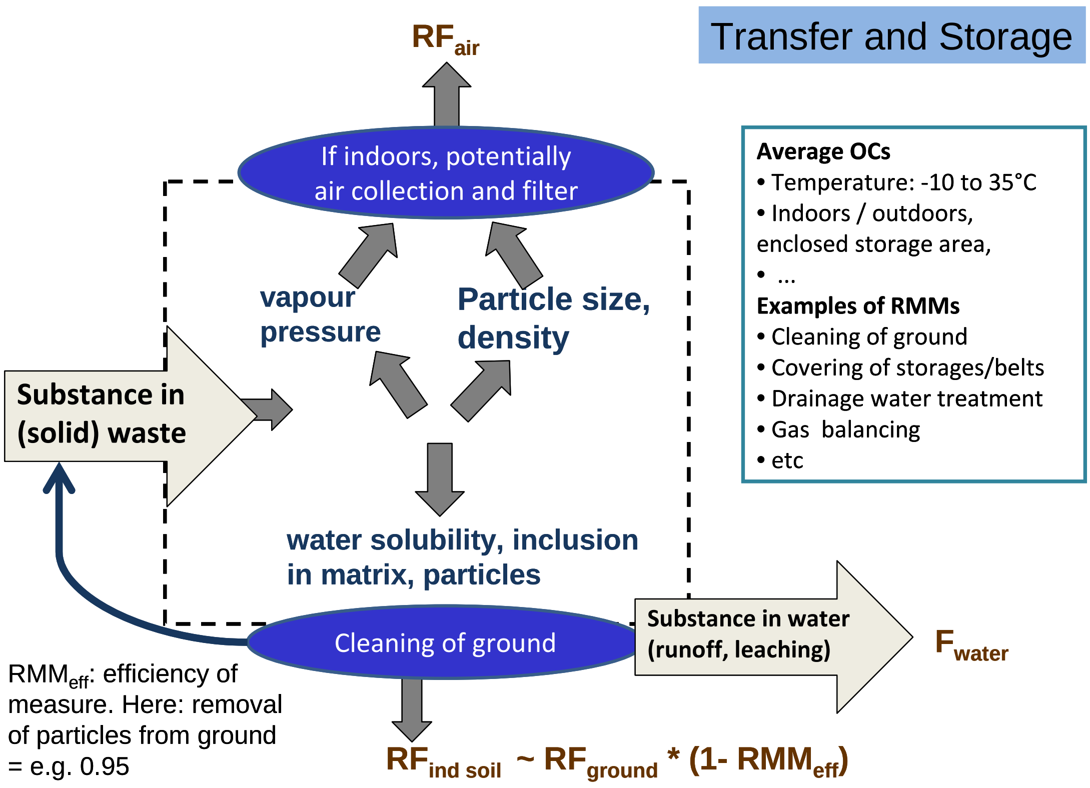


**Figure R.18- 8: Distribution model for transport and storage of wastes**

### 1.2 Scheme "Mixing and Milling"

Mixing or shredding / milling of wastes could be the only treatment of waste applied, e.g. for rubber tires or construction and demolition waste. In other cases, it is one process in a sequence of processes in the waste treatment chain.

Mixing results in the movement of individual waste components. The substances contained in the waste components or main materials could evaporate, if they are not firmly bound to the matrix of the material, or be emitted to air as part of dust particles. In most cases, evaporation will be much less relevant than releases of dust. If volatile substances are (still) present in the mixed/milled waste, evaporation will depend on the volatility of the substance. In all other cases, releases depend on the properties of the dust particles (particle size and density).

If mixing / milling is carried out in the frame of several waste treatment steps, release factors can be combined with the preceding step of transport/storage or with subsequent steps like separation.

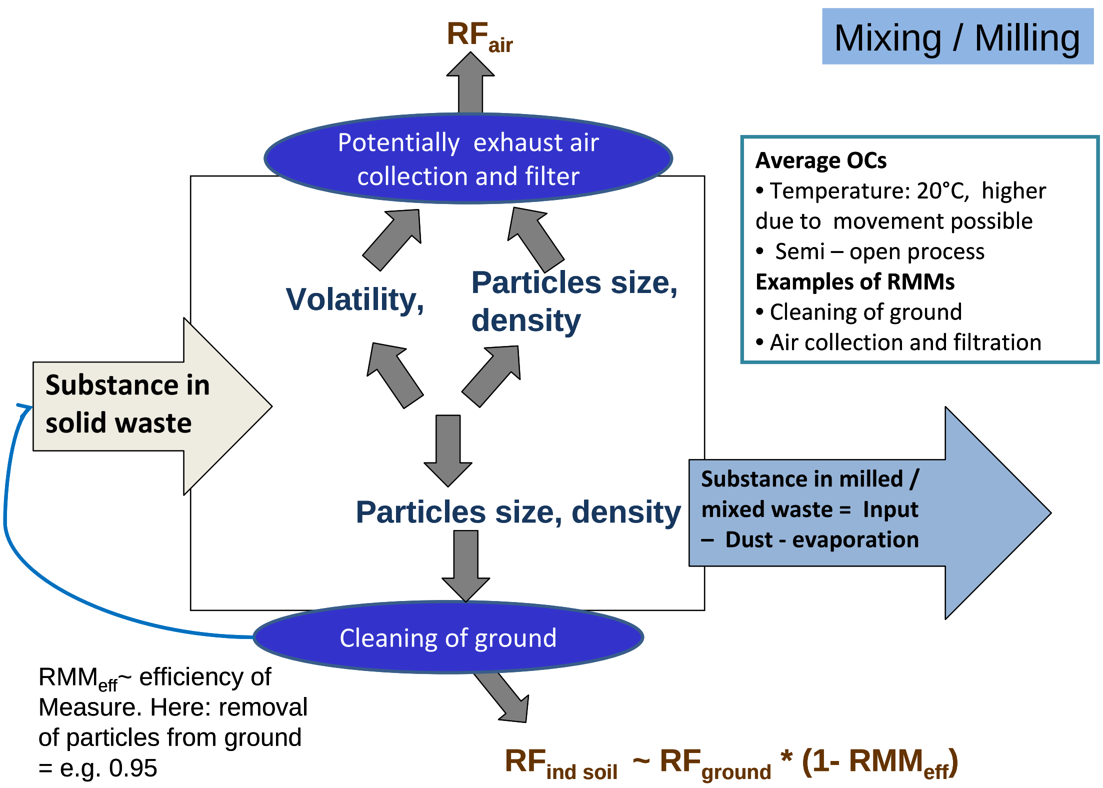


**Figure R.18- 9: Distribution scheme for mixing and milling of wastes**

## 1.3 Schemes "Separation"

Separation techniques are distinguished according to the phases to be separated from each other. The sequence of phases in the names of the schemes indicates which phase is to be concentrated (first part) and which is the remains (second part). For example, in solid / liquid separation, solids are aimed to be concentrated as a solid phase by removing them from the liquid phase.

The use of treatment chemicals as part of the separation process of (mostly liquid) waste mixtures may change the equilibrium of the separation (increased separation efficiency) and dominate over the influence of substance properties[94]. Any such techniques could be included in an exposure assessment as operational condition, if the waste management measures of the DUs can be influenced.

### 1.3.1 Solid-solid separation techniques

Examples for physical / mechanical separation techniques are sieving, manual sorting and automatic separation techniques using air, water (washing) or physical properties (magnetic separation, eddy current separation). A solid phase of the waste is separated from another solid phase with the aim of

[94] Examples of chemical treatment to enhance separation are shown in the WTO list and are briefly described in the section on chemical treatment.

de-contamination/purification of a material. As substances are part of materials to be separated, the distribution of substances only depends on the separation efficiency.

The separated solid phases of wastes are normally further processed. Hence, the amount leaving the separation process should be used as input to the further waste treatment processes.

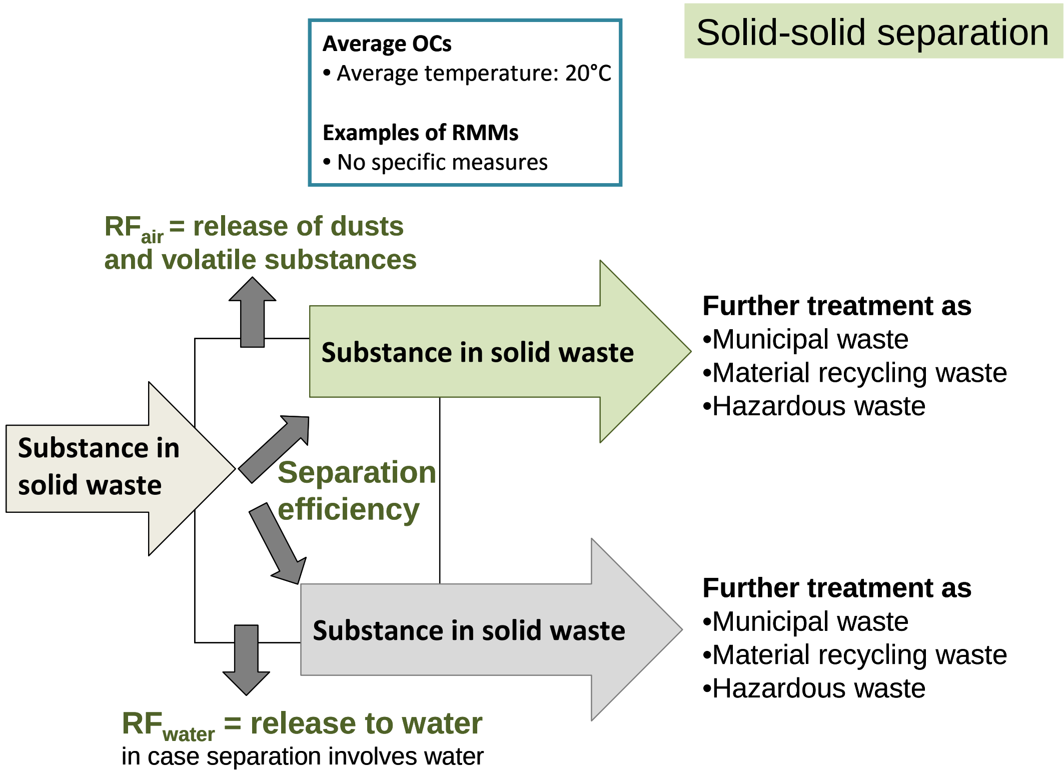


**Figure R.18- 10: Distribution scheme for separation techniques applied to solid dry wastes**

1.3.2 Solid-liquid separation techniques

Examples for these separation techniques are filtration, sorption, flotation, sedimentation and centrifugation. Separation of these phases can be facilitated by chemical treatment (flocculation or pH variations of the waste). Separation is mainly carried out to concentrate components of the waste of concern in one of the phases in order to subject both phases to further treatment in a more efficient way. Two cases can be distinguished which influence the phase into which a substance is separated:

**a) Substance is not bound to waste matrix/particles**

If the assessed substance is not integrated into a matrix, its distribution depends on its substance properties. These substance properties may enhance each other, resulting in the substance unambiguously being distributed to only one of the phases or may counteract, resulting in more complex relations determining in which phase the substance will end up. The most relevant properties determining distribution are:

LogKow: with increasing LogKow, the substance concentrates in the solid phase. Other indicators of hydrophobicity can be used as well. Also the Koc as indicator for the tendency of substances to sorb to organic matter may be used.

Solubility: the more soluble the substance is, the higher is its percentage in a water phase

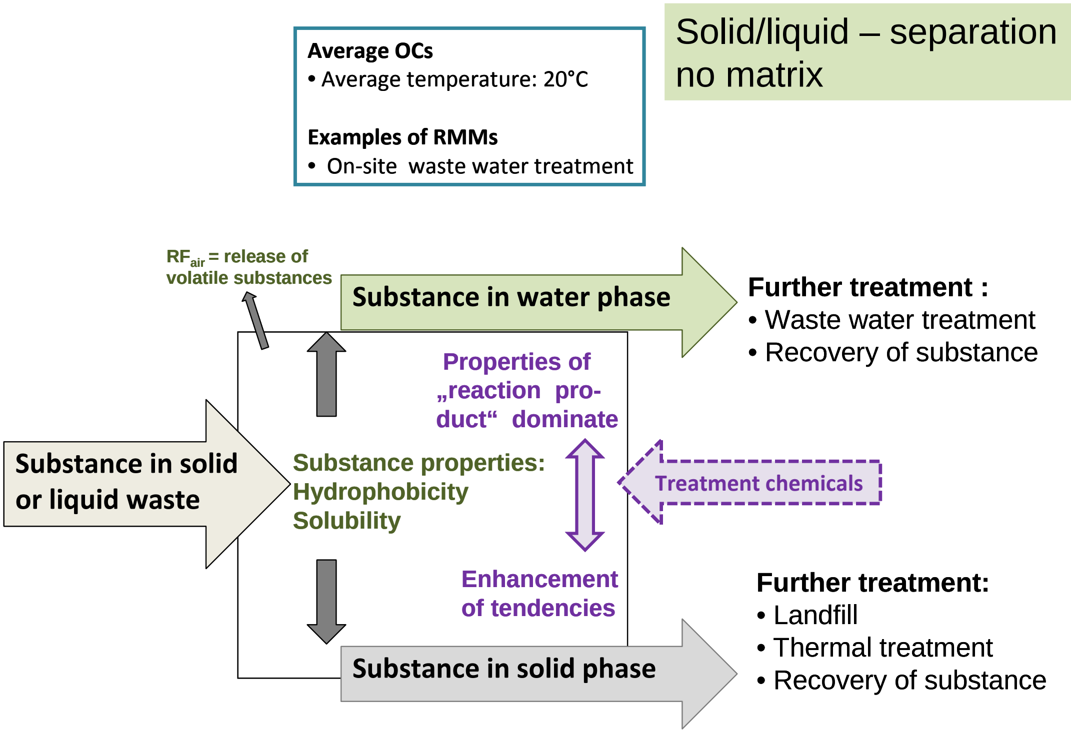


**Figure R.18- 11: Distribution scheme for separation techniques, substance is not bound to the matrix**

**b) Substance is bound to matrix/particles**

If the substance is bound to a matrix when entering the separation process as part of waste, its distribution is dominated by the behaviour of the matrix (particles), except if the substance disintegrates from the matrix upon contact with the liquid phase. This scenario is not applicable to sludge (no integration in matrix). In analogy to the behaviour of substances, the following relationships can be assumed:

If the (surface of the) matrix is hydrophobic, particles are likely to distribute to the solid phase[95]

If the matrix (particles) is/(are) small and heavy, they will rather deposit and remain in the solid phase; if they are big and light, they are more likely to float

[95] This is the case if the liquid is water (as in the majority of such waste separation processes).

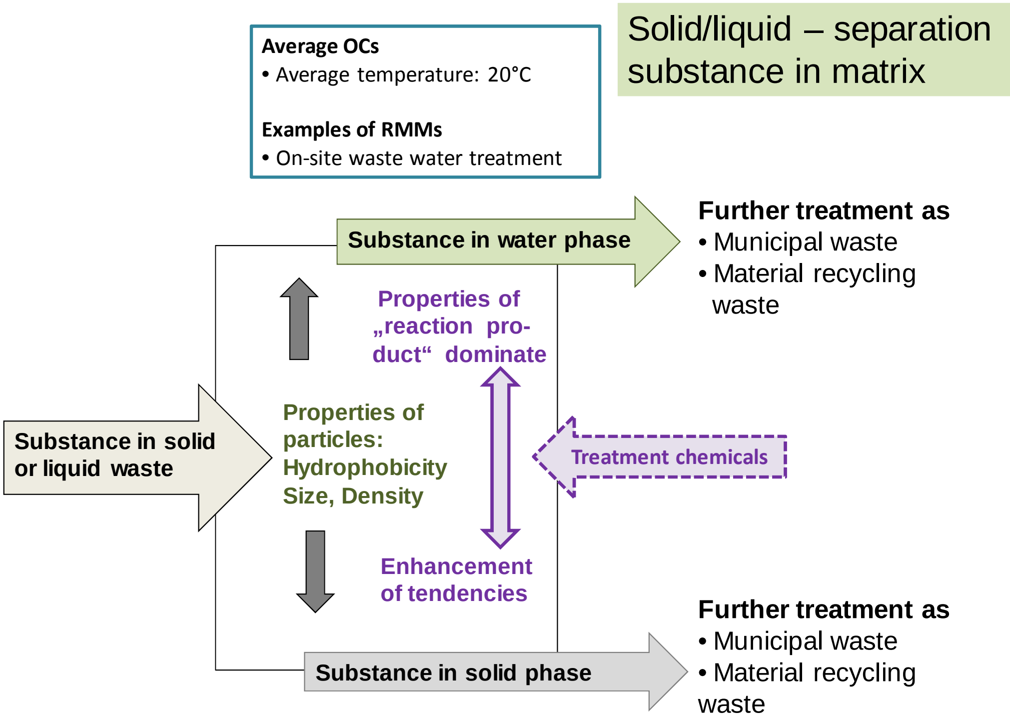


**Figure R.18- 12: Distribution scheme for separation techniques, substance is integrated in matrix**

### 1.3.3 Liquid-liquid separation techniques

Examples for separation techniques for two liquid phases are decanting, stripping, ultra filtration, ion exchange and sorption. Separation could be facilitated by chemical treatment (e.g. by adding flocculation agents or changes of the pH of the waste). Since the waste is liquid, no binding to the waste matrix is assumed for the assessed substance.

The phases to be separated are distinguished by their polarity or "oiliness": polarity differs widely in water/oil phases, but also two different organic phases with different polarities could form liquid wastes. The distribution of the substance depends mainly on the log Kow. The water solubility is relevant also, if a water phase exists.

The use of chemicals to change the equilibrium of separation could dominate over the substance properties and hence change the distribution pattern (even reversal could be achieved). It could also enhance existing tendencies of distribution. Any such techniques could be included in the exposure assessment as operational condition, if the waste management measures of the DUs can be influenced. This should be included in the exposure scenario and communicated down the supply chain, as it cannot be assumed to be state-of-the-art.

## Appendix R.18-3: Fate of substance in waste treatment processes

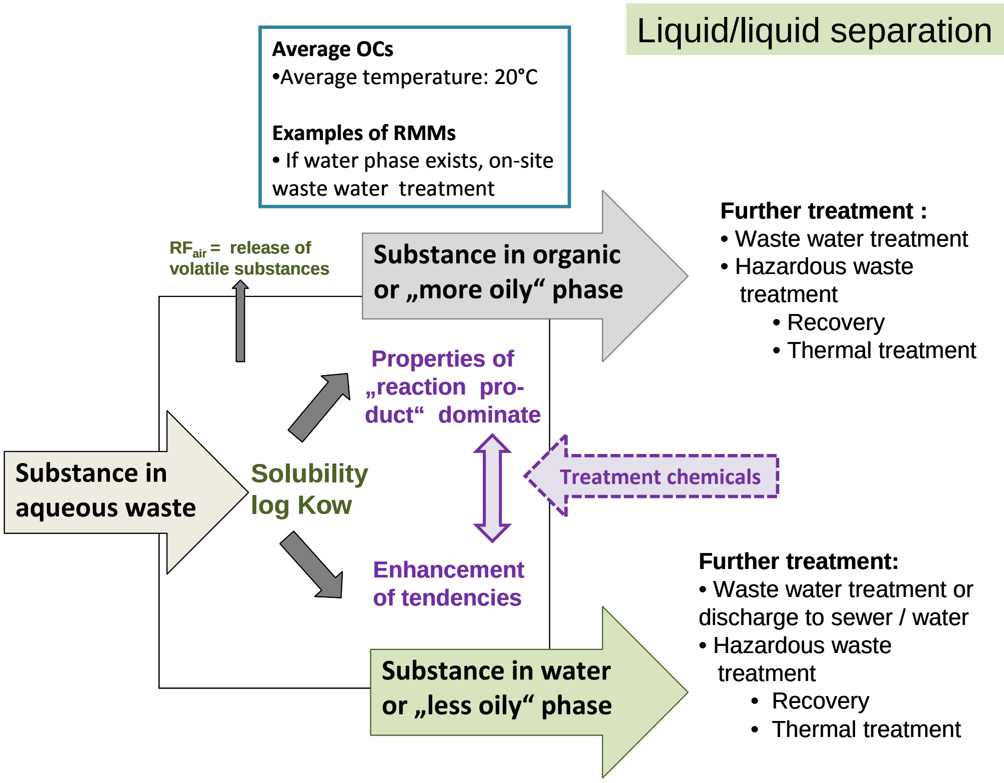


**Figure R.18- 13: Distribution scheme for separation techniques, two liquid phases**

### 1.3.4 Gas-solid separation techniques

Separation techniques resulting in a solid and a gaseous phase are applied to gases in containers as such or as part of articles, e.g. cans or lamps. The substance included in that waste could either be (contained in) the gas or could be contained in the container and hence included in or onto the container matrix (in solids/particles).

The distribution of the substance is determined by the following parameters:

- If the substance is included in the article matrix, it will distribute to the solid phase
- If the substance is not integrated into a matrix it will be included in the gas phase

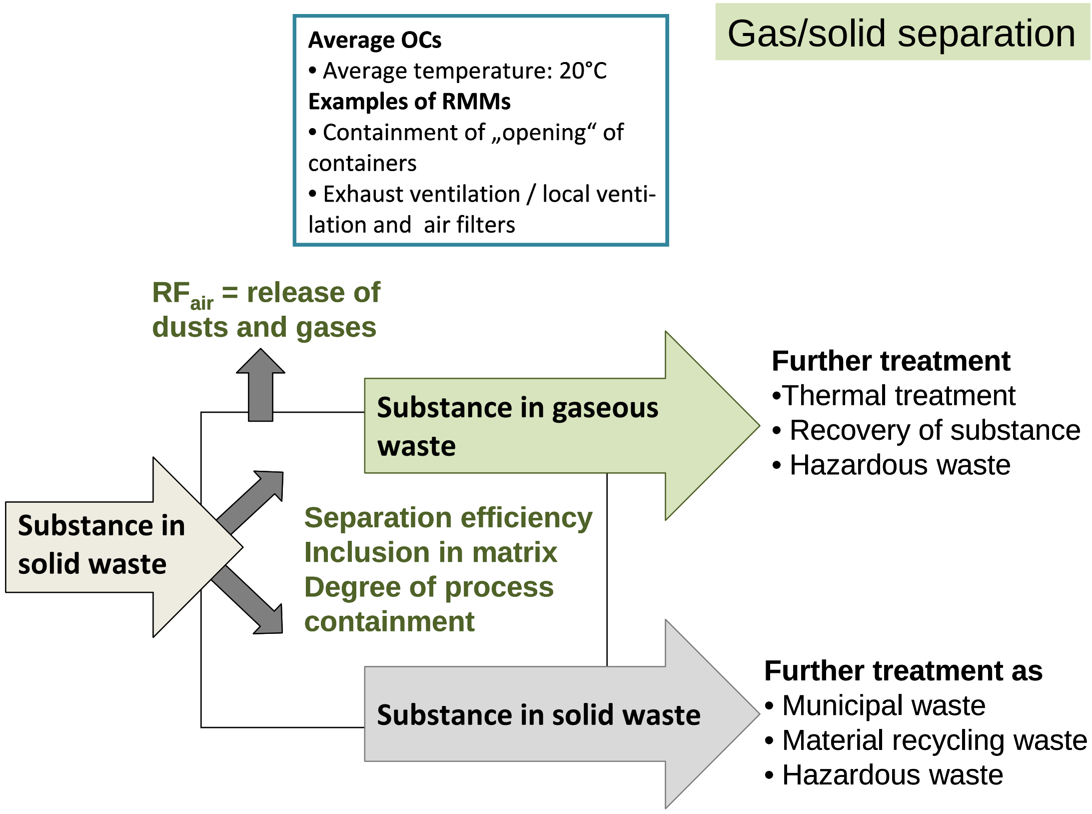


**Figure R.18-14: Distribution scheme for separation techniques, two liquid and one solid phase**

## 1.4 Chemical treatment

The chemical treatment processes of liquid wastes in the list are usually not separate and "stand-alone" waste treatment processes, but facilitate the conduction of other processes and operations. In most cases, chemicals are applied in the frame of phase separation, in order to increase the efficiency of separation. This is achieved for example, by changing the solubility of substances or particles via pH-manipulation (chemicals added are normally acids or bases), adding flocculants to precipitate substances (could be organic substances or salts), surfactants (change of solubility/surface characteristics of particles) etc.

In this sense, these processes are not considered separately but could be added to a separation process as an operational condition influencing the distribution of the substance. Also, therefore, no distribution scheme is provided.

If chemical treatment is used in a specific assessment or as refinement option for release factors, this is a condition not to be regarded as state-of-the-art but as additional. Hence, the safety assessor should only use this option if he can ensure that the measure and conditions (e.g. efficiency (gain) by application of chemicals in a separation step) can be communicated to those actors in the supply chain that dispose of the respective waste.

## 1.5 Thermal treatment

1.5.1 Fully or partly oxidising processes

Examples of fully or partly oxidising thermal treatment processes are: municipal waste incineration, hazardous waste incineration and co-incineration of waste, e.g. in grate combustion, fluidised beds or rotary kilns, as well as pyrolysis and gasification of wastes. The scheme can also be applied to metal recycling processes; however different operating temperatures and residence times need to be assumed. In thermal treatment processes, the core operational condition is the temperature.

- Substances with decomposition temperatures below the incineration temperature will be mineralised almost completely (and are not released in the original form)
- Substances which are not mineralised by the high temperatures will
    - Distribute to ashes/slags, if they are non-volatile, part of (heavy) particles (mainly minerals, some metals). These are assumed to be either landfilled or submitted to recovery processes (only valuable metals)

    - Distribute to fly ash, resulting from thermal movement of fine particles in waste gas, from a high volatility and/or a high tendency to absorb to organic matter / particles (mainly stable organic compounds as well as elements). From fly ash, substances distribute between water and air depending on the efficiency of the flue gas cleaning device. It is assumed that washers or dry adsorbents are applied.

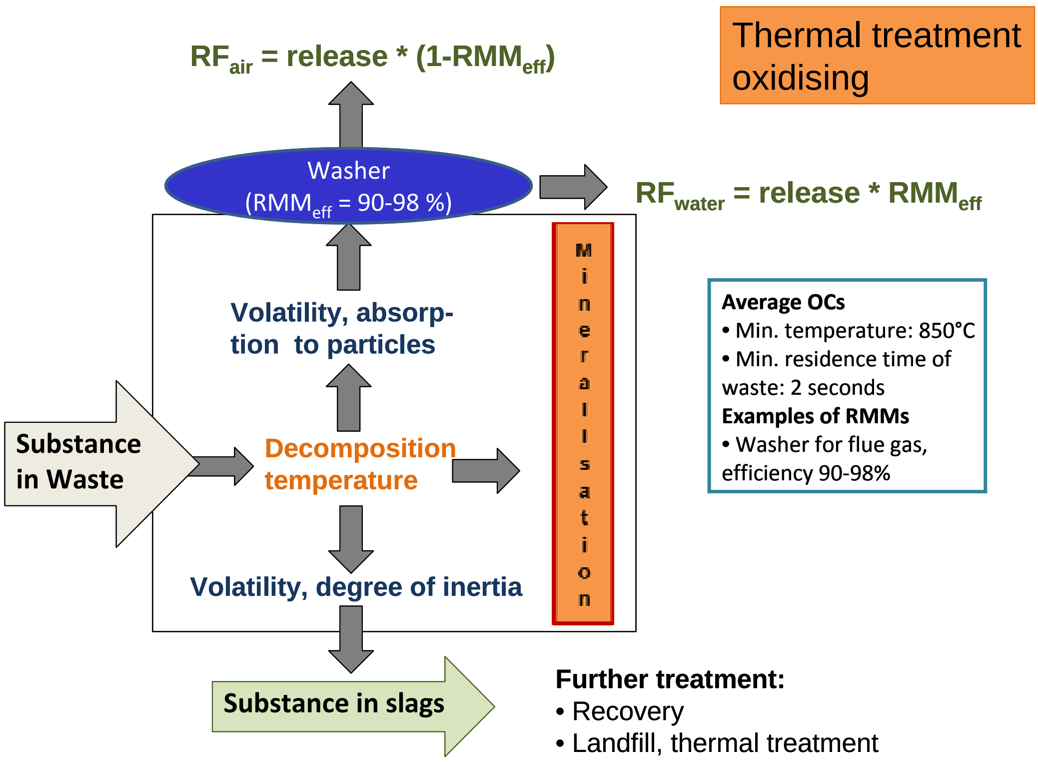


**Figure R.18-15: Distribution scheme for oxidizing thermal treatment processes**

1.5.2 Non-oxidising thermal treatment

Non-oxidising thermal treatment of waste mainly relates to drying of wastes or thermal desorption of substances, e.g. from activated carbon filters. The treatment involves storage of wastes, feeding into the process and drying at elevated temperatures. Substances included into matrices will most likely not be affected by the treatment at all. The behaviour of substances, which are not bound to matrices, depends on their properties:

- If the decomposition temperature of the substance is below the operating temperature, the substance will be mineralised to a large extent
- Stable and volatile substances are likely to evaporate

Secondary wastes from waste gas treatment as well as dried wastes are normally submitted to further processing, such as landfills or oxidising thermal treatment.

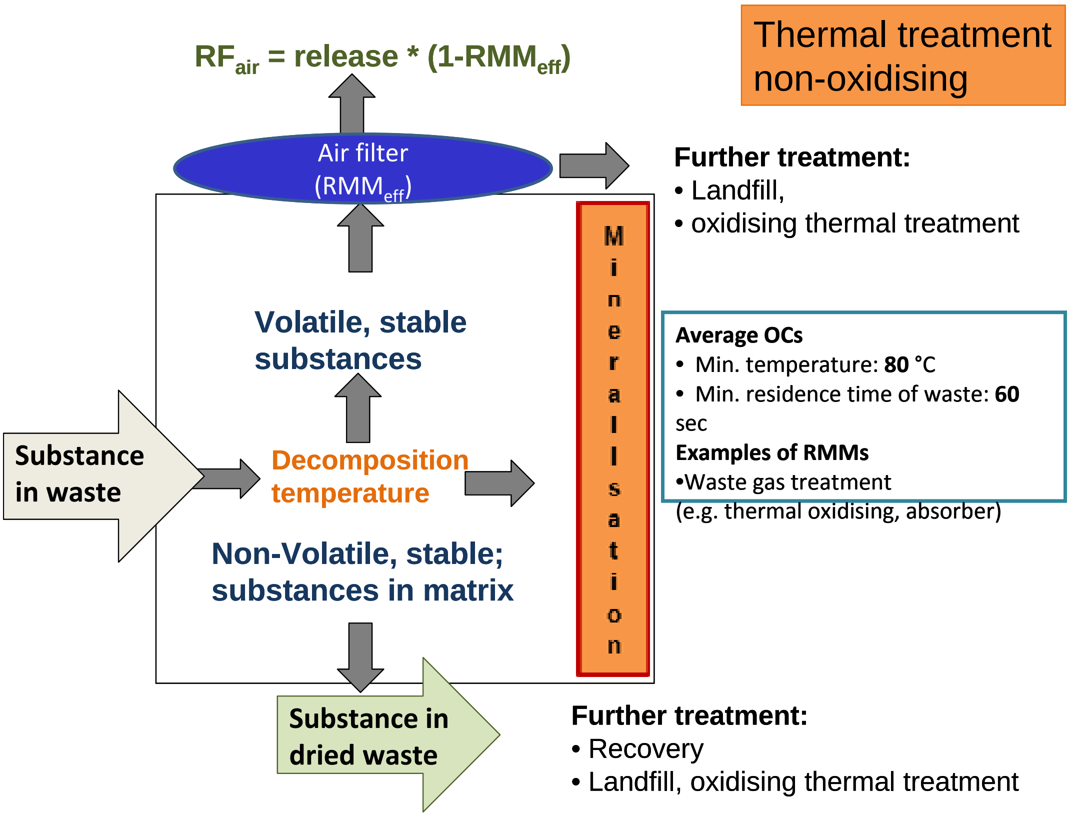


**Figure R.18-16: Distribution scheme for non-oxidizing thermal treatment processes**

## 1.6 Distillation

Substances in liquid wastes or specific fractions of mixtures can be recovered by distillation processes. The distribution of the substance depends on the vapour pressure / boiling points in relation to the distillation temperature: substances boiling at temperatures below the distillation temperature would distribute to the evaporated and condensed fraction, whereas substances with boiling at higher temperatures would remain in the bottom residues.

Sometimes various fractions are obtained from distillation. Frequently one of these is “desired” and either directly used as product or further treated in a process for recovering one or more substances. The other fractions may, depending on their value for recycling or recovery, be subjected to recovery processes or finally disposed of.

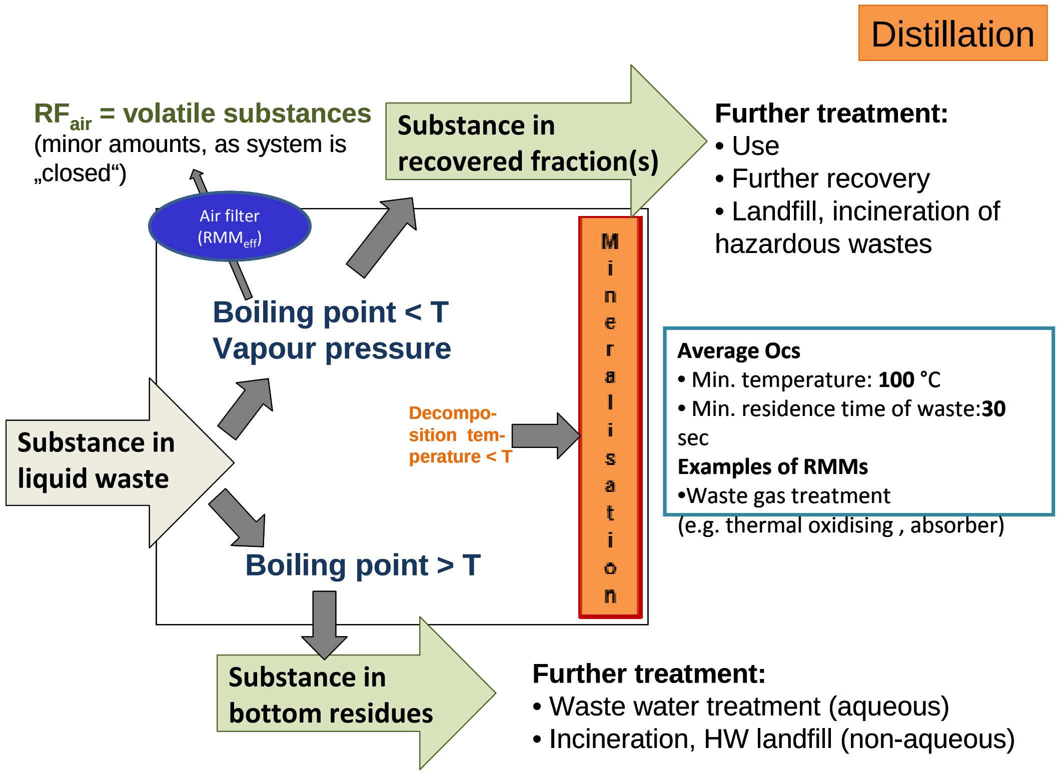


**Figure R.18-17: Distribution scheme for distillation**

## 1.7 Landfill

Conditions and processes in the landfill are heterogeneous and it is not possible to develop a general distribution scheme for substances. Explanation of the conditions in landfills and what to take into account in order to derive release factors or qualitative arguments in the release estimation are provided in the specific section on the landfill scenario for exposure assessment.

## 1.8 Scheme “Road construction”

Construction and demolition wastes may be size reduced and used in road construction as filling material. Furthermore, sludge or other dried wastes may be used as filling materials and could be assessed following this distribution scheme.

The construction and demolition waste is used to stabilize and fill up e.g. street pavement. It may therefore come into contact with groundwater directly or via leaching of rainwater through the pavement. Furthermore, water may enter the material through capillary forces and leach out substances in the materials.

If the substances are firmly included in the matrix of the construction waste material, releases are likely to be low. If the substances are not chemically bound, they may leach out and either reach the environment via run-off water or enter the soil.

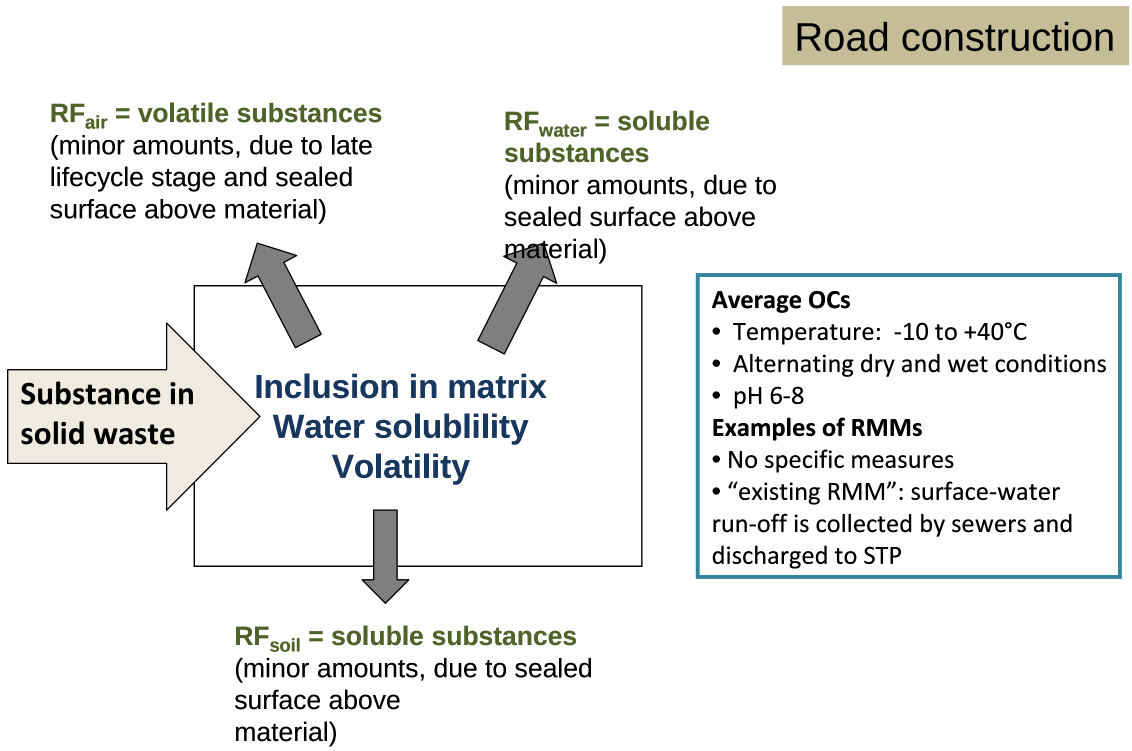


**Figure R.18-18: Distribution scheme for use of waste as road construction materials**

## 2 Exemplification how Distribution schemes contribute to the calculation of release estimates

The following section provides an example on how the distribution schemes presented in this appendix may be used for the derivation of specific release factors[96].

### 2.1 Derivation of a release factor to air

In the distribution model "thermal treatment – oxidizing" (compare Figure R.18-15) it is shown that the relation between operating temperatures and decomposition temperature of the substance is relevant for the release factor to air. If the substance decomposes well below 850 °C it is very likely that most of the substances entering the incineration process are mineralized and therefore not emitted. However, the substance may for example, have a tendency to adsorb to organic matter (fly ash) and may partly be transferred to the waste gas stream and to the air. Information regarding such transfer rate may possibly be received from the operator of the incineration facility or secondary sources.

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96 Further examples are found in the three substance exemplifications.

If for example, 0.1% of the substance distributes to fly ash (F waste gas = 0.001) and the washer for waste gas has an efficacy of 95% (RMMeff=0.95) the resulting release factor to ambient air is calculated as Fair = 0.001 * 0.05 = 0.00005.

## 2.2 Derivation of release factor to water

According to the distribution scheme of the main text, emissions from incineration plants to water only may occur from washing of waste gas if such type of abatement technique is used[97]. Hence, the emissions from the incineration with fly ash, which are not emitted to air, would enter the water pathway. This is calculated by:

Fwaste water = F waste gas (=0.001) * RMMFilter_eff [98](=0.95) = 0.00095

Treatment of wastewater from washers is state-of-the-art in incineration plants in order to meet the legally required emission limit values[99].

A substance (-group) specific filtration efficacy (RMMSTP_eff) may be inquired from the operator of the treatment facility. If this efficacy is for example, 70%, the resulting release rate to surface water would calculate as the following:

Fwater = Fwaste-water (=0.00095) * (1 - RMMSTP_eff (=0.7)) = 0.000285

## 2.3 Derivation of release factor to soil

No emissions to soil are assumed to occur in accordance with the distribution scheme.

97 Because under alternative conditions, when dry adsober techniques are used the secondary waste is disposed of in underground disposal facilities with very small risk of exposure to environment, it is in line of a conservative assessment to assume that such filter are used as long as no more specific information is received from the waste treatment operator.

98 Effectiveness of washer

99 Compare the respective emission limit values in

Table R.18- 28.

# APPENDIX R.18-4: DEFAULT VALUES FOR DETERMINING THE AMOUNT OF SUBSTANCE TREATED AT THE WASTE STAGE

## 1 Fraction as waste

In the first generic assessment step, M/I are to identify the fraction of the substance becoming waste and entering the three main waste streams (MW/RW/HW). The method described in Section R.18.4 and the default values provided in this Appendix can be used.

The result of this step is the identification of $f_{waste\_MW}$, $f_{waste\_RW}$ and $f_{waste\_HW}$ which need to be calculated differently for industrial setting uses and wide dispersive uses. According to the waste treatment assessed, the relevant of these values will be applied to the amount of registered substance per use, together with the dispersiveness factor, as explained in section 2 of this Appendix.

### 1.1 Conservative defaults

The "fraction as waste" ($f_{waste}$) describes the percentage of the registered volume of the substance entering a particular waste stream or waste treatment process.

The fraction of the registered amount of the substance becoming waste depends on the type and function of the substance: solvents are usually emitted to air during use – and therefore need to be assessed as release from manufacturing or downstream uses – and only small fractions end up as waste. In contrast, the fraction of waste for flame retardants in articles can be expected to be quite high.

The generic approach proposes that for each use (or group of uses covered by an exposure scenario) the fraction of the registration volume enters one of the three main waste streams ($f_{waste\_MW}$, $f_{waste\_RW}$ and $f_{waste\_HW}$). In every case a distinction has to be made between industrial setting uses (e.g. manufacturing and some industrial uses) and wide dispersive uses (e.g. substances or mixtures included into articles). The estimation of the amount of substance entering a particular waste stream and affecting the exposure requires taking into account the predictable distribution of the substance in the EU market. In particular the registrant may consider which waste treatment routes are prescribed by national laws, according to his main markets.

A further distinction can be done based on information of applied waste treatment processes.

Table R.18- 19 gives conservative default values for the fraction of the registration volume becoming waste based on the substance functions and uses. Furthermore, it is specified whether the respective waste fractions should be assessed as manufacturing and industrial setting use or a wide dispersive use. In a specific assessment, the registrant should use his specific information on amounts of the substance becoming waste at each of the lifecycle steps.

## Appendix R.18-4: Default values for determining the amount of substance treated at the waste stage

**Table R.18- 19: Conservative default values for $f_{waste}$ based on substance function and use**

| Substance used as / in | Type of waste[100] | Default $f_{waste}$ | Setting[101] | Justification |
|---|---|---|---|---|
| Intermediate[102] | HW[103] (M) | 5%[104] | IND | Average value for losses to waste during manufacturing. This takes into account that substances collected in RMMs are wastes and that wastes result from cleaning. |
| Substance reacts on use | HW (M) | 5% | IND | Expert judgement: waste from manufacture (5%) |
| | HW (IU) | 2.5% | IND | Expert judgement: waste from formulation (50% of manufacturing wastes, due to lower concentrations in formulations).<br>Residues from end use (reaction products) should be considered in the assessment but are not included as substance waste. |
| Solvents | HW (M) | 5% | IND | Expert judgement: based on work with solvent management plans (VOC solvent emission directive). In spite of evaporation, amounts of solvents can be significant in solid and liquid wastes. |
| | HW (IU) | 5% | IND/WD[105] | Expert judgement: based on work with solvent management plans (VOC solvent emission directive). In spite of evaporation, amounts of solvents can be significant in solid and liquid wastes. |
| | HW (PU,CU) | 10% | WD | Expert judgement: based on work with solvent management plans (VOC solvent emission directive). In spite of evaporation, amounts of solvents can be significant in solid and liquid wastes. |
| Processing aids, open use | HW (M) | 5% | IND | Average value for losses to waste during manufacturing. This takes into account that substances collected in RMMs are wastes and that wastes result from cleaning. |
| | HW (IU,PU) | 85% | IND/WD | Expert judgement: the range of processing aids and respective fractions becoming waste is very broad. 85% represent a conservative estimate of the maximum amount expected in wastes. The exact |

100 This column specifies to which waste stream the default values apply in principle; however, this is not exclusive. If other scenarios are applied than specified, the applicability of the default value should be checked. The character in brackets indicate the origin of the waste M= manufacture waste; IU= waste from industrial use; PU: professional use waste; CU= consumer use waste and AU= Waste from article use.

101 IND = Industrial use setting, WD= wide dispersive use setting; IND/WD = both settings possible, further specification needed.

102 Isolated intermediates and transported intermediates are excluded, if used exclusively in closed systems and declared as such. For further information compare the respective ECHA guidance.

103 Hazardous wastes.

104 This value is based on expert judgment and several values in different publications all being below the value of 5%. It can be assumed that losses to waste are minimized by M/I due to efficiency reasons and production taking place in well controlled, frequently closed systems. This may not hold true for inorganic production processes, where wastes may occur from the raw material containing “non extracted” rests of the substance. This does however not fall under REACH. M/I is in possession of specific information and would be able to refine the value, if necessary.

105 It could be wide dispersive or industrial setting use, on a case by case basis. The registrant may be consider as wide dispersive as worst case.

## Appendix R.18-4: Default values for determining the amount of substance treated at the waste stage

| | | | | |
|---|---|---|---|---|
| | | | | fraction depends on the type of processing aids, e.g. for cutting fluids forming aerosols or volatile degreasing agents, the percentage may be lower. This should be specified in refinement steps and cannot be expressed as "default". |
| Processing aids, closed use[106] | HW (M) | 5% | IND | Average value for losses to waste during manufacturing. This takes into account that substances collected in RMMs are wastes and that wastes result from cleaning. |
| | HW (IU/PU) | 95% | IND/WD | Expert judgment: substances used in closed circuits are likely to be recollected almost completely. 5% are assumed to be lost to the environment due to cleaning operations. |
| Mixture, no inclusion into articles | HW (M) | 5% | IND | Expert judgement: Refinement is possible based on information. |
| | HW (IU formulation) | 2.5% | IND | Expert judgement: 50% of manufacturing waste due to lower concentrations |
| | HW (CU) | 10% | WD | Expert judgement: Consumer mixtures are normally entirely used up and released during use. Therefore, the defaults are conservative but reflect a realistic worst case. Waste from manufacture and formulation to be added |
| | HW (PU) | 5% | WD | Expert judgement: Professionals may use mixtures more efficiently than consumers. Waste from manufacture and formulation to be added |
| Mixture inclusion into article matrix | HW (M) | 5% | IND | Expert judgement: c.f. above for manufacturing waste |
| | HW (IU) | 5% | IND | Expert judgement: c.f. above for waste from formulation |
| | MW[107] | 95% | WD | Common sense and conservative thinking: 100% into articles, 5% waste from M and DU subtracted |
| | RW[108] | 95% | WD | Common sense and conservative thinking: 100% into recycling waste, 5% waste from M and DU subtracted |
| Mixture inclusion onto article matrix | HW (M) | 5% | IND | Expert judgement, c.f. above |
| | HW (IU) | 10% | IND | Expert judgement: wastes formulation and other downstream uses. Due to more precise application techniques more downstream waste than above |
| | MW | 95% | WD | Common sense and conservative thinking: 100% into municipal waste, 5% waste from M and DU subtracted |
| | RW | 95% | WD | Common sense and conservative thinking: 100% into recycling waste, 5% waste from M and DU subtracted |
| | RW | 1% | WD | Worst case assumption on fractions of a substance potentially contaminating material streams. |

[106] E.g. substances used in cooling water, hydraulic fluids etc.

[107] Municipal wastes.

[108] Recycling wastes.

## 1.2 Refinement of waste fractions entering main waste streams

M/I could refine the fractions entering the main waste streams by further detailing the product and article types the substance ends up in based on waste statistics, actual collection rates of recycling materials etc. Information on manufacturing wastes should be available in-house. Amounts of wastes from downstream uses and substance concentrations therein could be inquired from downstream users and from knowledge of the substance function and uses, as well as sector information. Further information supporting refinement is market volumes of the products, e.g. as published in sector statistics.

### *Refinement of municipal waste fractions ($f_{waste\_MW}$)*

As a first default value, 95% of a substance is assumed to enter MW. This can be refined by subtracting amounts entering other waste streams and introducing a split between thermal treatment and landfilling of municipal waste. The following fractions of the substance could be subtracted:

- Wastes entering recycling waste: to remain conservative, the fraction corresponding to the lowest recycling rates should be subtracted from the municipal waste stream. Default recycling rates are presented in the following section.
- Depending on the regional waste treatment situation the remaining fraction of municipal waste may either go to thermal treatment or to landfills without any possibility of M/I to influence the route. A default split between the two is proposed, taking account of the wide range of disposal options across Europe.

Consequently, the fraction entering the municipal waste stream is the registered volume (1) minus the fraction entering other waste streams:

$$f_{waste\_MW} = 1 - f_{waste\_RW} - f_{waste\_HW}$$

The fraction disposed of by landfilling and incineration is obtained by multiplying $f_{waste\_MW}$ with 95% for each of the waste treatment processes[109].

$$f_{waste\_MW\_landfill} = f_{waste\_MW} * 0.95 \text{ and } f_{waste\_MW\_thermal} = f_{waste\_MW} * 0.95$$

### *Refinement of fractions of recycling wastes*

For substances included in materials which enter the material recycling waste stream, information on the use (which % of the registered amount is included in materials which could be subjected to recycling?) and the recycling rates (which share of the total amount of the material is collected and actually recycled?) have to be combined. This is expressed in the following equation:

$$f_{waste\_RW} = \text{amount used in the material [\%] of Q * recycling rate [\%]}$$ [110]

[109] Currently, implementation of these processes range between 10% and 90% landfilling and 10% to 90% incineration. A conservative default of 95% is therefore proposed for either process.

[110] This refers to the share of the total amount of a material placed on the market within one year, which is subjected to recycling processes during the waste stage.

## Appendix R.18-4: Default values for determining the amount of substance treated at the waste stage

If M/I cannot identify which fraction of the substance is used in a recyclable material, as default the registration volume minus wastes from manufacturing and downstream uses should be used.

If the substance is used in different recycled materials, $f_{waste\_RW}$ of the different materials and material recycling streams have to be identified separately and summed up.

If recycling rates are defined in legislation, M/I may use these values to calculate the amount of wastes entering recycling[111]. If statistical information from the EU is used (e.g. from waste statistics[112]) it is to be noted that the reported recycling rates may be reached on average but that at local scale the situation may differ significantly. Consequently, conservative assumptions should be made. The registrant may decide to consider local recycling routes in his main market. It has to be considered that the most conservative assumption corresponds to the highest recycling rates, as the amount entering the process is highest. For subtracting amounts from municipal wastes, the opposite is true, as the lowest recycling rates should be subtracted, resulting in higher amounts entering the municipal waste stream.

**Table R.18- 20: Recycling rates per material produced (to be used for $f_{waste\_RW}$)**

| | **Material recycling rates** | | | **Information Sources (different scopes, e.g.: EU-27+1: EU-27+CH, EU-27+2: EU-27+CH+ NO, EU-27+3: EU-27+CH+NO+HR)** |
|---|---|---|---|---|
| | **Minimum (1), year** | **Maximum (2), year** | **Average (3), year** | |
| Paper | 0%/7% (MT/CY) 26% (FI) 30% (PT) 34/36 % (HR/RO), 2006 | 77% (NO) 75% (PL,DE) 73% (NL) 70% (AT), 2006 | 59%, 2005 61%, 2006 | (1) (2) (3) EU-27+3 Recycling rate (waste paper collection relative to paper consumption) based on RISI+VDP, Performance report, VDP, 2008.<br>(3) EU-27+3 Recycling rate, European Recovered Paper Council, 2009. http://www.paperrecovery.org |
| Rubber | 0/7% (BG, CY, MT/CH) 17/19/21% (CZ/IT/PL) 25% (DE), 2008 | 95% (DK) 92% (SK) 89% (FI), 2008 | 39%, 2007 39%, 2008 | (1) (2) (3) EU-27+3 Material recycling of End-of-life-tires, based on: Press release, European Tyre & Rubber Manufacturers' Association, 9.11.2009. http://www.etrma.org |
| Plastic | 8/10% (EL,LT/CY, MT) 12% (BG, RO) 15% (PL), 2008 | 35% (DE) 30% (BE) 28% (AT), 2008 | 20%, 2007 21%, 2008 | (1) (2) (3) EU-27+2 Material recycling (mechanical and feedstock), The compelling facts about plastics, Plastics Europe, 2009. http://www.plasticseurope.org |
| Construction | 1% (CY), 2004 14/16% (ES, HU) | 98% (NL) 92/94% (EE/DK) | 63%, differen | (1) 2004: Data of AT,BE,CY,CZ,DK,EE,DE,FR,IE, LV,LT,NL,NO,UK (2) 2005-2006: Data of AT,CZ,DK, EE,DE,IE,LV,LT,NL,PL,ES,UK; EU as a Recycling Society - |

[111] Note: values may regard collection rates (amount of material placed on the market that is recollected as wastes) or recycling rates (amount of material recycled from the total amount which is collected).

[112] see http://epp.eurostat.ec.europa.eu and http://www.eea.europa.eu.

## Appendix R.18-4: Default values for determining the amount of substance treated at the waste stage

| | Material recycling rates | | | Information Sources (different scopes, e.g.: EU-27+1: EU-27+CH, EU-27+2: EU-27+CH+ NO, EU-27+3: EU-27+CH+NO+HR) |
|---|---|---|---|---|
| | **Minimum (1), year** | **Maximum (2), year** | **Average (3), year** | |
| material | 23% (CZ), 2005-2006 | 86% (DE), 2005-2006 | t years | Present recycling levels of Municipal Waste and Construction & Demolition Waste in the EU, European Environment Agency, ETC/SCP working paper 2/2009. http://www.eea.europa.eu<br>(3) EU-27 data (7 countries estimated), in: Study on the selection of waste streams for End of Waste assessment, European Commission, 2009. http://susproc.jrc.ec.europa.eu/activities/waste/index.html |
| Container Glass | 9% (RO)<br>13% (HE)<br>19% (TR), 2007 | 95% (CH)<br>92/94% (BE/SE)<br>87% (DE), 2007 | 62%, 2007 * | (1) (2) (3) Data of AT,BE,BG,CH,CZ,DK,EE,EL,ES,DE, FI,FR,HU,IE,NL,PO,PT,RO,SE,SK,TR,UK. Glass recycling - national rates, European Container Glass Federation (www.feve.org) |
| Glass | | | 45% | (3) European data with several data sets missing, Glass recovery of total glass waste, Key figures flow sheet, in: Study on the selection of waste streams for End of Waste assessment, European Commission, 2009. http://susproc.jrc.ec.europa.eu/activities/waste/index.html |
| Iron & Steel | 48/52% (MT/CY)<br>55/57% (BG/EE)<br>58% (CZ), 2004 | 85% (NL)<br>83% (DE, DK)<br>77% (FR, UK), 2004 | 76%, 2004 ** | (1) (2) (3) EU-27 with incomplete data of LV+PT, Estimated share of alternatives in iron & steel management, in: Study on the selection of waste streams for End of Waste assessment, European Commission, 2009. http://susproc.jrc.ec.europa.eu/activities/waste/index.html |
| Aluminium | 38% (SI)<br>43% (SK)<br>45% (CY, DK, IE), 2004 | 85% (LU)<br>68/69% (HU/UK)<br>60% (CZ,DE,IT), 2004 | 58%, 2004 *** | (1) (2) (3) EU-27 with incomplete data of LV+PT, Estimated share of alternatives in aluminium management, in: Study on the selection of waste streams for End of Waste assessment, European Commission, 2009. http://susproc.jrc.ec.europa.eu/activities/waste/index.html |
| Copper | 38% (SI)<br>45/48% (EE/RO)<br>50% (BG, CY,LV); 2004 | 73% (DK, SE)<br>67% (NL, PT)<br>65/63% (IT/ES, DE) | 62% (a) 2004 ****<br>41% (b), 2007 | (1) (2) (3a) EU-27 with incomplete data of LV+PT, Estimated share of alternatives in copper management, in: Study on the selection of waste streams for End of Waste assessment, European Commission, 2009. http://susproc.jrc.ec.europa.eu/activities/waste/index.html<br>(3b) Press Release, European Copper Institute, 3.6.2008 |
| * Container glass covers 60% of total production. Remaining glass fractions: Flat glass (22%, waste in construction and demolition waste), Mineral wool (6-7%, waste in construction and demolition waste), Special glass (6%, waste in construction and demolition waste), Domestic glass (4%, waste in municipal waste) **69% recycling of iron & steel packaging in 2007, Press Release, Association of European Producers of Steel for Packaging, 11.9.2009. Iron & Steel waste fractions (Literature source under (3): Ferrous metal waste, mixed metallic packaging and other mixed metallic waste (55%), Demolition & construction waste (30%), Municipal solid waste, bulky waste (6%), End-of-life vehicles, electrical equipment (5%), Production area, industrial sources (4%)<br>*** 62% recycling of aluminium cans in 2007, Press Release, European Aluminium Association, 13.10.09. Aluminium fractions (Literature source under (3): Waste aluminium, mixed metallic packaging and other mixed metallic waste (25%), Demolition & construction waste (33%), Municipal solid waste, bulky waste (22%), End-of-life | | | | |

| | Material recycling rates | | | Information Sources (different scopes, e.g.: EU-27+1: EU-27+CH, EU-27+2: EU-27+CH+ NO, EU-27+3: EU-27+CH+NO+HR) |
|---|---|---|---|---|
| | Minimum (1), year | Maximum (2), year | Averag e (3), year | |
| vehicles, electrical equipment (10%), Production area, industrial sources (10%) **** Copper waste fractions (Literature source under (3a): Copper waste, mixed metallic packaging and other mixed metallic waste (31%), Demolition & construction waste (35%), Municipal solid waste, bulky waste (8%), End-of-life vehicles, electrical equipment (23%), Production area, industrial sources (5%) | | | | |

### *Refinement of hazardous waste shares*

No generic refinement of the default fractions of waste proposed in Table 2 can be given. More specific information can only be obtained from supply chain communication.

## 2 Maximum amount used per day and site

As explained in Section 18.4, for the local release estimation the substance in waste being treated in one waste treatment site can be calculated on the basis of the fraction of the registration volume per use becoming waste and entering a specific waste stream ($f_{waste}$), a factor characterising the dispersiveness of treatment (*DF*) and the number of days of operation of a waste treatment installation [d/a] ($T_{emission}$).

The formula is:

$$Q_{max,inst}\ [kg/d] = (Q\ [t/a] * f_{waste} * DF * 1000)\ /\ T_{emission}$$

It is proposed to use the following approaches to make assumptions on the dispersiveness of treatment:

- DF = 1: To be applied in conservative default assessment for manufacture and industrial use[113]. It is assumed for use, that the total registered volume for this use is used at one site in the region and that also the related waste is treated in one site (not necessarily the same).
- DF = 0,002. To be applied for dispersive uses[114]. It is assumed that the substance volume locally used by 10.000 inhabitants is 0.02% of the total EU tonnage for that use, respectively 0.2% of the regional tonnage (see Guidance R.16.3.2.2)[115]. For calculating $Q_{max}$ as a 10.000 person equivalent DF is to be set to 0.0002 (referring to EU tonnage). This includes the default assumption that water emissions from waste treatment would enter into a 2,000 m3/d sewage system and from there into an 18.000 $m^3$/d river. However, waste treatment usually will take place in larger installations which can still be connected to a relatively small sewage system. In order to address this, $Q_{max}$ need to be determined by employing a concentration factor to adapt

[113] Indicated in Table R.18-19 as "IND"-setting.

[114] In Table R18-19 indicated as "WD"-setting.

[115] 20 million persons in the region compared to 10,000 persons leads to a fraction of 0.05%. Multiplication with a safety factor of 4 (for regional or seasonal fluctuations) leads to 0.2%.

DF to the specific structure of the relevant waste treatment technique. Thus for 500 installations at EU level the person equivalent would be 400,000 (instead of 10.000) leading to a DF of 0.008. It reflects the fact that each waste treatment installation serves more than one standard town equivalent. Table R.18- 21 provides conservative information on a number of waste treatment installations and operating days in the EU. In the last column conservative concentration factors are suggested for each type of waste treatment installation.

The assumptions and the calculation shall therefore be dependent on the type of use.

**Table R.18- 21: Information to derive fractions at main source and alternative approaches to determine the values**

| | **Total number of installations in EU** | **Operation days/ year**[116] | **Data source** | **Concentration factor for dispersive uses (conservative)** |
|---|---|---|---|---|
| Landfills | App. **8400** | 365 | Data bases inter alia: Presentation by Helmut Maurer, European Commission Unit ENV G4, Sustainable Production and Consumption, 7 December 2006; Presentation by Jorge DIAZ DEL CASTILLO, DG Environment, European Commission, 13 May 2008 | 2.38 |
| Thermal treatment | **500 – 700** | 330 | CEWEP, http://www.cewep.com/data/studies/art145,138.html, accessed November 2009, Reference Document on the Best Available Techniques for Waste Incineration, Seville, August 2006 | 40 |
| Hazardous waste incinerators | **115**[117] | 330 | BREF Waste Incineration 2006 | 174 |
| Shredders | "over 200" => ~**210** | 330 | European Shredder Group http://www.efr2.org/html/esg.php. Mobile shredders not included. | 92.5 |
| Plastic converters | no data | 220 | | |
| Paper recyclers | 335<br><br>(mills using recovered paper and wood, 255 using only | 330 | CEPI09 | 59.7 |

[116] Default values proposed.

[117] The figure given in Table 18-12 also takes into account very small installations. Hence this should be considered for assessment purposes.

### Appendix R.18-4: Default values for determining the amount of substance treated at the waste stage

| | **Total number of installations in EU** | **Operation days/ year**[116] | **Data source** | **Concentration factor for dispersive uses (conservative)** |
|---|---|---|---|---|
| | recovered papers) | | | |
| Glass recyclers | **140** | 330 | http://www.feve.org | 142.8 |
| Iron & Steel recyclers | **231** | 330 | BREF Iron & Steel 2009 (draft) | 86.6 |
| Ph-C-treatment plants | 618 (EU-15+NO+IS) EU-27/EU-15+NO+IS = 1,26 => ca. **780** in EU-27+NO+IS | 220 | BREF Waste Treatment 2006 | 25.6 |
| Distillation plants | 108 (EU-15+NO+IS) (with EU-27/EU-15+NO+IS = 1,26) => ca. **140** in EU-27+NO+IS | 220 | BREF Waste Treatment 2006 | 142.8 |

## 2.1 Refinement

The maximum amount of a substance contained in waste can be iterated if specific waste treatment processes or operations are used in the assessment (limitation only possible for wastes from manufacturing and downstream uses) and information on the amount entering the treatment process per day are available. If any iteration regarding the amounts entering the treatment processes per day is made, it must be checked carefully because the operation days may need to be adjusted as well[118].

[118] This might specifically be the case when treatment is made in a batch process. Under such conditions only the operation time for the batches containing the substance under consideration shall be used as reference for the calculation.

# APPENDIX R.18-5: REFINEMENT OPTIONS FOR RELEASE FACTORS

## 1 Landfill

### 1.1 General considerations for refining release factors

When justifying the use of release factors other than the defaults, the following phase model of processes in the landfill should be taken into account[119]. Each of the phases may influence the integration of the substance in the matrix (destruction of chemical bonds, enhancement of migration etc.) as well as its degradation/destruction (activity of micro-organisms, oxidation and reduction) or leaching/evaporation (pH-values) behaviour:

- Phase I: Aerobic conditions prevail until the oxygen contained in the fresh waste is consumed. The phase lasts for approximately 14 days. In this phase, degradation of substances could occur.
- Phase II: Anaerobic and acidogenic conditions occur as the oxygen level decreases and bacteria decompose the easily degradable material of the waste. The pH-values may decrease and lead to higher solubilities of some inorganic substances and heavy metals. This phase is longer than the initial one; a precise prediction of the time span is not possible.
- Phase III: The anaerobic methanogenic phase is characterised by the proliferation and activity of the methanogenic bacteria. Fatty acids are gradually consumed and pH will increase. Organic substances are degraded only to a low degree. This phase is rather long and can last several centuries.
- Phase IV: The last phase is again aerobic and is expected to follow the methanogenic phase; however, current landfills have hardly reached this phase. The change to the aerobic conditions may lead to mobilisation of heavy metals.

Substance properties which could be relevant in relation to the conditions in the landfill are their biodegradability under aerobic and anaerobic conditions, their solubility at low pH-values as well as their vapour pressure. The above phase model could be used to provide qualitative or semi-quantitative argumentation on release factors to any of the environmental compartments.

### 1.2 Release factors to air

*Qualitative argumentation*

The release factor to air can be refined for substances based on information on their volatility and their way of inclusion in matrices:

- For substances with high volatilities, e.g. $\geq$ 0.01 kPa[120], which are not integrated into the matrix, M/I should assess the life-cycle of the substance and provide arguments why by the time of disposal, it should have fully evaporated.

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[119] Source: European Commission DGXI.E.3, The behaviour of PVC in landfills, final report, February 2000.

[120] Definition of volatile organic compounds from Solvent Emission Directive (1999/13/EC).

- Substances with low volatilities, e.g. < 0.01 kPa most likely don't evaporate during normal conditions[121]. M/I could therefore argue that they be assessed as releases to leachate / water, rather than to air.
- For substances with medium to high volatilities, starting with a vapour pressure of about ≥ 0.1 kPa[122], which are not integrated into the matrix, M/I should assess the life-cycle of the substance and may provide arguments why by the time of disposal, it should have fully evaporated.
- For substances integrated in matrices, a lower release than the defaults could be justified, if M/I can demonstrate that the conditions in the landfill do not lead to a destruction of the matrix and subsequent release of the substance to air.

*Available models*

Due to the manifold types of wastes, landfills and conditions inside the landfill body, no validated models are available to simulate releases of substances to air. Most existing models focus on the formation and emission of methane. Substances contained in waste and being released to the air would be part of these methane emissions from the landfill.

A detailed calculation could be carried out based on the Australian manual for estimating emissions from landfills[123]. The model provides equations to calculate the amount of landfill gas generated (information on capacity and age of landfill, as well as accepted waste amounts needed) and gives examples of likely concentrations of specific substances in the landfill gas.

*Measured data*

A refinement of releases to air based on measured values is unlikely, due to lack of respective data.

### 1.3 Releases to water

*Qualitative argumentation*

The release factor to leachate[124] can be refined for substances based on information on their water solubility and Koc-Value and their way of inclusion in matrices:

- Substances with a low solubility (e.g. < 0.1 mg/l[125]) and/or high tendencies to adsorb to organic matter are more likely to remain in the landfill body (either included into the matrix or adsorbed to organic waste particles or liner materials) than to leach.

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121 However, temperatures in landfills may rise well above 20°C, which should be taken into account.

122 Definition of volatile organic compounds from Solvent Emission Directive (1999/13/EC).

123 Australian Government, Department of Environment and heritage: Emission Estimation Technique Manual for Municipal Solid Waste (MSW) Landfills Version 1.2, May 2005.

124 The release estimation covers emissions from the landfill body to the leachate. The further assessment covering the discharge of the collected leachate to a municipal sewage treatment plant is part of the fate model into which the release amounts should be entered. No specific on-site leachate treatment is assumed.

125 This value has been given based on expert judgement.

- Substances integrated in matrices are considered to be released only in minor amounts[126]. The conditions in the landfill may however lead to the destruction of the matrix or the bonds between the substance and the matrix and result in the disintegration of the substance. In these cases, the retaining function of the matrix is lost and releases are to be considered assuming no integration.

*Available models*

As there are no general models available for landfill, the "Lifecycle inventory model"[127] is reported here and could be used to model releases from landfills to leachate.. The use of the model requires knowledge on the landfill as such and can therefore not be used 1:1 for exposure assessment under REACH.

In principle, calculations can be made assuming parameters of an "average standard landfill". The amount of a substance entering the landfill as contained in waste could be assumed based on knowledge of the amount and composition of municipal wastes and information on the uses of the substance.

According to the "Lifecycle inventory model" the amount of leachate generated per year from a landfill can be calculated, assuming that 13%[128] of the rainfall emerges as leachate and assuming an efficiency of liners and collection system of 70%.

$E_{leachate}$ [l/a] = Amount of waste in landfill [t] * [average rainfall [mm/a] * 0.13[129] *0.3[130]

(landfill depth [m] * density of waste - 0.688 [kg/m$^3$])

Based on the amount of leachate, the annual emission of a substance could be calculated using the equation:

$E_{water}$ [kg/a] = $E_{leachate}$ * $RF_{leachate}$ / $10^{-6}$

$E_{water}$ [kg/a] = total annual release of the substance to surface waters
$E_{leachate}$ [l/a] = amount of leachate generated in a landfill body per year
$RF_{leachate}$ = rFelease factor of a substance to the leachate
Daily releases can be calculated by dividing the annual emission ($E_{water}$) by 365 d/a.

[126] Example PVC: It has been shown that the plasticiser DEHP is generally bound in the matrix of the polymer and cannot leach out readily.

[127] Australian Government, Department of Environment and heritage: Emission Estimation Technique Manual for Municipal Solid Waste (MSW) Landfills Version 1.2, May 2005.

[128] The 13% relate to the total amount of rainfall. There is no information in the model if that percentage would change if the rainfall was significantly higher or lower in the EU compared to Australia.

[129] Share of rainfall emerging as leachate.

[130] Efficiency of liner and leachate collection system assumed as 70%.

## Appendix R.18-5: Refinement options for release factors

The following emission factors are provided[131] as part of the model and could be used for the release factor to the leachate ($RF_{leachate}$) in the assessment. The figures provided in Table 18-21 serve as an indication and may be applied when the actual model is used.

**Table R.18- 22: Release factors used in the lifecycle inventory model of Australia**

| **Substance** | **Emission factor [mg/l]** |
|---|---|
| 1,2-Dichloroethane | 0.01 |
| Ammonia (total) | 210 |
| Antimony & compounds | 6.6E-02 |
| Arsenic & compounds | 1.4E-02 |
| Benzene | 3.7E-02 |
| Benzo(a)pyrene | 2.5E-04 |
| Beryllium & compounds | 4.8E-03 |
| Cadmium & compounds | 1.4E-02 |
| Chloroform | 2.9E-02 |
| Chlorophenol | 5.1E-04 |
| Chromium (III) compounds | 4.2E-02 |
| Chromium (VI) compounds | 1.8E-02 |
| Copper & compounds | 5.4E-02 |
| Dichloromethane | 4.4E-01 |
| Ethylbenzene | 5.8E-02 |
| Fluoride compounds | 3.9E-01 |
| Lead & compounds | 6.3E-02 |
| Mercury & compounds | 6.0E-04 |
| Nickel & compounds | 1.7E-01 |
| Phenol | 3.8E-01 |
| Toluene | 4.1E-01 |
| Total Nitrogen | 425 |
| Total Phosphorus | 30 |
| Vinyl chloride monomer | 4.0E-02 |

131 These emission factors have been developed in relation to the specific model. They should not be used to replace the default emission factors.

| Substance | Emission factor [mg/l] |
|---|---|
| Zinc & compounds | 6.8 E-01 |

*Calculations based on emission limit values*

A refinement of release factors to the leachate based on limit values of the Landfill Directive (mainly metals) or based on measured data for specific substances is difficult, as no correlation with the amount of the substance in the waste and the leachate produced can be established. Furthermore, there are no emission limit values defined for specific substances.

If an emission limit value for a substance exists in legislation or can be assumed to be fulfilled for the substance based on information supporting the option to read-across, this can be provided as supportive argumentation that disposal of the substance in landfills does not pose a risk.

*Measured data*

Measured concentrations of substances in landfill leachate may be available for specific substances in literature. Also newer EU risk assessment reports sometimes include measured data[132]. In all studies quoting measured concentrations, neither a relation to the type and amount of waste containing the substance is provided, nor information on the landfill size and age.

If measured data for a substance exist or can be assumed to apply to the substance based on read-across, this can be provided as supportive argumentation that disposal of the substance in landfills does not pose a risk.

### 1.4 Releases to soil

The default release factor from landfills to soil 0.0016 corresponds to the highest release factor to soil for substances in articles with low release promotion during service life.

Emissions from landfills to soil could take place via:

- Direct contamination of soils upon receipt of wastes and depositing inside the landfill. This is not regarded as an emission to the natural environment and therefore not further considered
- Leaching of leachate through the artificial and mineral liners due to remaining permeability of the layers and/or their failure and/or their insufficient design (non compliance with the Landfill Directive).
- Other releases, e.g. due to leaching from particles eroded or blown off by wind are negligible.

Refinement of the release factors to soil could be justified by the behaviour of a substance inside the landfill body. For example, substances with a high tendency to adsorb to organic matter would most likely leach to a lesser extent than reflected in the default factors. Substance for which degradation or abiotic destruction under conditions in the landfill is documented would be decomposed rather than leach out of the waste.

[132] E.g. RAR on TDCP.

## 1.5 Generic exposure scenario „Landfill“

**Table R.18- 23: Generic exposure scenario municipal waste landfill**

| Parameter | Description |
|---|---|
| Title of the scenario | Landfill for municipal solid wastes |
| Types of wastes | Any types of wastes except: liquid wastes, wastes with hazardous PC properties, hospital or clinical wastes, wastes not meeting the legal acceptance criteria |
| Assumptions | The landfill is assumed to comply with the Landfill Directive |
| Pre-treatment | Wastes are pre-treated in order to reduce hazards and quantity, either by mechanical or thermal processing. |
| Physical form | Substance is contained in waste, mostly solid |
| Operational conditions | Landfill is operated according to good practice and compliant with the requirements of the landfill directive. It has got an artificial bottom liner as well as a top soil layer. Leachate and landfill gas are collected and treated. Surface water runoff is collected and discharged to the sewer |
| Amount of waste disposed of in landfill per day | *To be calculated based on registration amount and number of installations, as well as release time* |
| Release time | 365 d |
| Leachate treatment | 100%[133] |
| Default release factor to air | 0 (VOC)[134]<br>0.0005 (non-VOC) |
| Default release factor to water | 0.032 |
| Default release factor to soil | 0.0016 |

# 2 Municipal waste – Incineration scenario

## 2.1 Refinement options for releases to the air

Release rates for metals could be refined based on emission limit values of the Waste Incineration Directive and on studies determining transfer factors for output fractions from incineration (bottom ash/slag, boiler ash and filter dust, waste water filter cake). Release from organic substances could be refined by assuming 100% destruction of the original organic substances, mainly emitted as $CO_2$ and to a minor extend emitted as organic pollutants, measured as TOC and (due to the presence of chlorine) as dioxins/furans.

[133] All leachate is collected and treated on-site.

[134] It is assumed as worst case that all VOC are released within one year.

According to the BREF document on Waste Incineration (2006), municipal waste incineration plants generally produce flue gas volumes (at 11 % oxygen) between 4500 and 6000 m³ per tonne of waste. For hazardous waste incineration, this value (at 11 % oxygen) is between 6500 and 10000 m³, depending on the average thermal value of the waste.

Table R.18- 24 lists emission limit values for air as given in the Waste Incineration Directive as well as exemplary annual average values. The table shows that the same emission limit values apply to waste incineration and waste co-incineration regarding dioxins/furans and metals with high volatility (Hg, Cd, Tl). For other metals the same emission limit values apply for waste incineration and for the sectors most frequently realising waste co-incineration (cement industry and combustion plants) [135].

**Table R.18- 24: Air emission limit values for waste incineration and co-incineration**

| Pollutant | Incineration [mg/m3] if not indicated else | Co-incineration [mg/m3] if not indicated else | MW Incineration annual average [mg/m$^3$] | MSWI average (g/t incinerated)12 BE / 3 AU plants[136] |
|---|---|---|---|---|
| Cd + Tl (1) | 0.05 | 0.05 | 0.0002 – 0.03 | 0.095 / - |
| Hg (1) | 0.05 | 0.05 | 0.0002 – 0.05 | 0.048 / 0.1 |
| Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V (1) | 0.5 | 0.5 (3) | 0.0002 – 0.05 | 1.737 / - |
| Dioxins and furans (1) | 0.1 (ng/m$^3$) | 0.1 (ng/m$^3$) | | 250 / 44.4 (ng/m$^3$) |
| TOC (1) | 10 | 10 (4) | 0.1-5[137] | |

1. All average values over the sampling period of 30 min and a maximum of 8 hours.
2. Daily average value.

3. For co-incineration in cement plants and combustion plants.
4. For co-incineration in cement plants.

Table R.18- 25 provides information on the transfer of some types of substances into different output fractions of the incineration process.

[135] For emissions of TOC and metals other than Hg, Cd and Tl, no EU-wide limit values have been set for sectors like ceramics industry and lime industry. Due to their low mass relevance concerning waste co-incineration, emissions are assumed as similar.

[136] BE = Belgium, AU = Austria.

[137] VOC as TOC.

### Table R.18- 25: Distribution of substances for an example incineration plant (BREF Waste Incineration)

| Substance | Cleaned flue-gas discharge | ESP[138] dust | Waste water | Filter cake from waste water treatment | Bottom ash (2), (3) |
|---|---|---|---|---|---|
| Carbon % | 98 (+/-2) | <1 | <1 | <1 | 1.5 (+/-0.2) |
| Chlorine % | <1 | 35 | 54 | <1 | 11 |
| Iron(1) % | <1 | 1 (+/-0.5) | <1 | <1 | 18 (+/-2) |
| Copper % | <1 | 6 (+/-1) | <1 | <1 | 94 (+/-1) |
| Lead % | <1 | 28 (+/-5) | <1 | <1 | 72 (+/-5) |
| Zinc % | <1 | 54 (+/-3) | <1 | <1 | 46 (+/-3) |
| Cadmium % | <1 | 90 (+/-2) | <1 | <1 | 9 (+/-1) |
| Mercury % | <5 | 30 (+/-3) | <1 | 65 (+/-5) | 5 (+/-1) |

1. the remaining approx. 80 % are sorted out as scrap

2. the bio-availability of materials that remain in the bottom ash depends on leach ability in-situ during subsequent use/disposal

3. the risk associated with the re-use of bottom ash is not necessarily indicated by the presence or absence of the substances indicated – the chemical and physical form of the substance as well as the nature of the environment where the material will be used is also important.

### Table R.18- 26: Grouping of air emission factors for waste incineration

| Substance | Transfer to slag | Transfer to waste gas | Share of waste gas in filter dust | Share of waste gas to air | Transfer of input to air | Grouped air emissions |
|---|---|---|---|---|---|---|
| Hg | 6% | 94% | 95% | 5% | 4.7% | 0.05 |
| e.g. 10 mg | 0.6 mg | 9.4 mg | 8.9 mg | 0.0047 mg | 0.0047 mg | |
| Cd | 23% | 77% | 99.9% | 0.1% | 0.07% | 0.001 |
| e.g. 10 mg | 2.3 mg | 7.7 mg | 7.6 mg | 0.0077 mg | 0.0077 mg | |
| Tl | 0% | 100% | 99.9% | 0.1% | 0.1% | |
| e.g. 10 mg | 0 mg | 10 mg | 9.9 mg | 0.010 mg | 0.010 mg | |
| Sb | 42% | 58% | 99.9% | 0.1% | 0.058% | |
| e.g. 10 mg | 4.2 mg | 5.8 mg | 5.7 mg | 0.0058 mg | 0.0058 mg | |

[138] ESP = Electrostatic precipitator (Electric dust filter).

| | | | | | | |
|---|---|---|---|---|---|---|
| Sn | 46% | 54% | 99.9% | 0.1% | 0.054% | |
| e.g. 10 mg | 4.6 mg | 5.4 mg | 5.3 mg | 0.0054 mg | 0.0054 mg | |
| Pb | 66% | 34% | 99.9% | 0.1% | 0.034% | |
| e.g. 10 mg | 6.6 mg | 4.4 mg | 4.4 mg | 0.0034 mg | 0.0034 mg | |
| As | 80% | 20% | 99.9% | 0.1% | 0.020% | 0.0002 |
| e.g. 10 mg | 8.0 mg | 2.0 mg | 2.0 mg | 0.0020 mg | 0.0020 mg | |
| Cr | 88% | 12% | 99.9% | 0.1% | 0.012% | |
| e.g. 10 mg | 8.8 mg | 1.2 mg | 1.2 mg | 0.0012 mg | 0.0012 mg | |
| Mn | 91% | 9% | 99.9% | 0.1% | 0.009% | |
| e.g. 10 mg | 9.1 mg | 0.9 mg | 0.9 mg | 0.0009 mg | 0.0009 mg | |
| Co | 92% | 8% | 99.9% | 0.1% | 0.008% | |
| e.g. 10 mg | 9.2 mg | 0.8 mg | 0.8 mg | 0.0008 mg | 0.0008 mg | |
| Ni | 92% | 8% | 99.9% | 0.1% | 0.008% | |
| e.g. 10 mg | 9.2 mg | 0.8 mg | 0.8 mg | 0,0008 mg | 0.0008 mg | |
| V | 92% | 8% | 99.9% | 0.1% | 0.008% | |
| e.g. 10 mg | 9.2 mg | 0.8 mg | 0.8 mg | 0.0008 mg | 0.0008 mg | |
| Cu | 96% | 4% | 99.9% | 0.1% | 0.004% | |
| e.g. 10 mg | 9.6 mg | 0.4 mg | 0.4 mg | 0.0004 mg | 0.0004 mg | |

Transfer factors of Reimann, in: Thomé-Kozmiensky “Ersatzbrennstoffe 2”, TK Verlag, 2002

The transfer factors above show that mercury, having a very high volatility, is emitted with the factor 0.05. This factor can be used up to a mercury concentration in the waste input of about 7 mg/kg (dry substance, 20% exemplary waste water content)[139]. Higher mercury concentrations would exceed the emission limit value of 0.05 mg/m$^3$ of the Waste Incineration Directive. Such waste fractions would be directed to underground disposal instead of thermal treatment.

For other metals with high volatiliy (cadmium, thallium, antimony, tin and lead), a factor of 0.001 can be used. The maximum concentration in waste for achieving the emission limit value of the Waste Incineration Directive is more difficult to determine because the limits refer to a combination of parameters (e.g. 0,05 mg/m$^3$ for Cd + Tl) and therefore assumptions regarding the share of both substances have to be made. In general, thallium is of low relevance in municipal waste incineration. Assuming conservatively that thallium achieves 50% of the limit value, the emission limit value would only be exceeded if high cadmium concentrations above 200 mg/m$^3$ occur (dry substance, 20% exemplary waste water content).

[139] Based on expert knowledge.

Based on the transfer factors above, the maximum average capacity of an installation and the information that maximum 6000 $m^3$ of flue gas is generated per tonne of waste, a release could be calculated as follows[140].

**Table R.18- 27: Refined release estimate to air from incineration**

| **Refined release estimate for Hg** | | |
|---|---|---|
| Maximum Air per t of waste | 6000 | m3 |
| Average capacity per installation | 200000 | t/a |
| Emission limit value (example) | 0.05 | mg/m3 |
| Freight per t of waste | 300 | mg |
| Maximum emission per year | 0.06 | t/a |
| Maximum emission per day | 0.2 | kg/d |

Based on the distribution shown, the release estimate could take account of the total input of the substance. The efficiency of standard risk management measures for exhaust gas cleaning and/or waste water treatment would have to be taken into account in the assessment. Some information on the efficiency of RMMs for certain substances are provided in the main text. Furthermore, the library of risk management measures could be consulted.

## 2.2 Releases to water

Releases to water only occur in installations, which apply wet flue-gas cleaning techniques. As M/I cannot influence the type of waste incinerator, a refinement of this factor is not easily possible. It could be based on the distribution of a substance in the incineration process (low release via flue-gas) in combination with a high removal factor from the cleaning water.

According to the voluntary risk assessment (VRAR[141]) on copper, per tonne of waste an average amount of 0.15 – 0.3 $m^3$ of waste water is generated, depending on the capacity of the installation and the type of flue-gas cleaning. Emission limit values before discharge of the wastewater to a treatment plant are defined in the Waste Incineration Directive.

[140] Note: this does not take account of the substance content in the waste processed.

[141] European Copper Institute: Voluntary Risk assessment of COPPER, COPPER II SULPHATE PENTAHYDRATE, COPPER(I)OXIDE, COPPER(II)OXIDE, DICOPPER CHLORIDE TRIHYDROXIDE, June 2008; available at: http://echa.europa.eu/web/guest/information-on-chemicals/transitional-measures/voluntary-risk-assessment-reports.

**Table R.18- 28: Water emission limit values for waste water from flue gas cleaning**

| Polluting substances | Emission limit values (unfiltered samples) |
|---|---|
| Total suspended solids | 30 mg/l |
| Mercury and its compounds, expressed as mercury (Hg) | 0.03 mg/l |
| Cadmium and its compounds, expressed as cadmium (Cd)<br>Thallium and its compounds, expressed as thallium (Tl)<br>Chromium and its compounds, expressed as chromium (Cr)<br>Copper and its compounds, expressed as copper (Cu)<br>Nickel and its compounds, expressed as nickel (Ni) | 0.05 mg/l |
| Arsenic and its compounds, expressed as arsenic (As)<br>Zinc and its compounds, expressed as zinc (Zn) | 0.15 mg/l |
| Lead and its compounds, expressed as lead (Pb) | 0.2 mg/l |
| Furans, defined as the sum of the individual dioxins and furans evaluated in accordance with Annex I | 0.3 mg/l |

## 2.3 Generic exposure scenario municipal waste (MW) incineration

**Table R.18- 29: Generic exposure scenario for municipal waste incineration**

| Parameter | Description |
|---|---|
| Types of wastes | Any types of wastes |
| Assumptions | The incineration / co-incineration process is operated according to the legal requirements. The incinerator is equipped with wet flue-gas cleaning devices and secondary wastes are disposed of in landfills or in road construction. |
| Pre-treatment | No pre-treatment of wastes, except mechanical reduction of volume and mixing |
| Title of the scenario | Municipal waste incineration |
| Physical form of the substance | Contained in waste, solid wastes |
| Operational conditions | Storage of waste in closed bunkers, operating temperatures according to waste incineration directive (850°C) |
| Release time | 330 d |
| Amount of substance contained in waste disposed of in incineration per day | *To be calculated based on registration amount and number of installations, as well as release time* |
| Water treatment | 100% |
| Default release factor to air | 0.05 (Hg) / 0.001 (Cd, Tl, Sb, Sn) / 0.0003 (other metals) |
| Default release factor to air | 0.0001 (organic substances) |

| | |
|---|---|
| Default release factor to water | 0.0002 (metals) / 0.0001 (organic substances) |
| Default release to soil | 0 |

# 3 Material recycling – Mixing / Milling

## 3.1 Refinement options for the shredding scenario

Refinement of emission factors could be done based on substance properties and based on considerations related to the inclusion in the matrix.

## 3.2 Generic exposure scenario "Shredding"

**Table R.18- 30: Generic exposure scenario shredding**

| **Parameter** | **Description** |
|---|---|
| Types of wastes | Plastics, rubber, paper, construction materials, metals, complex article wastes |
| Pre-treatment | No pre-treatment |
| Title of the scenario | Shredding |
| Physical form | Solid |
| Operational conditions | Shredding process is carried out as industrial operation but outdoors. No specific operational conditions. Emissions of the substance could occur mainly as particulate matter due to abrasive conditions of the process<br><br>No separation processes of the shredded fraction is performed |
| Release time | 330 d |
| Amount of substance contained in shredded waste per day | *To be calculated based on registration amount and number of installations, as well as release time* |
| Default release factors to air | 0.1: Paper and plastics, minerals: material has low weight and/or dust is likely to occur<br><br>0.05: rubber<br><br>0.01: metals |

# 4 Construction wastes

## 4.1 Refinement options for use in road construction

The release factors to air, water and soil could be refined based on substance properties. Furthermore, models of the construction products directive in combination with specific tests or other respective measured data could be used. According to CEN TC 351 a scenario should reflect that: "water is transported into the matrix by capillary forces, and a fraction may be redirected at the surface of the product. In the matrix the capillary force is considered to be significant and the water movement is slow. Dissolved substances are transported out of the matrix by (capillary driven-) advection and diffusion. At the surface substances will precipitate" [142].

## 4.2 Generic exposure scenario for use in road construction

**Table R.18- 31: Generic exposure scenario for road construction**

| Parameter | Description |
|---|---|
| Types of wastes | Construction and demolition wastes |
| Pre-treatment | Mechanical treatment, potentially incineration and/or co-incineration |
| Title of the scenario | Final use in road construction |
| Description of the scenario | Waste is mechanically broken to usable material parts. Waste is used as construction material and leaching may take place. |
| Physical form of the substance | Part of waste, solid or liquid |
| Operational conditions | Normal environmental conditions, water contact, changing temperatures |
| Release time | 365 d |
| Amount of substance in construction and demolition waste | *To be calculated based on registration amount and number of installations, as well as release time* |
| Default release factor to air | 0.00005 |
| Default release factor to water | 0.0016<br><br>For the exposure assessment, connection to STP should be assumed. |
| Default release factor to soil | 0.0016 |

[142] CEN TC 351/WG1/AHG "Work plan generic leaching procedures" N 0012.

# 5 Paper recycling

## 5.1 Refinement options for the paper recycling scenario

There are no specific refinement options for the process, apart from refining the fraction of waste and the release rates, either based on substance properties or on measured data. The release estimates of the OECD for paper mills could be used as reference, however they apply to processing chemicals rather than to contaminations.

The retention time of paper in the deinking process ranges between 1.5 and 8 hours. pH-Values are between 9.5 and 10.5 and temperatures are around 45°C[143]. Based on this and information on the hydrolysis of substances, the emission factors to water could be refined.

## 5.2 Generic exposure scenario "paper recycling"

**Table R.18- 32: Generic exposure scenario paper recycling**

| **Parameter** | **Description** |
|---|---|
| Types of wastes | Paper products (e.g. newspapers and magazines, packaging paper, office paper) |
| Assumptions | The pulping process is carried out in accordance with the legal requirements, wastewater is treated. |
| Pre-treatment | Recovered paper is pre-sorted before being delivered to a mill. The deinking process is covered by this scenario |
| Title of the scenario | Paper recovery |
| Physical form | Substance is part of solid paper waste |
| Operational conditions | Paper recovery process is carried out as an industrial operation. Emissions could occur mainly in the water-phase due to the recovery process taking place in aqueous solution. |
| Release time | 330 d |
| Amount of substance contained in recycled waste paper per day | *To be calculated based on registration amount and number of installations, as well as release time* |
| Wastewater treatment | Wastewater streams from the process are generally sent to an on-site wastewater treatment system before being discharged to a receiving water body. These streams are derived from flotation, washing and thickening operations. |
| Default release factor to air | 0.15 |
| Default release factor to water | Worst case: 0.90144<br><br>Mineral oil based inks: 0. 90144 |

[143] TGD, part 4.

| | |
|---|---|
| | Flexographic inks and toners 0.30048<br><br>Dyes 0.5008<br><br>For the exposure assessment, direct discharge to surface water should ba assumed. |
| Default release factor to soil | 0.00144 |

## 6 Thermal treatment of hazardous wastes

### 6.1 Refinement options

The options to refine emission factors are the same as for thermal treatment of municipal waste. They are also valid for hazardous organic substances like PCBs due to higher combustion temperatures foreseen by the Waste Incineration Directive.

### 6.2 Default exposure scenario for hazardous waste incineration

**Table R.18- 33: Generic exposure scenario for hazardous waste incineration**

| Parameter | Description |
|---|---|
| Types of wastes | Hazardous wastes, wastes containing hazardous substances |
| Assumptions | The incineration / co-incineration process is operated according to the legal requirements |
| Pre-treatment | No pre-treatment of wastes, except mechanical reduction of volume and mixing |
| Description of the scenario | Waste incinerator is authorized and complies with the local conditions |
| Physical form of the substance | Part of hazardous waste, solid or liquid |
| Operational conditions | Storage of waste in closed bunkers, operating temperatures according to waste incineration directive (1100°C) |
| Release time | 330 d |
| Amount of substance contained in waste disposed of in incineration per day | *To be calculated based on registration amount and number of installations, as well as release time* |
| Water treatment | 100% |
| Default release factor to air | 0.002 (metals) / 0.0001 (organic substances) |
| Default release factor to water | 0.0002 (metals) / 0.0001 (organic substances)<br><br>For the exposure assessment, direct discharge to surface water should be assumed. |
| Default release to soil | 0 |

# 7 Distillation of hazardous wastes

## 7.1 Refinement options

Some guidance on the refinement of emission factors to air are provided in the proposal for an emission scenario document for the chemical industry. In addition, the fractions becoming waste could be modified for substances contaminating the cleaning product / solvent.

## 7.2 Generic exposure scenario "Re-distillation"

**Table R.18- 34: Generic exposure scenario re-distillation**

| Parameter | Description |
|---|---|
| Types of wastes | Spent / contaminated cleaning products (solvents) and extraction agents |
| Pre-treatment | No pre-treatment |
| Physical form | Liquid |
| Operational conditions | Distillation in a closed system, e.g. vacuum distillation. Operating temperatures depend on boiling points / vapour pressures. Extracted air is filtered by air filters / absorbers |
| Release time | 220 d |
| Amount of substance contained in waste disposed of in incineration per day | *To be calculated based on registration amount and number of installations, as well as release time* |
| Release factor to air | 0.007: Component to be recovered |
| | 0.007 * average concentration (%): volatile contaminations of distilled product |
| | 0.00007 * average concentration (%): metals and inorganic substances |
| Release to water | c.f. equation in main document.<br>For the exposure assessment, direct discharge to surface water should ba assumed. |
| Release factor to soil | 0 |

# 8 Phase separation

## 8.1 Refinement options for separation processes

If the generic assessment results in a risk, the first step for M/I would be to determine the specific treatment process based on the list of operations or information from the supply chain. Information on separation techniques can be found in the BREF on waste industries. Some specific information is also contained in the OECD ESD on metal treatment.

## 8.2 Generic exposure scenario chemical-physical treatment

**Table R.18- 35: Generic exposure chemical-physical treatment**

| **Parameter** | **Chemical physical treatment** | **Further information** |
|---|---|---|
| Types of wastes | Aqueous wastes from spent processing aids, secondary wastes from waste water treatment | |
| Pre-treatment | No specific pre-treatment | |
| Title of the scenario | Chemical physical treatment | |
| Physical form | Liquid wastes | |
| Operational conditions | Semi-open to open processing involving rapid temperature changes, vigorous agitation, mixing, stripping etc. | |
| Release time | 220d | |
| Amount of substance contained in waste disposed of in chemical-physical treatment per day | *To be calculated based on registration amount and number of installations, as well as release time* | |
| Default release factor to air | Volatile compounds: 1<br><br>Non-volatile compounds: 0.15 | |
| Default release factor to water | Solubility > $C_{waste}$ → $F_{water}$ = solubility [mg/l] / 100,000<br><br>Solubility < $C_{waste}$ → $F_{water}$ = solubility [mg/l] / concentration [mg/l]<br><br>For the release estimate, the efficiency of onsite-WWTP should be integrated into the release factors.<br><br>For the exposure assessment, direct discharge to surface water should ba assumed. | |
| Release to soil | To be determined based on amount of secondary wastes potentially used in road construction or other waste treatment processes, if none arise: no release to soil | |

# APPENDIX R.18- 6: EXEMPLIFICATION OF EXPOSURE ASSESSMENT OF THE LIFE WASTE CYCLE STAGE FOR MCCPS

## General approach of exemplification

This example has been developed based on information of the EU risk assessment report on medium chain chlorinated paraffins and the method for release estimation for the waste stage as suggested in this guidance. Exposure scenarios and corresponding releases have not been estimated for all, but only selected identified uses and waste treatment processes. Please note:

- This selection did not follow a systematic assessment regarding the relevance of the waste life stage.
- The calculation of releases to the environment is largely standardised and relies only on a few case-specific parameters. Thus the waste-stage related assessment process can be largely automated in future.

No exposure estimation and risk characterisation is illustrated for this example.

## 1. Substance information

**Table R.18- 36: Substance information on MCCP**

| **Property** | **Unit** | **Medium chain chlorinated paraffins** |
|---|---|---|
| Substance name | | Alkanes, C14-17, chloro |
| CAS No | | 85535-85-9 |
| Average chlorine content | % Cl by weight | 40-63%, most common 45-52% |
| Classification according to DSD | | N; R 50/53 |
| Labelling according to DSD | | N<br>R: 64-66-50/53<br>S: (2-)24-60-61 |
| Classification according to Table 3.1, Annex VI to CLP Regulation | | Lact.-H362<br>Aquatic Acute 1 –H400<br>Aquatic Chronic 1 – H410 |
| Labelling according to Table 3.1, Annex VI to CLP Regulation | | GHS09; Wng; H362; H410; EUH066 |
| Boiling point | °C | > 200°C |
| Decomposition temperature | °C | Starts at 200°C with release of HCl |
| Vapour pressure | kPa | 0.05 |
| Density | g/cm$^3$ | 1.1 – 1.38 (Cl-content 40-58%) |
| Water solubility | mg/l | 0.027 |
| Log Kow | | 7 |
| BCF | l/kg | 1,087 |

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| **Property** | **Unit** | **Medium chain chlorinated paraffins** |
|---|---|---|
| Koc | l/kg | 588,844 |
| Abiotic degradation | Half-life [days] | 2 days in air, no hydrolysis |
| Biodegradation | | Not biodegradable |

**Table R.18- 37: PNECs and DNEL for inhalation for the risk characterisation**

| **Property** | **Unit** | **Medium chain chlorinated paraffins** |
|---|---|---|
| $PNEC_{,water}$ | µg/l | 1 |
| $PNEC_{soil}$ | mg/kg | 10.6 |
| $PNEC_{sediment}$ | mg/kg | 5 |
| $DNEL_{inhalation}$ [144] | $mg/m^3$ | 0.32 |

### 2. Relevance of wastes streams – scope of the assessment

MCCPs are only used in industrial and professional applications. No waste is generated from consumer uses of MCCPs in formulations. Nevertheless Carbonless paper may also be used by consumers. Therefore, handling of carbonless copy paper by consumers is considered in the assessment.

The lifecycle stages of MCCP include the manufacture of MCCPs, the formulation of mixtures and the use of mixtures in professional uses with and without inclusion in articles. Hence, at all lifecycle stages wastes may occur.

### 3. Derivation of main waste streams

The registrant manufactures 2,700 t/a. He collected information from clients and identified three uses as relevant. Although not all customers were consulted, the main clients excluded significant use of MCCPs in other areas, as they are specialised for the respective industry sectors. Hence, the manufacturer identifies the uses:

- Metal cutting fluids (60% of the production volume) – PC25
- Sealants (app. 25% of the production volume) – PC1
- Carbonless copy paper (app. 15% of production volume) – AC 8

In Table R.18- 38 the waste types generated at each lifecycle stage of the identified uses are provided. The manufacturer used information provided by the guidance, in-house knowledge and information by his main clients. Amounts of MCCPs in wastes include the share of wastes related

144 The value of 0.32 mg/m3 of the risk assessment report of SCCPs is used, as no other information is available. This value may overestimate the toxicity of MCCPs, as short term toxicity studies showed no effects at high concentrations of MCCP.

to the used amounts (indicated by main clients). This value will be used for the local release estimation.

In Table R.18- 39 the share of the total registration volume entering a waste stream is indicated. This value will be used for the estimates at regional scale.

In this example only the waste treatment processes corresponding to the shaded line are assessed.

**Table R.18- 38: Waste types, amounts and waste treatment processes for MCCPs**

| Origin of waste (use/life cycle stage) | Use amount (t/a) | Type of waste | Fraction of used amount as waste | Type of use | Waste treatment process (destination) | Information source | Fraction of the use amount as waste entering WTP |
|---|---|---|---|---|---|---|---|
| Manufacture | 2,700 | Solid/liquid: off-specifications, cleaning material | 2% | Ind | Hazardous waste incineration | In-house (waste doc.) | $f_{waste\_HW\_incineration}$ = 2.001% = 0.02 |
| | | Solid: Air filters | 0.001% | Ind | | | |
| Formulation (metal working fluids) | 1,620 | Solid/liquid: rests, off-specifications, packaging | 2% of use<br>1.2% of total | Ind | Hazardous waste incineration | DU, waste documentation | $f_{waste\_HW\_incineration}$ = 2.001% = 0.02001 |
| | | Solid: Air filters | 0.001% of use<br>0.0006% of total | Ind | | | |
| Formulation of sealants | 675 | Solid/liquid: rests, off-specifications, packages | 2% of use<br>0.05% of total | Ind | Hazardous waste incineration | DU, waste documentation | $f_{waste\_HW\_incineration}$ = 2.0001% = 0.02001 |
| | | Solid: Absorbers | 0.01% of use<br>0.0025% of total | Ind | | | |
| Use of metal working fluids | 1,620 | Solid: Air filters, "empty packaging" | 2% of use<br>1.2% of total | Ind/ WD | HW incineration | DU, waste doc. | $f_{waste\_HW\_incineration}$ = 2% = 0.02 |
| | | Liquid: Spent metal working fluids | 45% of use[145]<br>27% of total | Ind/ WD | Separation | SDS, confirmation by DU | $f_{waste\_HW,separation}$ = 45% = 0.45 |
| MCCPs in metal swarf | 1,620 | Spent fluids contaminating metal swarf/scrap[146] | 94%[147] of use<br>56.4% of total | Ind/ WD | Metal recycling | Assumption | $f_{waste\_RW\_metal}$ = 94% = 0.94 |

145 The 45% corresponds to collectable metal working fluids as quoted in the main text (Table R.18- 14).

146 From the use as metal working fluids, wastes of metal scrap contaminated with MCCPs occur, which are assumed as the amount NOT disposed of as liquid wastes. Recovery of MCCPs is normally not performed, as the metal swarf would have to be stripped.

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| Origin of waste (use/life cycle stage) | Use amount (t/a) | Type of waste | Fraction of used amount as waste | Type of use | Waste treatment process (destination) | Information source | Fraction of the use amount as waste entering WTP |
|---|---|---|---|---|---|---|---|
| Use of sealants | 675 | Solid: rests of sealants, packaging" | 5% of use 1.25% of total | WD | Landfill, Incineration | Several customers | $f_{waste\ MW}$ = 5% = 0.05 |
| Use for copy paper | 405 | Liquid: production rests, cleaning processes | 1.5% of use 0.225% of total | WD | HW Incineration | Info by customer | $f_{waste\_HW\_incineration}$ = 1.5% = 0.015 |
| EoL copy paper | 405 | Solid: Used carbonless copy paper | 100% of use 15% of total | WD | Paper recycling, Landfill, Incineration | Common sense | $f_{waste\ RW\ paper}$ = 100% = 1 |
| EoL sealants | 675 | Construction and building material wastes | 100% of use 25% of total | WD | Landfill, Incineration, Construction | Common sense | $f_{waste\ MW}$ = 100% = 1 |

**Table R.18- 39: Fraction of substance becoming waste to be used for estimation at regional scale.**

| Waste treatment process | Wastes considered | % of registration volume as waste | Fraction of registered volume entering WTP | Type of use (industrial or dispersive) |
|---|---|---|---|---|
| Hazardous waste incineration | Manufacturing waste | M: 2.001 | $f_{waste\_HW\_incineration}$ = 0.02001 | IND ← manufacturing waste |
| Hazardous waste incineration | Formulation metal working and sealants | F: 1.2 + 0.0006 +0.05 + 0.0025 DU: 1.2 + 24.57 + 0.225 | $f_{waste\_HW\_incineration}$ = 0.2725 | IND ← wastes from formulation regarded as disposed in one site |
| Landfill / incineration | EoL copy paper, sealants, use of sealants | EoL: 25 + 15, DU: 1.25 | $f_{waste\ MW}$ = 0.4125 | WD ← dispersive use, disposal in dispersive waste infrastructure |

147 This is a conservative worst case assumption assuming that most of the collectable metal working fluids are not actually collected but remain with the metal parts.

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| | | | | |
|---|---|---|---|---|
| Separation (liquid/liquid) | Use of metal working fluids | DU: 0.27 | $f_{waste\_HW\_separation}$ = 0.27 | IND ← industrial and dispersive use, more conservative approach chosen |
| Construction waste | Use of sealants | EoL: 25 | $f_{waste\_MW\_construction}$ = 0.25 | WD ← dispersive use, open disposal in environment |
| Paper Recycling | Use of copy paper | EoL: 15 | $f_{waste\_RW\_paper}$ = 0.15 | WD ← dispersive use, disposal in dispersive waste infrastructure |
| Metal recycling (contamination) | Use of metal working fluids | DU: 56.4 | $f_{waste\_RW\_metal}$ = 0.564 | WD ← dispersive use, disposal in dispersive waste infrastructure |

### 4. Considerations on the type of assessment

For all the considered waste treatment processes the release estimation has been exemplified using the suggested values in order to illustrate how the guidance's approach can be applied. Nevertheless, as explained in the guidance, case by case conclusions need to be reached in order to decide whether a quantitative exposure estimate and risk characterization is needed or whether a qualitative assessment is more appropriate.

For incineration and landfill well-defined EU standards exist and a qualitative assessment may be more suitable to support the conclusion on the waste treatment. Thus the approach described below may need to be replaced by qualitative argumentations.

For construction waste, recycling and separation scenarios a quantitative assessment should be performed because either EU standards are not available or because the characteristics of the process requires a quantitative exposure assessment to be carried out.

### 5. Equations used for estimating releases

Equation 1 is used to estimate the maximum amount of the substance treated in a waste treatment facility at local scale (default conservative assessment).

***Equation 1: Derivation of $Q_{max}$ at local scale***

$$Q_{max,process}\ [kg/d] = (Q\ [t/a] * f_{waste} * 1000 * DF) / T_{emission}$$

| | |
|---|---|
| $Q_{max,process}$ = | *maximum treated amount per day in a specific waste treatment process expressed as kg of the substance contained in wasted per day* |
| Q = | total registration volume per use [t/a]. |
| $f_{waste}$ = | fraction of the registration volume of the substance becoming waste that is treated by the waste treatment process, for which the assessment is carried out. These values are derived in Table R.18-38, column fraction as waste. |
| Factor 1000 | used to convert the registration amount [t] to an amount expressed in [kg] |
| DF = | Factor of dispersiveness. This factor is used to take account of the type of use of the substance, which could either be industrial or dispersive. The types of use assumed in the assessment are indicated in Table R.18- 38.<br>The factor DF is 1 for all industrial settings (assumption that the total amount of wastes generated is |

treated in one site)
The factor DF is 0.002 for all dispersive uses[148] (assumption that the wastes treatment processes are distributed over a number of treatment sites in the region, corresponding to the number of standard town-equivalents of 10,000 persons.). An appropriate concentration factor may need to be applied to address the concentration of the waste treated in a specific WTP[149].

$T_{emission}$ = days of operation of the waste treatment facility. This information is taken from Table R.18- 21 of the core guidance.

Equation 2 is used to estimate the maximum amount of the substance contained in waste treated at regional scale per year. It is assumed that 100% of the waste from industrial settings and 10% of wastes from dispersive uses is treated in the region.

***Equation 2: Derivation of $Q_{max}$ at regional scale***

$$Q_{max,regional,ind} = Q * f_{waste} * 1$$

$$Q_{max,regional,DW} = Q * f_{waste} * 0.1$$

$Q_{max,regional,ind}$ = maximum amount of the substance contained in waste from industrial uses treated in specific waste treatment processes at regional scale [t/a]

$Q_{max,regional,DW}$ = maximum amount of the substance contained in waste from dispersive uses treated in specific waste treatment processes at regional scale [t/a]

Q = registration volume expressed in [t/a]

$f_{waste}$ = fraction of the substance used in the industrial or dispersive uses becoming waste.

Equation 3 is used to estimate releases from waste treatment processes at local or regional scale.

***Equation 3: Derivation of local releases***

$$E_{env} = Q_{max} * RF_{env}$$

$E_{env}$ = Released amount of the substance from the waste treatment process to the local environment [kg/d] or regional environment [t/a]. Indices according to receiving media = water, air and soil

$Q_{max}$= Maximum amount of the substance contained in waste being treated in the waste treatment process; [kg/d] for local scale and [t/a] for regional scale.

$RF_{env}$ = Release factor specifying the fraction of the substance entering the waste treatment process that is released to the environment. Releases occur to water, air and soil and are indicated by respective indices. Emission factors are the same for the local and regional assessment.

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148 The assumptions are the same as used in Chapter 16 of the Guidance on IR/CSA and are explained in the Appendix R.18-4.

149 Refer to Appendix R.18-4 for detailed explication and Table R.18- 21 for information of concentration factors to be applied.

## 6. Information for release estimation[150]

### 6.1 Introductory note on the derivation of some release factors

Release factors for MCCPs and measured data in emissions from waste treatment processes could not be identified by the manufacturer. Also, models to calculate emission factors are not available or difficult to apply.

The manufacturer therefore used the simple treat model of EUSES to derive emission factors to water and air as well as to derive the efficacy of biological sewage treatment plants as on-site risk management measure. The following arguments are used to justify the approach:

**Releases to air:**

- The conditions of use of the compared processes (paper recycling, emulsion splitting) are similar to the treatment of wastewater:
  - Process in aqueous media
  - Ambient temperatures.
  - Wastewater is aerated in the STP, promoting the formation of aerosols and evaporation. The conditions in waste treatment processes are less release promoting (no aeration, potentially same degree of agitation)
- Risk management measures: in either process, no risk management measures to clean waste gas are assumed to exist.

**Releases to water:**

- The conditions of use of the compared processes (emulsion splitting, landfilling of waste) are similar or less release promoting than the waste water treatment process
  - MCCPs are not biodegradable and therefore no related “loss” would occur in the treatment plant. This is also the case in the any waste treatment processes.
  - MCCPs are eliminated in the STP (mainly distribution to sludge), indicating the physico-chemical nature of the removal rates. This “partitioning” is assumed to be transferable to other processes, where aqueous and oily phases / organic matter are separated.
  - The conditions in the landfill may promote degradation of MCCPs more than in an STP, hence the use of the release factor is conservative.
- Risk management measures: may be included in the release estimate in addition to the release factors based on simple treat, which are used as initial release factors.

The above argumentation is valid for all cases, where release factors for waste treatment processes have been based on the release factors of simple treat.

### 6.2 Landfill[151]

150 The assessment made for exemplification does not cover all identified treatment processes.

MCCP-containing wastes being landfilled mainly are end-of-life articles, i.e. used carbonless copy paper and sealants. Municipal waste is either disposed of in non-hazardous landfills or by thermal treatment (incineration, c.f. next chapter). Landfills have to be operated according to the requirements of the landfill directive.

There is no specific model available to estimate the release of MCCPs from landfills. The method for deriving the release factors to the environment is explained below.

### 6.2.1 Derivation of input amount to the landfill ($Q_{max}$) – local scenario

For the release estimate from landfills, three wide dispersive uses will be taken into account, as identified in Table R.18- 38 and Table R.18- 39. As for wide dispersive uses leading to discharge into the waste water, a fraction of 0.002 of the regional amount per use is assumed to fully or partly enter into waste to be treated at a local site. This is based on the assumption that the assessment approach for municipal waste water treatment applied in Chapter R.16 can be also applied to the treatment of waste from wide dispersive use. According to the approach explained in APPENDIX R.18-4, a concentration factor of 2.38 is applied. This addresses the higher number of standard town (i.e. equivalent population) connected with the waste treatment installation compared to the STP[152].

As a worst case, 95% of the MCCP – containing wastes are assumed to be disposed of in landfills[153]. The resulting fraction as waste is $f_{waste,landfill} = f_{waste\_MW} * 0.95$.

$$Q_{max,local,landfill}\ [kg/d] = (Q_{use} * f_{waste,landfill} * 1000 * 0.002 * 2.38) / 365$$

[151] The assessor may come to the conclusion that a qualitative assessment is sufficient or even more appropriate. Such qualitative assessment would take into account: Fraction of the total MCCP mass-flow ending up in landfills, conclusions regarding the PBT/vPvB status of MCCP, behaviour of MCCP under landfill-conditions (based on water solubility, type of article-matrix containing MCCP, adsorption behaviour, vapour pressure and degradability).

152 For full explanation refer to chapter R.16 and Appendix R.18-4.

153 The same assumption is used for the waste treatment process incineration (c.f. next chapter).

**Table R.18- 40: Calculation of maximum amounts of substance treated per day at site.**

| Use | Total tonnage of registrant per use (t/y) | $f_{waste\_MW}$ | $f_{waste,landifll}$ | $Q_{max, local}$ (kg/d) |
|---|---|---|---|---|
| Use of sealants | 675 | 0.05 | 0.0475 | 0.418 |
| EoL copy paper | 405 | 1 | 0.95 | 5.02 |
| EoL sealants | 675 | 1 | 0.95 | 8.36 |

### 6.2.2 Derivation of input amount to landfill ($Q_{max}$) – regional scenario

### 6.2.3

The manufacturer assumes that 70% of municipal wastes are disposed of in landfills ($f_{waste}$ = 0.4125 * 0.7 = 0.289). This is regarded conservative, as the manufacture supplies clients in northern Europe, where a larger share of municipal waste is incinerated. Furthermore, the release factors from the landfill (see below) are higher than those for the incineration scenario.

$$Q_{max,regional,landfill} = 2{,}700 * 0.2887 * 0.1 = \mathbf{77.963\ [t/a]}$$

### 6.2.3 Derivation of release factor from landfill to air

The release factor to air is derived using information on the physico-chemical properties of MCCPs (vapour pressure) and the equation proposed in the OECD ESD for plastic additives concerning the evaporation rate of plastic additives from polymers.

In the OECD ESD, a release factor for additives in polymers to air during service life is derived based on the formula $1.1 * 10^{-6} * Vp$ (mmHg). Although the conditions in the landfill may be different than for indoor use of articles, the value is used in the release estimation. Using the average vapour pressure of 0.05 kPa would result in a release factor to air of $\mathbf{RF_{air,initial} = 0.004}$. This release factor constitutes the initial release.

In compliant landfills, landfill gas is to be captured and treated. It is assumed that 50% of the landfill gas is captured and that the efficacy of removal of MCCPs from landfill gas is 80%[154]. Hence, the efficacy of the risk management measures at the landfill is 40%, resulting in a release factor of $\mathbf{RF_{RMM} = 0.6}$.

The initial release factor is multiplied by the release factor from the landfill gas treatment device to derive the final release rate for MCCPs from landfills to air:

$$RF_{air} = RF_{air,initial} * RF_{RMM} = 0.004 * 0.6 = \mathbf{0.0024}$$

154 This information was obtained from manufactures of landfill gas treatment devices.

### 6.2.4 Derivation of release factor from landfill to water

There are neither measured data nor other respective data available on MCCP concentrations in landfill leachate. The manufacture considers the behaviour of MCCPs in landfills comparable to their behaviour in a biological sewage treatment plant (STP), as normally little biodegradation takes place and the distribution of MCCPs in STPs is mainly driven by their physico-chemical properties.

In contrast to the STP, in landfills not only aerobic but also anoxic, anaerobic and acidic conditions occur. This may lead to higher biotic degradation and abiotic destruction of MCCPs. Therefore, using a release factor based on the simple treat model is considered as a conservative approach.

According to simple treat, in an STP approximately 9.08% of MCCPs are discharged to surface water (corresponding to the landfill leachate) after treatment, 90.8% are adsorbed to sludge (corresponding to the waste in the landfill body and the bottom liners) and 0.1% is emitted to air.

Consequently, the initial release factor for MCCPs to landfill leachate is assumed $\mathbf{RF_{water,initial}}$ = **0.0908.**

Landfill leachate is normally drained with an assumed degree of collection of ca. 100%. The drained leachate is treated in an on-site STP and discharged to surface. A biological onsite wastewater treatment plant is assumed to determine the release from the landfill. The release rate to water is the same as the initial release factor to landfill leachate, which constitutes an efficacy of the risk management measure of 90.92 %. The release factor from the onsite WWTP is therefore $\mathbf{RF_{RMM}}$ **= 0.0908.**

The initial release factor is multiplied by the release factor from the onsite WWTP to derive the final release rate for MCCPs from landfills to surface water[155]:

$$\boldsymbol{RF_{water}} = RF_{water,initial} * RF_{RMM} = 0.0908 * 0.0908 = \mathbf{0.00824}$$

### 6.2.5 Derivation of release factor from landfill to soil

No emissions to soil are assumed to occur in accordance with the proposed factors for landfill in the main text. Emissions to leachate are assumed to be collected by the landfill drainage system.

[155] In the exposure assessment, direct discharge to surface water is to be assumed; hence no additional STP should be used in EUSES modelling.

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

### 6.2.6 Summary of information on MCCPs in the landfill

**Table R.18- 41: Information to estimate releases of MCCP contained in wastes disposed of in landfills**

| Parameter | Description | | | |
|---|---|---|---|---|
| Assessed waste treatment process | Landfill for municipal wastes | | | |
| Coverage | The processes of transport, interim storage and final disposal of wastes in landfills are covered by the release estimation. Releases from transport and interim storage are regarded as negligible and not estimated separately but are regarded as covered by the conservativeness of the assessment. | | | |
| Types of wastes | MCCP containing construction and demolition wastes (sealants), used carbonless copy paper, non-hazardous production wastes from use of MCCP containing mixtures. | | | |
| Assumptions | The landfill is assumed to comply with the Landfill Directive | | | |
| Pre-treatment | No specific pre-treatment is applied. | | | |
| Physical form | Substances are contained in waste; wastes are mostly solid. There may be some matrix effects slowing down releases from wastes. | | | |
| Operational conditions and risk management measures | The landfill is operated according to good practice and compliant with the requirements of the landfill directive. It has got an artificial bottom liner as well as a top soil layer. Leachate, surface water run-off and landfill gas are collected and treated onsite. Surface water runoff is collected and discharged to the sewer. No specific operational conditions or risk management measures exceeding legal requirements / state-of-the-art are assumed. | | | |
| Maximum amount treated: Local scenario | Use of sealants: **0.418 kg/d** | EoL copy paper: **5.02 kg/d** | EoL sealants: **8.36 kg/d** | **Total: 13.8 kg/d** |
| Maximum amount treated: Regional scenario | **77.963 t/a** | | | |
| Information on installations | Operating days<br>365 d/a | Number of installations 8400 | | |
| Collection rate of initial releases | 100% of leachate is treated onsite<br>50% of landfill gas before treatment | | | |
| Release factors to air | **$RF_{air,initial}$ = 0.004**<br>Justification: OECD ESD equation for release of additives from polymers during service life | **$RF_{RMM}$ = 0.6**<br>Justification: information from equipment manufacture and literature information on degree of capture of landfill gas | **$RF_{air}$ = 0.0024** | |
| Release factor to water | **$RF_{water,initial}$ = 0.0908**<br>Justification: simple treat model assumed reflecting worst case in landfill | **$RF_{RMM}$ = 0.0908**<br>Release factor for onsite WWTP derived from simple treat model | **$RF_{water}$ = 0.00824** | |
| Release factor to soil | **$RF_{soil}$ = 0**<br>Due to the high tendency to adsorb to organic matter, MCCP are not expected to pass through the landfill body AND the mineral liners of the landfill. No direct releases to soil. | | | |

### 6.2.7 Release estimation for MCCPs in landfills

**Table R.18- 42: Summary of release factor for landfill scenario.**

| Modelling | Initial release factor | Release factor of RMM | Total release factor |
|---|---|---|---|
| Release to water | 0.0908 | 0.0908 | 0.00824 |
| Release to air | 0.004 | 0.6 | 0.0024 |
| Release to soil | 0.0 | n.a. | 0.0 |

**Table R.18- 43: Release amounts (kg/d) for MCCPs in landfills for each relevant use, local scenario**

| | Use of sealants | EoL copy paper | EoL sealants |
|---|---|---|---|
| Release to water | 0.00344 | 0.414 | 0.114 |
| Release to air | 0.001 | 0.012 | 0.0331 |
| Release to soil | 0.0 | 0.0 | 0.0 |

**Table R.18- 44: Release estimate for MCCPs in landfills, regional scenario**

| Modelling | Released amount | Unit |
|---|---|---|
| $Q_{max,regional,landfill}$ | **77.963** | t/a |
| Release to water | **0.6424** | t/a |
| Release to air | **0.1871** | t/a |
| Release to soil | **0.0** | t/a |

## 6.3 Incineration of municipal wastes[156]

End-of-life articles are likely to be disposed of as municipal waste. Municipal wastes may either be disposed of in landfills (c.f. previous chapter) or incinerated (thermal treatment, oxidizing).

Waste incineration facilities are to be operated according to the IPPC Directive and should comply with BAT requirements. Normally, emission limit values are set in the permits of these facilities. Exhaust gas is to be treated in order to comply with the air emission limit values. Operating temperatures of 800°C minimum have to be achieved.

[156] The assessor may come to the conclusion that a qualitative assessment is sufficient or even more appropriate. Such assessment would assume that MCCP is destroyed in incineration processes operated according to EU standard.

The manufacturer supplies customers in northern Europe, where both processes take place, however with an increasing tendency towards incineration.

### 6.3.1 Derivation of input amount to incineration ($Q_{max}$) - local scenario

For the release estimate from municipal incineration the same three wide dispersive uses as for landfill will be assessed. As for wide dispersive uses leading to discharge into the waste water, a fraction of 0.002 of the regional amount per use is assumed to fully or partly enter into waste to be treated at a local site. A concentration factor of 40 needs to be applied to address the number of equivalent population connected with the waste treatment plant compared to those connected to a STP. The waste treatment infrastructure may lead to a situation that a higher fraction of substances in dispersive use is treated at a local site[157]. As a worst case it is assumed that 95% of the MCCP – containing wastes is incinerated. The resulting fraction as waste is $f_{waste,incineration} = f_{waste\_MW} * 0.95$.

$$Q_{max,local,incineration}\ [kg/d] = (Q_{use} * f_{waste,incineration} * 1000 * 0.002 * 40) / 330$$

**Table R.18- 45: Calculation of maximum amounts of substance treated per day at site.**

| Use | Reg.tonnage per use (t/y) | $f_{waste\_MW}$ | $f_{waste,incineration}$ | $Q_{max,\ local}$ (kg/d) |
|---|---|---|---|---|
| Use of sealants | 675 | 0.05 | 0.0475 | 7.773 |
| EoL copy paper | 405 | 1 | 0.95 | 93.273 |
| EoL sealants | 675 | 1 | 0.95 | 155.454 |

### 6.3.2 Derivation of input amount to incineration ($Q_{max}$) - regional scenario

In deriving the maximum amount of MCCP-containing waste incinerated per year in a region, the manufacturer assumes that 30% of municipal waste is incinerated (70% to landfill). This results in a fraction as waste of $f_{waste} = 0.4125 * 0.3 = 0.1234$

$$Q_{max,incineration} = 2{,}700 * 0.1234 * 0.1 = \mathbf{33.413\ [t/a]}$$

### 6.3.3 Derivation of release factor from incineration to air

According to the distribution scheme “thermal treatment – oxidizing”, the relation between operating temperature and decomposition temperature is relevant for deriving the release factor of MCCPs to air. MCCPs decompose above 200°C, which suggests that most of the substances entering the incineration process are mineralized and therefore not emitted. However, MCCPs also have a tendency to sorb to organic matter (fly ash) and residual emissions to air may occur. As a

157 For full explanation refer to chapter R.16 and Appendix R.18-4.

worst case it is assumed that 0.01% of MCCPs could distribute to fly ash, yielding an initial release factor to air of $\mathbf{RF_{air,initial} = 0.0001}$.

The fly ash is treated before release to the environment using a wet washer. This is a worst case assumption, because this technology is less efficient than dry treatment techniques and because emissions to water are generated, which lack for dry treatment (c.f. derivation of release factor to water). The efficacy of the washer has been enquired to be approximately 95%. The release factor from treatment is $\mathbf{RF_{RMM} = 0.05}$.

The initial release factor is multiplied by the release factor of the wet washer to derive the final release factor for MCCPs from incineration plants to air:

$$\boldsymbol{RF_{air}} = RF_{air,initial} * RF_{RMM} = 0.0001 * 0.05 = \boldsymbol{0.00005}$$

### 6.3.4 Derivation of release factor from incineration to water

According to the distribution scheme of the main text, emissions from incineration plants to water only occur from washing of waste gas: The initial release factor to water equals the initial release factor to air multiplied with the efficacy of the risk management measure (wet washer): $\mathbf{RF_{water,initial}}$ = 0.0001 * 0.95 = **0.000095.**

Treatment of wastewater from washers is state-of-the-art in incineration plants. The filtration effectiveness of the wastewater treatment plant has been inquired at a municipal waste incineration operator and was provided as having an efficacy of 70% for MCCPs. The release factor of MCCPs from the on-site WWTP of $\mathbf{RF_{RMM} = 0.3}$.

The initial release factor is multiplied by the release factor from the WWTP to derive the final release factor for MCCPs from incineration plants to water:

$$\boldsymbol{RF_{water}} = RF_{water,initial} * RF_{RMM} = 0.000095 * 0.3 = \boldsymbol{0.0000285}$$

### 6.3.5 Derivation of release factor to soil

No emissions to soil are assumed to occur in accordance with the distribution scheme in the main text.

### 6.3.6 Derivation of amounts of MCCPs in secondary wastes (sludge)

MCCPs are assumed to be emitted via the fly ash (0.01%) and washed out from waste gas (95% effectiveness). The waste water from waste gas washing is treated onsite and generates sludge containing the majority of MCCPs (effectiveness 70% as informed by the operator of an installation). This results in a “release” factor for MCCP with sludge[158] 0.0000065.

158 Releases from sludge to soil have not been further assessed in this example.

### 6.3.7 Summary of information on MCCPs in waste incineration

**Table R.18- 46: Information to estimate releases of MCCP contained in wastes treated by incineration of MW**

<table>
<tr><th>Parameter</th><th colspan="4">Description</th></tr>
<tr><td>Assessed waste treatment process</td><td colspan="4">Municipal waste incineration</td></tr>
<tr><td>Coverage</td><td colspan="4">Waste collection, transport, temporary storage, feeding into the furnace and thermal treatment are covered. As MCCPs are not contained in bottom ashes or slags, no processing of secondary waste is considered.<br>Sludge from wastewater is regarded as being disposed of by incineration or in hazardous waste landfills. Emission resulting from these processes are regarded as covered by the scenario due to a) insignificant emissions and b) conservativeness of assessment</td></tr>
<tr><td>Types of wastes</td><td colspan="4">End-of-life sealants, carbonless copy paper</td></tr>
<tr><td>Assumptions</td><td colspan="4">The process is operated according to the legal requirements.</td></tr>
<tr><td>Pre-treatment</td><td colspan="4">No pre-treatment of wastes, except mechanical reduction of volume and mixing</td></tr>
<tr><td>Physical form</td><td colspan="4">Contained in solid wastes</td></tr>
<tr><td>Operational conditions and risk management measures</td><td colspan="4">Storage of waste in closed bunkers, operating temperatures according to waste incineration directive (850 + 1100), furnace is fully closed.<br>The incinerator is equipped with wet flue-gas cleaning (washer) with an efficacy of 95% for MCCPs and an on-site WWTP with an efficacy of removal of MCCP from water of 70%. Secondary wastes (sludge) are disposed of in landfills or incinerated.</td></tr>
<tr><td>Information on installations</td><td colspan="2">Operating days<br>330 d/a</td><td colspan="2">Number of plants<br>600</td></tr>
<tr><td>Maximum amount treated: Local scenario</td><td>Use of sealants: 7.773 kg/d</td><td>EoL copy paper: 93.273 kg/d</td><td>EoL sealants: 155.454 kg/d</td><td>Total: 256.5 kg/d</td></tr>
<tr><td>Maximum amount treated: Regional scenario</td><td colspan="4">33.41 t/a</td></tr>
<tr><td>Water treatment</td><td colspan="4">On-site waste water treatment with effectiveness of at least 70% removal from waste water.<br>For the exposure assessment, direct discharge to surface waters is to be assumed.</td></tr>
<tr><td>Collection rate of initial releases</td><td colspan="4">100% of flue gas enters washer<br>100% of water in washer enters WWTP</td></tr>
<tr><td>Release factor to air</td><td colspan="2">$RF_{air,initial}$ = 0.0001<br>Justification: high degree of decomposition, residual release in fly ash</td><td>$RF_{RMM}$ = 0.05<br>Justification: efficacy specified by manufacturer as 95%</td><td>$RF_{air}$ = 0.00005</td></tr>
<tr><td>Release factor to water</td><td colspan="2">$RF_{water,initial}$ = 0.000095<br>Justification: emissions to air multiplied with efficacy of washer</td><td>$RF_{RMM}$ = 0.3<br>Justification: WWTP efficacy of 70%</td><td>$RF_{water}$ = 0.0000285</td></tr>
<tr><td>Release factor to soil</td><td colspan="4">No direct emissions to soil –> 0.0</td></tr>
</table>

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| Parameter | Description |
|---|---|
| Amount in filtration sludge / material | RF to sludge = 0.000095 * 0.7 = 6.65* $10^{-5}$<br>Amount in water from washer which is filtered out in the on-site WWTP. This equals a total amount of 7.074 t/a or 0.026% of the production volume |

### 6.3.8 Release estimation for MCCPs in thermal treatment

**Table R.18- 47: Summary of release factor for municipal incinerator scenario.**

| Modelling | Initial release factor | Release factor of RMM | Total release factor |
|---|---|---|---|
| Release to water | 0.000095 | 0.3 | 0.0000285 |
| Release to air | 0.0001 | 0.05 | 0.00005 |
| Release to soil | 0.0 | n.a. | 0.0 |

**Table R.18- 48: Release amounts (kg/d) for MCCPs in incineration for each relevant use, local scenario**

| | Use of sealants | EoL copy paper | EoL sealants |
|---|---|---|---|
| Release to water | 0.0002215 | 0.00266 | 0.00443 |
| Release to air | 0.000389 | 0.00466 | 0.00777 |
| Release to soil | 0.0 | 0.0 | 0.0 |

**Table R.18- 49: Release estimate for MCCPs in incineration, regional scenario**

| Modelling | Released amount | Unit |
|---|---|---|
| $Q_{max,regional,incineraation}$ | **33.41** | t/a |
| Release to water | **0.0010** | t/a |
| Release to air | **0.0017** | t/a |
| Release to soil | **0.0** | t/a |

*Note to the example: For a complete assessment, the secondary wastes from sludge would also have to be assessed. As the amounts are small and the disposal in landfill is assessed already, use in road construction would have to be assessed. Due to high dispersion of the rather low total amounts of MCCPs, no risks are expected and the assessment is not done in detail here.*

### 6.4 Separation (emulsifiable metal working fluids)

In total, 60% of the registration volume is used in metal working fluids. MCCPs are used in emulsions and oil based metal working fluids. Both are normally disposed of to specific waste management companies for phase separation. The water phase is filtrated and the oil phase is normally incinerated (information from waste management company). The OECD emission

scenario document on lubricants is used for identifying relevant information for the release estimate.

### 6.4.1 Derivation of input amount to phase separation ($Q_{max}$) – local scenario

The total amount of wastes containing MCCPs generated from the use in metal cutting fluids is assumed to be treated by phase separation. The fraction as waste has been determined as 0.45 of the registered amount for this use. The use of metal cutting fluids takes place in industrial setting and as wide dispersive use. The industrial setting is more conservative and therefore assumed in the assessment of local releases. In the default assessment it is assumed that waste from 100% of the regional tonnage for a use is treated in one local waste treatment site.

$$Q_{max,local,separation} = 1{,}620 * 0.45 * 1000 * 1 / 220 = \mathbf{3{,}313.64\ kg/d}$$

### 6.4.2 Derivation of input amount to phase separation ($Q_{max}$) – regional scenario

The use of metal cutting fluids is industrial and wide dispersive. The industrial setting is more conservative and therefore used in the assessment of the regional releases.

$$Q_{max,regional,separation} = 2{,}700 * 0.27 * 1 = \mathbf{729\ t/a}$$

### 6.4.3 Derivation of release factor from phase separation to air

For estimating releases to air, no information could be obtained by the registrant from any separation installation for metal working fluids. The registrant therefore assumes the phase separation process to be similar to a waste water treatment plant with regard to emissions to air (justification c.f. section 0).

The distribution of MCCPs to air in a biological waste water treatment plant is **0.00107** according to simple treat. This is used as release factor in the assessment. It is regarded as a worst case assumption, as temperatures and agitation of baths are likely to be higher during waste water treatment than in emulsion splitting.

### 6.4.4 Derivation of release factor from phase separation to water

For the same reasons as described above, EUSES has also been used to derive a release factor to water from emulsion splitting. This derived release factor from emulsion separation is $\mathbf{RF_{water,initial} = 0.0908}$. Consequently a fraction of 0.91 of the MCCP entering into phase separation leaves the separation with the oil phase, and subsequently enters into hazardous waste incineration.

An on-site waste water treatment is assumed in separation plants as normally, emission limit values can not be remained under without treatment. The efficacy of the water treatment plants is approximately 98% for organic substances. Hence, the release factor for MCCPs from waste water treatment is $\mathbf{RF_{RMM} = 0.02}$.

The initial release factor is multiplied by the release factor from the WWTP to derive the final release factor for MCCPs from phase separation plants to water:

$$RF_{water} = RF_{water,initial} * RF_{RMM} = 0.0908 * 0.02 = \mathbf{0.02724}$$

### 6.4.5 Derivation of release factor from phase separation to soil

No emissions to soil are assumed to occur in accordance with the proposed distribution scheme for phase separation (liquid/liquid). This has also been confirmed by literature (BREF waste treatment).

### 6.4.6 Summary of information for MCCPs in phase separation

**Table R.18- 50: Information to estimate releases of MCCP contained in spent metal cutting fluids treated in phase separation processes**

| Parameter | Description | | |
|---|---|---|---|
| Assessed waste treatment | Phase separation – emulsion splitting | | |
| Coverage | The release estimate covers emissions from waste collection, transport and temporary storage at the treatment plant, emulsion splitting and cleaning of wastewater with standard techniques as well as incineration of the oil phase from separation.<br>Emissions from secondary waste (incineration of oil phase, sludge) are regarded as covered due to insignificant amounts and the conservativeness of the assessment | | |
| Types of wastes | Spent emulsifiable metal working fluids. | | |
| Assumptions | The separation process is operated according to the legal requirements and emission limit values are complied with. | | |
| Pre-treatment | No pre-treatment of wastes | | |
| Physical form of the substance | Metal working fluids (cooling lubricants) | | |
| Operational conditions and risk management measures | Emulsion splitting is carried out in semi-open processes, temperatures are around 20°C, slight agitation may occur, no chemicals are added<br>The water phase from the separation process is treated on-site by specific treatment plants (efficacy of 98%). The oily phase from separation is incinerated as well as sludge wastewater treatment. No waste gas is captured and treated.<br>For the exposure assessment, direct discharge to surface water is to be assumed. | | |
| Maximum amount treated | Local scenario<br>**3313.64 kg/d** | Regional scenario<br>**729 t/a** | |
| Information on the installation | Operating days<br>220 d/a | Number of installations<br>780 | |
| Collection rate of initial releases | 100% of flue gas enters washer<br>100% of water in washer enters WWTP | | |
| Release factor to air | **$RF_{air,initial}$ = 0.00107**<br>Justification: simple treat model | **$RF_{RMM}$ = 1**<br>No RMM applied | **$RF_{air}$ = 0.00107** |
| Release factor to water | **$RF_{water,initial}$ = 0.0908**<br>Justification: simple treat model | **$RF_{RMM}$ = 0.02**<br>Justification: efficacy of 98% specified for MCCPs | **$RF_{water}$ = 0.00182** |
| Release factor to soil | No release to soil. | | |

### 6.4.7 Release estimation for MCCPs in phase separation

**Table R.18- 51: Release estimate for MCCPs in phase separation, local scenario**

| Modelling | Initial release factor | Release factor of RMM | Total release factor | Released Amount | Unit |
|---|---|---|---|---|---|
| $Q_{max,local,separation}$ | | | | **3313.64** | kg/d |
| Release to water | 0.0908 | 0.02 | 0.00182 | **6.018** | kg/d |
| Release to air | 0.00107 | 1 | 0.00107 | **3.546** | kg/d |
| Release to soil | 0.0 | n.a. | 0.0 | **0.0** | kg/d |

**Table R.18- 52: Release estimate for MCCPs in phase separation, regional scenario**

| Modelling | Released amount | Unit |
|---|---|---|
| $Q_{max,regional,separation}$ | **729** | t/a |
| Release to water | **1.3239** | t/a |
| Release to air | **0.780** | t/a |
| Release to soil | **0.0** | t/a |

## 6.5 Paper recycling

MCCPs are used as part of the coating of carbonless copy paper. Waste carbonless copy paper could be disposed of as municipal waste or as waste paper in recycling processes. As MCCPs are added to the paper after the pulping, the recycling step has to be assessed.

### 6.5.1 Derivation of input amount to paper recycling ($Q_{max}$) – local scenario

The amount of MCCPs entering paper recycling processes equals the amount registered for use of copy paper (100% of the registrant's total amount per this use). The use is regarded as wide dispersive. As for wide dispersive uses leading to discharge into the waste water, a fraction of 0.002 of the regional amount per use is assumed to fully or partly enter into waste to be treated at a local site. This is based on the assumption that the assessment approach for municipal waste water treatment can be also applied to the treatment of waste from wide dispersive use. Following the assumption explained before, a concentration factor of 59.7 has been estimated and will be applied[159].

The operation days of paper plants using recycling paper are 330 d/a.

$$Q_{max,local,paper} = (405 * 1 * 1000 * 0.002 * 59.7) / 330 = \mathbf{146.536\ [kg/d]}$$

159 For full explanation refer to chapter R.16 and Appendix R.18-4.

### 6.5.2 Derivation of input amount to paper recycling ($Q_{max}$) – regional scenario

Carbonless copy paper could either enter municipal wastes or be disposed of as waste paper for recycling. The total amount of MCCPs has been used in the calculation of regional releases from municipal waste (landfill / incineration). Furthermore, it is assumed that 50% of the MCCPs used in carbonless copy paper enter the waste treatment process paper recycling. This means that this amount is “double counted” in the regional release estimate (not subtracted from landfill/incineration).

The use of carbonless copy paper is wide dispersive, therefore 10% of the volume is assumed to be used in the region.

$$Q_{max,regional,paper} = 2{,}700 * 0.15 * 0.5 * 0.1 = \mathbf{20.250\ [t/a]}$$

### 6.5.3 Derivation of release factor from paper recycling to air

In the absence of better data and information, the emission factor to air as derived by EUSES is used for MCCPs paper recycling (Justification c.f. Section 0). The initial release factor is **$RF_{air}$ = 0.00107.**

### 6.5.4 Derivation of release factor from paper recycling to water

In the deinking process, MCCPs should be removed as far as possible. The worst case release factor to water for mineral oil based inks (corresponds to maximum deinking efficiency) provided in the OECD ESD for paper recycling is used; the initial release is **$RF_{initial,water}$ = 0.90144.**

On-site waste water treatment is state-of-the-art in paper plants. As the main pollutants are organic substances, biological wastewater treatment is assumed and the simple treat model applied for determining the efficacy of removal of MCCPs (90.9%). The release factor from the WWTP used is **$RF_{RMM}$ = 0.0908**.

The initial release factor is multiplied by the release factor from the WWTP to derive the final release factor for MCCPs from paper recycling plants to water:

$$RF_{water} = RF_{water,initial} * RF_{RMM} = 0.90144 * 0.0908 = \mathbf{0.0819}$$

### 6.5.5 Derivation of release factor to soil

No emissions to soil are assumed to occur (c.f. OECD ESD).

### 6.5.6 Summary of information for MCCPs in paper recycling

**Table R.18- 53: Information to estimate releases of MCCP contained in wastes disposed of in paper recycling**

| Parameter | Description |
|---|---|
| Assessed process | Recycling of carbonless copy paper in paper mills using waste paper as input material |

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| **Parameter** | **Description** | | |
|---|---|---|---|
| Coverage | Collection, transport, storage, deinking, pulping and production of recycling papers. | | |
| Types of wastes | Carbonless copy paper | | |
| Assumptions | The pulping process is carried out in accordance with the legal requirements. | | |
| Pre-treatment | Pre-sorting before delivery to a mill. Size reduction, deinking as main process covered. | | |
| Physical form | Substance is part of solid paper waste | | |
| Operational conditions and risk management measures | Paper recovery process is carried out as an industrial operation. Emissions could occur mainly in the water-phase due to the recovery process taking place in aqueous solution. Operations are carried out indoors at normal temperatures.<br>No waste gas treatment is applied. Wastewater is treated on-site in a biological wastewater treatment plant. Sludge from wastewater treatment is incinerated or disposed of in hazardous waste landfills. | | |
| Maximum amount treated | Local scenario<br>**146.536 kg/d** | Regional scenario<br>**20.250 t/a** | |
| Information on the installation | Operating days<br>330 d/a | Number of installations<br>335 | |
| Collection rate of initial releases | 0% of waste gas<br>100% of wastewater enters on-site WWTP | | |
| Release factor to air | **$RF_{air,initial}$ = 0.00107**<br>Justification: simple treat model | **$RF_{RMM}$ = 1**<br>No RMM applied | **$RF_{air}$ = 0.00107** |
| Release factor to water | **$RF_{water,initial}$ = 0.90144**<br>Justification: worst case factor of OECD ESD for the deinking process | **$RF_{RMM}$ = 0.0908**<br>Justification: simple treat model | **$RF_{water}$ = 0.0819** |
| Default release factor to soil | 0 | | |

### 6.5.7 Release estimation for MCCPs in paper recycling

**Table R.18- 54: Release estimate for MCCPs in paper recycling, local scenario**

| **Modelling** | **Initial release factor** | **Release factor of RMM** | **Total release factor** | **Released Amount** | **Unit** |
|---|---|---|---|---|---|
| Release to water | 0.90144 | 0.0908 | 0.0819 | **12.001** | kg/d |
| Release to air | 0.00107 | 1 | 0.00107 | **0.157** | kg/d |
| Release to soil | 0.0 | n.a. | 0.0 | **0.0** | kg/d |

**Table R.18- 55: Release estimate for MCCPs in paper recycling, regional scenario**

| **Modelling** | **Released amount** | **Unit** |
|---|---|---|

| | | |
|---|---|---|
| $Q_{max,regional,paper}$ | **20.250** | t/a |
| Release to water | **1.658** | t/a |
| Release to air | **0.022** | t/a |
| Release to soil | **0.0** | t/a |

### 6.5.8 Discussion on iterating the assessment of paper recycling

It is assumed the risk characterisation carried out by the manufacturer identifies a risk from MCCPs entering paper recycling processes to surface water and sediments[160].

In such case, the manufacturer would not iterate the assessment (he could e.g. assume an increased effectiveness of the onsite waste water treatment) because REACH does not provide for a mechanism supporting i) the communication of this assumption to all the paper mills and ii) the subsequent implementation at the paper mills. Therefore, assuming a higher elimination rate for MCCP could result in a theoretically safe situation, but it would not be ensured that this is implemented in practice. Therefore, the only remaining option for the registrant is to advise that carbonless copy paper is **not disposed of to recycling** but as regular municipal waste, since here the risk has been demonstrated to be controlled (after refined assessment) . But also here, such advice can only be addressed to the producers of carbonless copy paper who can then forward the advice as product information to their customers.

## 6.6 Total amount of releases at regional scale

The total amount of MCCPs emitted from waste treatment processes equals the sum of all releases from point source and dispersive uses at regional scale. They are summarized in the following table[161]:

**Table R.18- 56: Amounts of MCCPs released from waste treated in a region per year**

| | Unit | Landfill | Waste incineration | Separation | Paper recycling[162] | Total |
|---|---|---|---|---|---|---|
| Release amount water | t/a | 0.642 | 0.00095 | 1.324 | 1.657 | 3.625 |
| Releases amount air | t/a | 0.187 | 0.00167 | 0.780 | 0.0217 | 0.99 |
| Released amount soil | t/a | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

<u>*Note to the example:*</u>

160 PECs and RCRs are not shown here for reasons of consistency of the example.

161 Not all waste treatment processes are assessed in this example; therefore, e.g. wastes from hazardous waste incineration or from the treatment of metal scrap contaminated with MCCPs are not included in the table.

162 Paper recycling is included here, although the assessment resulted in the conclusion that recycling of carbonless copy paper should be excluded by communication in the SDS and packaging of the article, because this documents the status quo.

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

*Large amounts of MCCPs are contained in metal swarf/scrap as contamination. This would have to be assessed for a complete CSA as well. As metal recycling is similar in conditions determining release as waste incineration for MCCPs (high temperatures leading to decomposition of the majority of substances) and the amounts potentially entering metal recycling are similar to the amounts used in the assessment of incineration, no additional calculations are performed to identify releases, exposures and risk characterisation rations. Furthermore, the waste treatment process of metal recycling is exemplified in the following example (Appendix R.18- 7).*

### 7 Additional qualitative considerations on risks

Additional qualitative considerations lead to the conclusion that information should be forwarded regarding the risk of dioxin formation in thermal processes due to HCl formation when the substance is decomposed.

### 8 Summary of information to be used for release estimation

The information and values used for estimating releases to the local and regional environment are summarized in the following tables. The effectiveness of waste treatment conditions (for disposal or recycling) is expressed as overall effectiveness: The initial release factor driven by the treatment technique (e.g. destruction and partitioning) and the additional risk management effectiveness on the air and water pathway (if relevant) are added to each other. Thus the treatment process is considered as a whole, since usually a registrant or a downstream user will not be in the position to include any specific advice or assumptions regarding risk management at waste treatment sites. Also, the exposure scenarios communicated to the downstream user does not need to contain information on exposure estimates related to the waste treatment process, since scaling and/or feedback to the registrant via the supply chain is not to be expected[163].

[163] As explained in the main text (Section R.18.7), the needs to include information on effectiveness of waste treatments is based on a case by case decision.

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

**Table R.18- 57: Compilation of information and values used for the local assessment**

| | Landfill | Incineration | Paper recycling[164] | Phase separation | Hazardous waste incineration |
|---|---|---|---|---|---|
| Fraction of registration volume per use becoming waste | Use of sealants: 0.05<br>EoL copy paper: 1<br>EoL sealants: 1 | Use of sealants: 0.05<br>EoL copy paper: 1<br>EoL sealants: 1 | 1 | 0.45 | Manufacturing waste: 0.02001<br>Formulation metal working fluids: 0.02001<br>Formulation of sealants: 0.02001<br>Use of metal working fluids: 0.02 + 0.405<br>Use in production of copy paper: 0.15 |
| | Share of registration volume of MCCPs contained in end-of-life articles. Information on amounts used for copy paper and sealants from customers | | 15% of MCCPs used to produce carbonless copy paper (info of customers). The total amount is assumed to end up in waste paper. | 60% of MCCPs used in metal working fluids. 45% disposed of with spent metal working fluid. Information on % of use from customers | Shares of wastes from manufacturing and uses which are disposed of as hazardous wastes |
| Split into different processes | 0.95 | 0.95 | 1 | 1 | 1 |
| | Worst case assumption | | Worst case assumption | Only one waste treatment process applied | Reasonable assumption, information from downstream users |
| $f_{waste}$ used in local release | Use of sealants: 0.0475 | Use of sealants: 0.0475 | 1 | 0.45 | Manufacturing waste: 0.02001<br>Formulation metal working fluids: |

164 Assessment showed no adequate control of risk. This waste treatment option is excluded via communication with extended SDS but the assessment is documented.

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| | Landfill | Incineration | Paper recycling[164] | Phase separation | Hazardous waste incineration |
|---|---|---|---|---|---|
| estimate | EoL copy paper: 0.95<br><br>EoL sealants: 0.95 | EoL copy paper: 0.95<br><br>EoL sealants: 0.95 | | | 0.02001<br><br>Formulation of sealants: 0.02001<br><br>Use of metal working fluids: 0.425<br><br>Use in production of copy paper: 0.15 |
| # of installations | 8400 | 600 | 335 | Not relevant | 115 |
| | Information by DG Env of EC | BREF waste incineration | Communication with CEPI | BREF waste treatment | BREF Waste treatment |
| days | 365 | 330 | 330 | 220 | 330 |
| | Common sense | BREF waste incineration | Communication with CEPI | BREF waste treatment | BREF Waste treatment |
| Type of use | WD | WD | WD | IND | IND (DU waste as WD) |
| $Q_{max}$ | Use of sealants: 0.418<br><br>EoL copy paper: 5.02<br><br>EoL sealants: 8.36 | Use of sealants: 7.773<br><br>EoL copy paper: 93.273<br><br>EoL sealants: 155.454 | 2.45 | 3313.64 | Manufacturing waste: 163.64<br><br>Formulation metal working fluids: 98.23<br><br>Formulation of sealants: 40.9<br><br>Use of metal working fluids: 2086.36<br><br>Use in production of copy paper: 184.09 |
| | $Q_{max}$ [kg/d] = (Q [t/a] * $f_{waste}$* 1000 * DF) / $T_{emission}$ | | | | $Q_{max}$ [kg/d] = (Q [t/a] * $f_{waste}$* 1000 * DF) / $T_{emission}$ |

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| | Landfill | Incineration | Paper recycling[164] | Phase separation | Hazardous waste incineration |
|---|---|---|---|---|---|
| | | | | | $Q_{max}$ [kg/d] = (Q [t/a] * $f_{waste}$* 1000 * 1) / $T_{emission}$ |
| $RF_{water}$ | 0.00824 | 0.0000285 | 0.081850752 | 0.001816 | c.f incineration |
| | $RF_{water,initial}$ = 0.0908: modelled using simple treat; efficacy of onsite WWTP = 90.92%, also based on simple treat<br><br>Discharge directly to surface water for exposure modelling | $RF_{water,initial}$ = 0.000095: high degree of destruction, emissions to air multiplied with efficacy of washer; Efficacy of WWTP = 70% (info by incineration plant).<br><br>Discharge directly to surface water for exposure modelling | $RF_{water,initial}$ = 0.90144 worst case factor of OECD ESD for the deinking process; efficacy of onsite WWTP = 90.92% according to simple treat model<br><br>Discharge directly to surface water for exposure modelling | $RF_{water,initial}$ = 0.0908: simple treat model; efficacy of WWTP on-site = 98%<br><br>Discharge directly to surface water for exposure modelling | c.f incineration |
| $RF_{air}$ | 0.0024 | 0.00005 | 0.00107 | 0.00107 | c.f incineration |
| | $RF_{air,initial}$ = 0.004: ESD plastic additives using vapour pressure; efficacy of treatment 40% (50% capture, 80% destruction). info of equipment manufacturer | $RF_{air,initial}$ = 0.0001: high degree of decomposition, residual release in fly ash Efficacy of washer 95% based on information from waste incineration plant | Simple treat model | Based on simple treat model; no RMMs applied | c.f incineration |
| $RF_{soil}$ | 0 | 0 | 0 | 0 | c.f incineration |
| | No direct emissions occur from the process to soil. | | | | c.f incineration |

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

**Table R.18- 58: Information and values used for the regional assessment**

| | **Landfill** | **Incineration** | **Paper recycling**[165] | **Phase separation** | **Hazardous waste incineration** |
|---|---|---|---|---|---|
| **Fraction of registrants total volume becoming waste** | Use of sealants: 0.0125<br>EoL copy paper: 0.15<br>EoL sealants: 0.25 | Use of sealants: 0.125<br>EoL copy paper: 0.15<br>EoL sealants: 0.25 | 0.15 | 0.27 | Manufacturing waste: 0.02001<br>Formulation metal working fluids: 0.012006<br>Formulation of sealants: 0.000525<br>Use of metal working fluids: 0.012 + 0.246<br>Use in production of copy paper: 0.00225 |
| **Split into different processes** | 0.70 | 0.30 | 1 | 1 | 1 |
| | Worst case assumption | | Worst case assumption | Only one waste treatment process applied | Reasonable assumption, information from downstream users |
| **$f_{waste}$ used in regional release estimate** | 0.2887 | 0.1234 | 0.15 | 0.45 | 0.292 |
| **Type of use** | WD | WD | WD | IND | IND (DU waste as WD) |
| **Regional $Q_{max}$ (t/y)** | 77.963 | 33.413 | 2.45 | 20.257 | 788.4 |
| | $Q_{max}$ [kg/d] = (Q [t/a] * $f_{waste}$* 0.1) | | | | $Q_{max}$ [kg/d] = (Q [t/a] * $f_{waste}$* 1) |
| **$RF_{water}$** | 0.00824 | 0.0000285 | 0.081850752 | 0.001816 | c.f incineration |
| **$RF_{air}$** | 0.0024 | 0.00005 | 0.00107 | 0.00107 | c.f incineration |
| **$RF_{soil}$** | 0 | 0 | 0 | 0 | c.f incineration |
| | No direct emissions occur from the process to soil. | | | | c.f incineration |

[165] Assessment showed no adequate control of risk. This waste treatment option is excluded via communication with extended SDS but the assessment is documented.

## 9 Documentation in the registration dossier – Section 3.6

MCCPs are used in industrial and professional applications. Consumers normally don't use any MCCP containing mixtures. End-of-life articles containing MCCPs are sealants and carbonless copy paper. Carbonless copy paper is normally used in the context of work activities but may also be used by consumers.

The following tables include the information that may be presented in section 3.6 of IUCLID and possibly also under section 2 (manufacture and use) of the CSR.

**Table R.18- 59: Waste types, amounts and waste treatment processes for MCCPs from manufacturing**

| Waste from | Type of waste | Amount [t/a] | MCCP content | Recycling | Information source |
|---|---|---|---|---|---|
| Manufacture | Solid: production rests, off-specifications, cleaning materials | 54 | . 80% | No recycling | In-house (waste documentation) |
| | Solid: Air filters | 0.0027 | 75% | No recycling | |

**Table R.18- 60: Waste types, amounts and waste treatment processes for MCCPs from identified uses**

| Waste from | Type of waste | Amounts [t/a] | MCCP content [%] | Waste process | Information source |
|---|---|---|---|---|---|
| Formulation (metal working fluids) | Solid / liquid: rests, off-specifications, packaging | 32.4 | . 30 | HW incineration | DU, waste documentation |
| | Solid: Air filters | 0.016 | 40 | HW incineration | |
| Formulation of sealants | Solid / liquid: rests, off-specifications, packaging | 13.5 | . 5 | HW incineration | DU, waste documentation |
| | Solid: Absorbers | 0.00675 | . 15 | HW incineration | |
| Use of metal working fluids | Solid: Air filters, "empty packaging" | 32.4 | 2 | HW incineration | DU, waste documentation |
| | oil phase from separation process | 663.39 | 2 | HW incineration | |
| Waste from | Type of waste | Amounts [t/a] | MCCP content [%] | Waste process | Information source |

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| Waste from | Type of waste | Amounts [t/a] | MCCP content [%] | Waste process | Information source |
|---|---|---|---|---|---|
| | Liquid: Spent metal working fluids | 729 | 40 | Emulsion splitting | SDS, confirmation by DU |
| | Spent fluids contaminating metal swarf/scrap[166] | 1522 | 1 | Metal recycling | Assumption |
| Use of sealants | Solid: rests of sealants, packaging", other wastes | 33.75 | . 5 | Landfill, incineration | Several customers |
| Use for production of copy paper | Liquid: production rests, cleaning processes | 6.75 | 1 | Landfill, incineration | Info by customer |

### Wastes from end-of-life articles

**Table R.18- 61: Waste types from the service life stage subsequent to the identified uses of MCCP**

| Waste from | Type of waste | Amount [t/a] | MCCP content [%] | Waste treatment process / recycling | Information source |
|---|---|---|---|---|---|
| end of service life copy paper | Solid: Used carbonless copy paper | 405 | 0.01 | Landfill, Incineration[167] | Common sense |
| End of service life sealants | Construction and building material wastes | 675 | 1-5 | Landfill, Incineration<br>Recycling as construction waste is unlikely. | |

## 10 Documentation in the CSRs Section 9 (exposure assessment)

### 10.1 Section 9: Exposure assessment[168]

In the following sections, the relevant parts of the exposure scenarios for the identified uses are provided, including information to be inserted regarding waste treatment. Sections of the ESs which are not provided here do not contain waste specific information.

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166 From the use as metal working fluids, wastes of metal scrap contaminated with MCCPs occur, which are assumed as the amount NOT disposed of as liquid wastes. Recovery of MCCPs is normally not performed, as the metal swarf would have to be stripped.

167 Recycling of carbonless copy paper is excluded because respective information is communicated with the extended SDS/ES.

168 In this example, only a release estimate has been performed. Therefore, no exposure levels and risk characterization rations are provided.

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

### 10.2.1 Exposure scenario sections for formulation stage (metal working fluids and sealants)

| **2.2 Control of environmental exposure** |
|---|
| **Organizational measures to prevent/limit release from site** |
| *MCCP containing residues, including spills and contaminants on the floor, are to be collected as hazardous waste in appropriate containers.* |
| **Conditions and measures related to external treatment of waste for disposal** |
| ***Fraction of daily/annual use expected in waste**: 0.02*<br>***Appropriate waste codes for wastes from formulation processes:** Organic halogenated solvents, washing liquids and mother liquors 07 07 03*; halogenated filter cakes and spent absorbents 07 07 09*; packaging containing residues of or contaminated by dangerous substances 15 01 10**<br>***Appropriate waste codes for wastes from formulation of sealants:** Waste adhesives and sealants containing organic solvents or other dangerous substances 08 04 09*; adhesive and sealant sludge containing organic solvents or other dangerous substances 08 04 11*; halogenated filter cakes and spent absorbents 07 07 09*; mineral-based non-chlorinated engine, gear and lubricating oils 13 02 05*, other emulsions 13 08 02*;, packaging containing residues of or contaminated by dangerous substances 15 01 10**<br>***Suitable disposal**: Keep separate and dispose of to hazardous waste incineration operated according to Council Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Available Techniques for Waste Incineration of August 2006* |
| **Conditions and measures related to external recovery of waste** |
| *No recovery of MCCPs should be performed.* |

### 10.2.2 Exposure scenario section for use of MCCP in metal working fluids

| **2.2 Control of environmental exposure** |
|---|
| **Organizational measures to prevent/limit release from site** |
| *Spent metal working fluids and contaminated swarf/scrap should be collected separately as hazardous wastes in suitable containers. Any release to the floor, water and soil is to be prevented.* |
| **Conditions and measures related to external treatment of waste for disposal** |
| ***Fraction of daily/annual use expected in waste**: up to 0.45 in collectable fluids; up to 0.94 in metal sward/scrap*<br>***Appropriate waste codes**: mineral-based machining oils containing halogens (except emulsions and solutions) 12 01 06*machining emulsions and solutions containing halogens 12 01 08*; machining sludge containing dangerous substances; 12 01 14* spent grinding bodies and grinding materials containing dangerous substances 12 01 20*; chlorinated emulsions 13 01 04*; 19 08 13 sludge containing dangerous substances from other treatment of industrial waste water.*<br>***Suitable disposal**: Keep collectable fluids separate and dispose of as hazardous waste to emulsion treatment operated according to the Reference Document on Best Available Techniques for the Waste Treatments Industries August 2006.The treatment installations are assumed to have an on-site wastewater treatment plant with an effectiveness of at least 98% regarding the removal of MCCPs from the water phase. The waste water treatment sludge is to be disposed of to hazardous waste incineration.*<br>*The oil fraction is to be disposed of via hazardous waste incineration operated according to Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Available Techniques for Waste Incineration of August 2006. The waste service provider is to be informed about the chlorine content of the oil waste Metals are to be removed from spent metal working fluids before incineration. ..*<br>*Assumed effectiveness overall regarding prevention of emission from separation of emulsifiable metal cutting fluids:* |

| |
|---|
| *to air > 99.9% water > 99.8%*<br>*Store and transport contaminated swarf or metal sludge in tightly closed containers. Treat the swarf/scrap in secondary metallurgy (metal recycling). A separation of the metal cutting fluids by e.g. centrifugation may be necessary. The waste service provider is to be informed about the chlorine content of the waste.*<br>*Assumed effectiveness regarding prevention of emission from metallurgy: to air > …. %, to water > …… %*<br>*Wastes from onsite risk management measures are to be disposed of to hazardous waste incineration plants as hazardous wastes. Sludge from on-site wastewater treatment plants is to be incinerated.* |
| **Conditions and measures related to external recovery of waste** |
| *MCCPs should not be recovered from spent metal working fluids.* |

### 10.2.3 Exposure scenario section for use of MCPP in sealants

| **2.2 Control of environmental exposure** |
|---|
| **Organizational measures to prevent/limit release from site** |
| *Wastes from used sealants and empty packaging may be disposed of as municipal wastes.* |
| **Conditions and measures related to external treatment of waste for disposal** |
| ***Fraction of daily/annual use expected in waste****: up to 0.05*<br>***Appropriate waste codes****: 15 01 02 plastic packaging, 15 01 04 metallic packaging, 17 01 07 mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06*<br>***Suitable disposal:*** *Rests from the use of sealants are usually hardened and therefore can be disposed of as municipal wastes. No specific measures need to be implemented to ensure adequate control of risks. Disposal of wastes could be via incineration (operated according to Directive 2000/76/EC on the incineration of waste) or landfilling (operated according to the Reference Document on the Best Available Techniques for Waste Treatment Industries of August 2006).* |
| **Conditions and measures related to external recovery of waste** |
| *Sealants (used, packaging, non-used rests) should not be submitted to any recycling processes.* |

### 10.2.4 Exposure scenario section for use of MCCPs for production of carbonless copy paper

| **2.2 Control of environmental exposure** |
|---|
| **Organizational measures to prevent/limit release from site** |
| *Rests of MCCPs, empty packaging and wastes from risk management measures should be collected separately and disposed of as hazardous waste to respective incineration plants.* |

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

| **Conditions and measures related to external treatment of waste for disposal** |
|---|
| ***Fraction of daily/annual use expected in waste****: up to 0.5*<br>***Appropriate waste codes****: paper and cardboard 20 01 01*<br>***Suitable disposal:*** *Carbonless copy paper can be disposed of to municipal waste according to Directive 2000/76/EC on the incineration of waste.* |
| **Conditions and measures related to external recovery of waste** |
| *Carbonless copy paper (off-specifications) are not to be entered to any paper recycling waste streams* |

### 10.2.5 Exposure scenario section for handling of carbonless copy paper (workes and consumers)

| **2.2 Control of environmental exposure** |
|---|
| **Conditions and measures related to disposal of articles at end of service life** |
| *Used carbonless copy paper should not be disposed to recycling processes. Disposal as municipal waste ensures adequate control of risks.* |
| **Conditions and measures related to recovery of articles at the end of service life** |
| ***Fraction of daily use expected in waste****: up to 1*<br><br>***Appropriate waste codes****: paper and cardboard 20 01 01*<br><br>*The following sentence is to be communicated with any carbonless copy paper placed on the market: "Carbonless copy paper must not be disposed of as waste paper for recycling. Dispose of with municipal waste!"*<br><br>*Waste carbonless copy paper should be disposed of as municipal waste. Disposal of waste could be via incineration (operated according to Directive 2000/76/EC on the incineration of waste) or landfilling (operated according to the Reference Document on the Best Available Techniques for Waste Treatment Industries of August 2006).* |

## 11. Information to include in the extended SDS for MCCP

Parts of the information documented in the CSR is also to be communicated to downstream users, in Section 13 of the extended SDS and/or in the exposure scenarios attached to the extended SDS: Suitable or required waste treatment techniques, and in specific cases also the required effectiveness of such waste treatment. It may be considered desirable to specify the suitable waste codes. Also, certain properties of the waste which may pose a particular risk based on qualitative considerations should be communicated (e.g. chlorine content).

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

The following list of information is *not* expressed in standard phrases as may need to be developed for standardised communication.

**SECTION 13: Disposal considerations (Sub-section 13.1 "Waste treatment methods")**

MCCP-containing wastes from use of MCCPs as such or in mixtures, are to be collected separately and to be treated as hazardous wastes. Waste from end of service life articles containing MCCP (carbonless paper and sealants) is to be treated as municipal waste.

Waste from formulation of sealants, metal working fluids and carbonless copy paper and comparable waste is to be disposed of to hazardous waste incineration operated according to Council Directive 91/689/EEC of 12 December 1991 on hazardous waste and Directive 2000/76/EC on the incineration of waste.

Suitable waste codes:

- Organic halogenated solvents, washing liquids and mother liquors 07 07 03*
- halogenated filter cakes and spent absorbents 07 07 09*
- packaging containing residues of or contaminated by dangerous substances 15 01 10*
- waste adhesives and sealants containing organic solvents or other dangerous substances 08 04 09
- adhesive and sealant sludges containing organic solvents or other dangerous substances 08 04 11
- mineral-based non-chlorinated engine, gear and lubricating oils 13 02 05*
- other emulsions 13 08 02*

MCCP in spent metal working fluids are to be treated by phase separation (emulsion treatment) in authorized installations only, operating according to the standard laid down in BREF on waste treatment industry. The overall effectiveness of the treatment regarding releases to water should be not less than 99.8%. The oil phase is to be disposed of by hazardous waste incineration meeting the standard as laid down in Directive 2008/98/EC on waste and Directive 2000/76/EC on the incineration of waste..The waste service provider is to be informed about the chlorine content of the waste.

Suitable waste codes:

- mineral-based machining oils containing halogens (except emulsions and solutions) 12 01 06
- machining emulsions and solutions containing halogens 12 01 08
- machining sludge containing dangerous substances 12 01 14
- chlorinated emulsions 13 01 04

MCCP-contaminated metal swarf/scrap from the use of metal cutting fluids should either be disposed of to metal recycling (secondary metallurgy) or to thermal treatment techniques for hazardous wastes (incineration or co-incineration), depending on the particle size and emulsion content in the waste. The waste service provider is to be informed about the chlorine content of the waste.

## Appendix R.18- 6: Exemplification of exposure assessment of the life waste cycle stage for MCCPS

Suitable waste codes:

- spent grinding bodies and grinding materials containing dangerous substances 12 01 20

Carbonless copy paper must be disposed of as municipal waste and any recycling is to be prevented. Respective information is to be forwarded with the carbonless copy paper.

Suitable waste codes:

- paper and cardboard 20 01 01

Wastes from used sealants and empty packaging may be disposed of to municipal waste incineration. Disposal of wastes could be via landfilling.

Suitable waste codes

- 15 01 02 plastic packaging,
- 15 01 04 metallic packaging,
- 17 01 07 mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06.

**References**

EU Risk assessment report: ALKANES, C10-13, CHLORO, Final report, October 1999, United Kingdom

OECD ESD on lubricants

European Commission: UPDATED RISK ASSESSMENT OF ALKANES, C14-17, CHLORO (MEDIUM-CHAIN CHLORINATED PARAFFINS), R331_0807_env, Draft of August 200

# APPENDIX R.18- 7: EXEMPLIFICATION OF EXPOSURE ASSESSMENT OF THE LIFE WASTE CYCLE STAGE FOR PLASTIC ADDITIVE

## General approach of exemplification

The example has been developed based on information provided by PEST project[169] and the method for release estimation for the waste stage as suggested in this guidance. Exposure scenarios and corresponding releases have not been estimated for all, but only selected identified uses and waste treatment processes. Please note:

- This selection did not follow a systematic assessment regarding the relevance of the waste life stage.
- The calculation of releases to the environment is largely standardised and relies only on a few case-specific parameters. Thus the waste-stage related assessment process can be largely automated in future.

No exposure estimation and risk characterisation is illustrated for this example.

## 1. Substance information

The substance information is extracted from the extended SDS of HALS-1[170] provided by Ciba.

**Table R.18- 62: Preliminary PNECs and DNELs for the risk characterisation**

| | | |
|---|---|---|
| $DNEL_{long\text{-}term,\ inhalation,\ consumer}$ | $mg/m^3$ | 1.4 |
| $DNEL_{long\ term,\ oral,\ systemic,consumer}$ | mg/kgbw/d | 0.4 |
| $PNEC_{,water}$ | µg/l | 38 |
| $PNEC_{soil}$ | mg/kg | 5.9 |
| $PNEC_{sediment}$ | mg/kg | 4.69 |

[169] Plastic Exposure Scenario Team. The project is association-based and all the actors of the plastic supply chain are represented. It has established a platform to collect information on OC and RMM for processes of plastic industries.

[170] Zweifel, H.; Editor, Plastics Additives Handbook, 5th Edition. 2001 p. 123.

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

### Table R.18- 63: Substance information on HALS

| Property | Unit | HALS-1 |
|---|---|---|
| Substance name | | bis(2,2,6,6-tetramethyl-4-piperidyl)sebacate |
| CAS No | | 52829-07-9 |
| EINECS No | | 258-207-9 |
| Classification according to DSD | | Xi; R 36<br>N; 51/53 |
| Labelling according to DSD | | Xi; N<br>R: 36-51/53 |
| Classification according to the CLP Regulation | | Eye Irrit. 2 – H319<br>Aquatic Chronic 2 – H411 |
| Labelling according to the CLP Regulation | | GHS07, GHS09; Wng; H319, H411 |
| Molecular weight | g/mol | 480.7 |
| Decomposition temperature | °C | > 350 |
| Melting point | °C | 81-85 |
| Vapour pressure | Pa (20°C) | 0.000000013 |
| Density | $g/cm^3$ (20°C) | 1.05 |
| Water solubility | mg/l (20°C) | 18.8 |
| Log Kow | | 3.24 (Log Dow at pH 7) |
| Henry's Law constant | $Pa*m^3/mol$ | $3.32 * 10^{-7}$ |
| BCF | [l/kg] | 113 (at pH 7) (calculated) |
| Koc values | | 1000 – 16000 |
| Hydrolysis | | Yes, no formation of PBT-like metabolites |
| Photo-stability | | Unstable in the atmosphere |
| Acute oral toxicity | mg/kg | > 2000 |
| Acute inhalation toxicity | $mg/cm^3$ | > 960 |
| Acute toxicity rainbow trout | mg/l | 13 |
| Acute toxicity daphnia | mg/l | 17 |
| Acute toxicity algae | mg/l | 1.9 |
| Sewage sludge (3h/LC50) | mg/l | > 100 |
| Biodegradation (half-lives) | D | Inherently biodegradable[171] (10°C: 162-220; 20°C: 59-86) |

171 Calculated half-life due to hydrolysis (highest value selected for lowest pH-value).

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

### 2. Relevance of wastes streams – scope of the assessment

HALS-1 is contained in polymer compounds in maximum concentrations of 0.5%. The lowest applicable concentration limit of Article 3(3) of the Mixtures Directive is 0.1%. This means that the entire life-cycle of HALS-1 should be assessed, including article service life and waste.

The life-cycle of HALS-1 includes manufacture, formulation (compounding and formulation of master batches), industrial use and the service life of articles. At all of these stages, wastes are produced for which risks are to be assessed. Waste from end-of-life articles constitutes the largest amount of HALS-1 in wastes.

Plastics are frequently recycled and HALS-1 may be recovered during these processes inside its polymer matrix. As the life-cycle of HALS-1 is interrupted by its becoming waste, any recycling process marks the start of a new life-cycle. Hence, no wastes from the recycled HALS-1 or the products containing recycled HALS-1 need to be assessed.

According to the current Chapter R.16[172] of the Guidance on IR/CSA releases of substances from waste should be projected into the year of marketing, assuming steady-state.

### 3. Derivation of main waste streams

HALS-1 is used as stabiliser preventing oxidative degradation of plastics (antioxidant). As oxidative degradation is triggered by light, the substance is a typical “light stabilizer”.

The registrant manufactures 10,000 t/a of HALS-1.

HALS-1 is used in practically all thermoplastics. A minor part goes into thermosetting resins (polyurethanes and unsaturated polyester resins). Thus, the substance can be present in practically all article categories, except food contact materials. HALS-1 does not chemically bind to the matrix but is physically bound into the plastic material. In the course of the mechanisms that give the stabilizing effects the substance undergoes chemical reactions yielding decreasing concentrations of the parent substance.

In Table R.18- 64 the waste types generated at each lifecycle stage are provided. Generic default values are used for the amounts of waste generated at each life-cycle stage.

**Table R.18- 64: Waste types, amounts and waste treatment processes for HALS-1**

| Origin of Waste | Use amount[173] (t/a) | Type of waste | Fraction of used amount as waste | Total amount [t/a] | Type of use | Waste process (destination) | Information source | Fraction of the use amount as waste entering WTP |
|---|---|---|---|---|---|---|---|---|
| Manufacture | 10,000 | Solid: production rests, off-specifications. | 4 %<br>1 % | 400.00<br>100.00 | IND | HW incineration | In-house (waste documentation | $f_{waste\_HW\_incineration} = 0.050$ |

[172] “Environmental exposure estimation”; see ECHA Guidance documents web page.

[173] The amounts lost to waste from each of the previous lifecycle stages are subtracted from the amount used in the subsequent stage. Due to lack of information on losses to the environment during use, these amounts could not be subtracted.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Solid: Air filters, cleaning materials | | | | | ) | |
| Formulation (master batch) | 9,500 | Solid / liquid: rests, off-specifications[174], packaging. air filters | 2.5 % | 237.50 | IND | HW incineration | Assumption based on defaults of guidance | $f_{waste\_HW\_incineration} = 0.025$ |
| Formulation (compound) | 9,262.5 | Residues from formulation. off-specifications[174], wastes from cleaning, wastes from risk management measures | 1.25 % | 115.78 | IND | HW incineration | Assumption based on defaults of guidance | $f_{waste\_HW\_incineration} = 0.0125$ |
| Conversion | 9,146.72 | Residues from conversion. off-specifications[174] | 1 % | 91.47 | WD | MW | Assumption based on defaults of guidance | $f_{waste\_MW\_total} = 0.01$ |
| | | Solid: Air filters, “empty packaging”. wastes from cleaning | 0.25 % | 22.87 | IND | HW incineration | Assumption based on defaults of guidance | $f_{waste\_HW\_incineration} = 0.0025$ |
| Plastic articles (EoL) | 9,032.38 | Wastes from end-of-life articles. Relevant is AC 13. but also other ACs could apply | 100 % | 9032.38 | WD | MW | 100% of all plastics containing articles assumed to end up as MW | $f_{waste\_MW\_total} = 1$ |

## 4. Consideration on the type of assessment

For all the considered waste treatment processes the release estimation has been exemplified using the suggested values in order to illustrate how the guidance’s approach can be applied. Nevertheless, as explained in the guidance, case by case conclusions need to be reached in order to decide whether a quantitative exposure estimate and risk characterization is needed or whether a qualitative assessment is more appropriate.

For incineration and landfill well defined EU standards exist, and a qualitative assessment may be more suitable to support the conclusion on the waste treatment. Thus the approach described below may need to be replaced by qualitative argumentations.

For construction waste, recycling and separation scenarios a quantitative assessment should be performed because EU standards are not available, or the characteristics of the process require a quantitative exposure assessment to be carried out.

## 5. Refinement of $f_{waste}$ for municipal waste

In the above table, no differentiation has been made yet for municipal waste and recycling wastes. However, HALS-1 is used in plastics, which are assumed to enter the recycling waste stream.

[174] On-site recycling is not assessed; it should be covered by the assessment of the use.

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

According to the figures provided in the main text, the recycling rates range from 8% (Baltic States) to 35% (Germany). The derivation of fractions as waste has been performed according to the following:

The maximum fraction entering recycling processes is 35%. The minimum fraction being recycled is 8%, which is subtracted from the municipal waste stream. Both assumptions relate to the local assessment and reflect the worst case for either waste stream / waste treatment process. Hence for each relevant use the refined faction can be derived as follows:

$$\mathbf{f_{waste,RW}} = f_{waste\_MW\_total} * \max f_{recycled}\ (35\%)$$

$$\mathbf{f_{waste,MW}} = f_{waste,MW,total} * (100\text{-}\min f_{recycled})$$

For the assessment of land-filling and incineration, 95% (default split) of the fraction of municipal waste, leaving out the default share sent to recycling, is used as fraction of waste, as worst case assumption for the local assessment:

$$\mathbf{f_{waste,landfill}} = f_{waste,MW} * \text{default split}$$

$$\mathbf{f_{waste,incineration}} = f_{waste,MW} * \text{default split}$$

Therefore, the fractions of substance per registered use entering a specific waste treatment process to be used for local assessment are listed in Table R.18- 65.

The total amounts and fractions as waste for each type of waste to be used for regional assessment are added up in Table R.18- 66.

**Table R.18- 65: refinement of fractions of registered substance per use entering a specific waste stream**

| Origin of Waste | Total amount [t/a] | Type of use | Waste process (destination) | Refinement of fraction of the use amount as waste entering WTP |
|---|---|---|---|---|
| Manufacture | 500 | IND | HW incineration | $f_{waste\_HW\_incineration}$ = 0.050 |
| Formulation (master batch) | 237.50 | IND | HW incineration | $f_{waste\_HW\_incineration}$ = 0.025 |
| Formulation (compound) | 115.78 | IND | HW incineration | $f_{waste\_HW\_incineration}$ = 0.0125 |
| Conversion | 79.94 | WD | MW incineration | $f_{waste\_MW\_incineration}$ = 0.00874 |
| | 79.94 | WD | MW landfill | $f_{waste\_MW\_landfill}$ = 0.00874 |
| | 32.01 | WD | Recycling | $f_{waste\_RW}$ = 0.0035* |
| | 22.86 | IND | HW incineration | $f_{waste\_HW\_incineration}$ = 0.0025 |
| Plastic articles (EoL) | 7894.3 | WD | MW incineration | $f_{waste\_MW\_incineration}$ = 0.874 |
| | 7894.3 | WD | MW landfill | $f_{waste\_MW\_landfill}$ = 0.874 |
| | 3161.33 | WD | Recycling | $f_{waste\_RW}$ = 0.35* |

* 0.01 of recycling waste could be metals contaminated with HALS-1 and will be specifically assessed: $f_{waste\_RW\_metal}$ = 0.000035 for use "conversion" and $f_{waste\_RW\_metal}$ = 0.0035 for Plastic Articles EoL)

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

**Table R.18- 66: Fraction of substance becoming waste to be used for estimation at regional scale.**

| Type of waste | Wastes considered | Total amount of waste [t/a] | $f_{waste}$ of EU registration amount as waste | Type of use |
|---|---|---|---|---|
| Hazardous waste incineration | Manufacturing, master batch, compound, RMMs conversion | 876 | 0.05 + 0.0237 + 0.0116 + 0.00228 = 0.0876 | IND |
| Municipal Waste | Conversion, EoL plastic articles | 3535 | 0.00914 + 0.903 = 0.912 | WD |
| Metal recycling | Conversion, EoL plastic articles | 31.9 | 0.00316 + 0.000032 = 0.00319 | WD |

### 6. Equations used for estimating releases

Equation 1 is used to estimate the maximum amount of the substance treated in a waste treatment facility at local scale.

Equation 4: Derivation of $Q_{max}$ at local scale

$$Q_{max,process}\ [kg/d] = (Q\ [t/a] * f_{waste} * 1000 * DF) / T_{emission}$$

$Q_{max,process}$ = maximum treated amount per day in a specific waste treatment process expressed as kg of the substance contained in waste per day

Q = total registration volume [t/a] per use.

$f_{waste}$ = fraction of the registration volume of the substance becoming waste that is treated by the waste treatment process for which the assessment is carried out. These values are derived in Table R.18-65

DF = Factor of dispersiveness. This factor is used to take account of the type of use of the substance, which could either be industrial or dispersive. The types of use assumed in the assessment are indicated in Table R.18- 64

.

The factor DF is 1 for all industrial settings (assumption that the total amount of wastes generated is treated in one site).

The factor DF is 0.002 for all dispersive uses[175] (assumption that the waste treatment processes are distributed over a larger area than the local town). An appropriate concentration factor may need to be applied to address the concentration of the waste treated in a specific WTP[176].

$T_{emission}$ = days of operation of the waste treatment facility. This information is taken from Table R.18- 21.

Equation 2 is used to estimate the maximum amount of the substance contained in waste treated at regional scale per year. It is assumed that 100% of the waste from industrial settings and 10% of wastes from dispersive uses is treated in the region.

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[175] The assumptions are the same as used in Chapter R.16 of the Guidance on IR/CSA and are explained in the Appendix R.18-4.

[176] Refer to Appendix R.18-4 and Table R.18- 21 where concentration factors are suggested and explained.

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

Equation 5: Derivation of $Q_{max}$ at regional scale

$$Q_{max,regional,ind} = Q * f_{waste} * 1$$

$$Q_{max,regional,DW} = Q * f_{waste} * 0.1$$

| | |
|---|---|
| $Q_{max,regional,ind}$ = | maximum amount of the substance contained in waste from industrial uses treated in specific waste treatment processes at regional scale [t/a] |
| $Q_{max,regional,WD}$ = | maximum amount of the substance contained in waste from dispersive uses treated in specific waste treatment processes at regional scale [t/a] |
| Q = | registration volume expressed in [t/a] |
| $f_{waste}$ = | fraction of the substance used in the industrial or dispersive uses becoming waste |

Equation 3 is used to estimate releases from waste treatment processes at local or regional scale.

Equation 6: Derivation of local releases

$$E_{env} = Q_{max} * F_{env}$$

| | |
|---|---|
| $E_{env}$ = | Released amount of the substance from the waste treatment process to the local environment [kg/d] or regional environment [t/a]. Indices according to receiving media = water, air and soil |
| $Q_{max}$= | Maximum amount of the substance contained in waste being treated in the waste treatment process; [kg/d] for local scale and [t/a] for regional scale. |
| $F_{env}$ = | Release factor specifying the fraction of the substance entering the waste treatment process that is released to the environment. Releases occur to water, air and soil and are indicated by respective indices. Emission factors are the same for the local and regional assessment. |

## 7. Information for release estimation

HALS-1 is used as a stabiliser in different types of plastics, which are used in different applications, excluding food contact materials. All applications involve the production of articles. Wastes from these articles are assumed to be disposed of as municipal waste. The municipal waste has been split in the assessment between a) waste for final disposal / thermal recovery and b) waste for recycling. In the following, the local and regional release estimate from these processes is exemplified for the municipal waste streams for each relevant use. The respective fractions of waste at local scale are derived in Table R.18- 65. The fractions as waste applied for the regional assessment are derived in the respective sub-chapters.

### 7.1 Landfill[177]

[177] The assessor may come to the conclusion that a qualitative assessment is sufficient or even more appropriate. Such qualitative assessment would take into account: Fraction of the total HALS-1 mass-flow ending up in

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

HALS-1 containing waste is assumed to be disposed of without further treatment in municipal waste landfills.

### 7.1.1 Derivation of input amount to the landfill ($Q_{max}$) – local scenario

For the release estimate from landfills wide dispersive use is assumed due to the substance being included in articles and the dispersive waste treatment infrastructure. A fraction of 0.002 of the regional amount per use is assumed to fully or partly enter into waste at local scale. In order to address the concentration of the substance in the waste treatment installation, a factor of 2.38 has been suggested and will be applied[178]..

$$Q_{max,local,landfill}\ [kg/d] = (Q_{use} * f_{waste\_landfill} * 1000 * 0.002 * 2.38) / 365$$

**Table R.18- 67: Calculation of maximum amount of substance treated per day at site.**

| Use | Total tonnage of registrant per use (t/y) | fwaste_MW_landfill | Qmax,local (kg/d) |
|---|---|---|---|
| Conversion | 9146.76 | 0.0087 | 1.038 |
| Plastic articles (EoL) | 9032.38 | 0.874 | 102.95 |

### 7.1.2 Derivation of input amount to landfill ($Q_{max}$) – regional scenario

For the regional assessment it is assumed that 20% of HALS-1 containing waste is sorted out and submitted to recycling. Of the remaining 80% of the municipal waste stream 70% is assumed to be landfilled and 30% is assumed to be incinerated (→ $f_{waste,MW,landfill} = 0.5108$). This assumption is regarded as worst case, as probably a higher share of municipal waste is incinerated and because the release rates from the landfill are higher than from incineration. The resulting maximum amount treated by landfilling is:

$$\mathbf{Q_{max,regional,landfill}} = 10{,}000 * 0.91239 * 0.20 * 0.70 * 0.1 = \mathbf{510\ [t/a]}$$

### 7.1.3 Derivation of release factor from landfill to air

The release factor to air is derived from the OECD ESD for plastic additives. Here, the release rate is specified as: $\mathbf{RF_{air,initial} = 0.005}$. This release factor constitutes the initial release.

In compliant landfills, landfill gas is to be captured and treated. It is assumed that 50% of the landfill gas is captured and that the efficacy of removal of MCCPs from landfill gas is 50%.

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landfills, conclusions regarding the PBT/vPvB status of HALS-1, behaviour of HALS-1 under landfill-conditions (based on water solubility, type of article-matrix containing HALS-1, adsorption behaviour, vapour pressure and degradability).

[178] For a full explanation refer to Chapter R.16 and APPENDIX R.18-4.

Hence, the efficacy of the risk management measures at the landfill is 25%, resulting in a release factor of $\mathbf{RF_{RMM}= 0.75}$.

The initial release factor is multiplied by the release factor from the landfill gas treatment device to derive the final release rate for MCCPs from landfills to air:

$$\boldsymbol{RF_{air}} = RF_{air,initial} * RF_{RMM} = 0.005 * 0.75 = \mathbf{0.00375}$$

### 7.1.4 Derivation of release factor from landfill to water

The release factor to landfill leachate could be obtained from the OECD document by multiplying losses during service life with 20 years of assumed duration of service life. The resulting value of 0.032 cannot be exchanged for another based on the OECD ESD. However, the same document states that emissions to air and leaching are likely to be "negligible" and emission factors are 0.

The long-term behaviour of antioxidants in plastics upon landfill has been assessed in more detail[179]. The model is based on the correlation of measured concentrations of organic pollutants in leachate and water solubility. The discharge of HALS-1 per tonne plastics in the leachate of landfill has been estimated.

Taking this annual discharge and the amount of plastics containing the registered amount of HALS-1, the release fraction to water after onsite treatment is calculated as follows:

Concentration of HALS-1 in plastics:

Typical: 0.15 %

Maximum: 0.5 %

Amount of plastic articles in landfill containing 6,090 t HALS-1(Table R.18- 64):

Typical: 4,060,000 t

Minimum: 1,218,000 t

Discharge of HALS-1 in the leachate of landfill:

Per 1 t plastics (conservative estimation): 0.420 mg/a

Per 1 t plastics (corrected by using measured 0.0007 mg/a values of a reference substance):

Total annual discharge of HALS-1 in the leachate of landfill:

Conservative estimation based on 4.1 Mio. t plastics: 1.7220 kg/a

Conservative estimation based on 1.2 Mio. t plastics: 0.5040 kg/a

Corrected estimation based on 4.1 Mio. t plastics: 0.0029 kg/a

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[179] Herrchen, M.; Kördel, W. *Comparative Risk Analysis of Additives (Antioxidants) in Plastics and Their Long-term Behavior Upon Landfilling*; Fraunhofer-Institute for Environmental Chemistry and Ecotoxicology: Schmallenberg, 25. March 1996, 1996; p 123.

Corrected estimation based on 1.2 Mio. t plastics: 0.0008 kg/a

The resulting release factor for HALS-1 based on highest annual discharge value is **$RF_{water}$ = 0.00000028**

Due to the way of deriving the release factor from measured and modelled data, the efficacy of risk management measures (collection of drained leachate, wastewater treatment on-site) are integrated already.

### 7.1.5 Derivation of release factor from landfill to soil

The release rated to soil specified in the OECD ESD for plastic additives (service life, outdoor) is used. No risk management measures are assumed. The release factor to soil is **$RF_{soil}$ = 0.016.**

### 7.1.6 Summary of information on HALS-1 in the landfill

**Table R.18- 68: Information to estimate releases of HALS-1 contained in wastes disposed of in landfills**

| **Parameter** | **Description** | | |
|---|---|---|---|
| Assessed waste treatment process | Landfill for municipal wastes | | |
| Coverage | The processes of transport, interim storage and final disposal of wastes in landfills are covered by the release estimation. Releases from transport and interim storage are regarded as negligible and not estimated separately but are regarded as covered by the conservativeness of the assessment. | | |
| Types of wastes | HALS-1 containing wastes are plastic articles or articles containing plastics | | |
| Assumptions | The landfill is assumed to comply with the Landfill Directive | | |
| Pre-treatment | No specific pre-treatment is applied. | | |
| Physical form | Substances are contained in waste; wastes are mostly solid. There are matrix effects slowing down releases from wastes. | | |
| Operational conditions and risk management measures | The landfill is operated according to good practice and compliant with the requirements of the landfill directive. It has got an artificial bottom liner as well as a top soil layer. Leachate and landfill gas are collected and treated. Surface water runoff is collected and discharged to the sewer. No specific operational conditions or risk management measures exceeding legal requirements / state-of-the-art are assumed. | | |
| Maximum amount treated: Local scenario | Conversion: **1.038 kg/d** | Plastic articles (EoL): **102.95 kg/d** | |
| Maximum amount treated: Regional scenario | **510 t/a** | | |
| Information on installations | Operating days<br>365 d/a | Number of installations 8400 | |
| Collection rate of initial releases | 100% for leachate discharged to the sewage system<br>50% of landfill gas before treatment | | |
| Release factors to air | **$RF_{air,initial}$ = 0.005**<br>Justification: OECD ESD, service life, outdoors over | **$RF_{RMM}$ = 0.75**<br>Justification: 50% collection rate and 50% | **$RF_{air}$ = 0.00375** |

| Parameter | Description | | |
|---|---|---|---|
| | 20 years | destruction by RMM | |
| Release factor to water | **$RF_{water,initial}$ = 0.00000028**<br>Derived value based on model using measured data of related substances | RMM integrated in initial factor | **$RF_{water}$ = 0.00000028** |
| Release factor to soil | **$RF_{soil}$ = 0.016**<br>Justification: OECD ESD (service life, outdoors over 20 years) | | |

### 7.1.7 Release estimation for HALS-1 in landfills

**Table R.18- 69: Summary of release factor for landfill scenario.**

| Modelling | Initial release factor | Release factor of RMM | Total release factor |
|---|---|---|---|
| Release to water | 0.00000028 | - | 0.00000028 |
| Release to air | 0.005 | 0.25 | 0.00375 |
| Release to soil | 0.016 | - | 0.016 |

**Table R.18- 70: Release amounts (kg/d) for HALS-1 in landfill for each relevant use, local scenario**

| | Conversion | Plastic articles (EoL) |
|---|---|---|
| Release to water | 0.000000291 | 0.0002883 |
| Release to air | 0.00389 | 0.3861 |
| Release to soil | 0.01661 | 1.6472 |

**Table R.18- 71: Release estimate for HALS-1 in landfills, regional scenario**

| Modelling | Released amount | Unit |
|---|---|---|
| Release to water | 0.000143 | t/a |
| Release to air | 1.912 | t/a |
| Release to soil | 8.16 | t/a |

## 7.2 Incineration of municipal wastes[180]

End-of-life articles are likely to be disposed of as municipal waste. Municipal wastes may either be disposed of in landfills (c.f. previous chapter) or incinerated (thermal treatment, oxidizing).

Waste incineration facilities are to be operated according to the IPPC directive and should comply with BAT requirements. Normally, emission limit values are set in the permits of these facilities. Exhaust gas is to be treated in order to comply with the air emission limit values. Operating temperatures of 800°C minimum have to be achieved.

### 7.2.1 Derivation of input amount to incineration ($Q_{max}$) - local scenario

For the release estimate from incineration the same two wide dispersive uses considered for landfill will be assessed. Following the same assumptions introduced before[181], a fraction of 0.002 of the regional amount per use is assumed to enter into the waste treatment. Again a further concentration factor needs to be applied. The emission days from the landfills are regarded to be 330[182].

$$Q_{max,local,inc}\ [kg/d] = (Q_{use} * f_{wasteinc} * 1000 * 0.002 * 40) / 330$$

**Table R.18- 72: Calculation of maximum amount of substance treated per day at site.**

| Use | Total tonnage of registrant per use (t/y) | fwaste_MW_incineration | Qmax,local (kg/d) |
|---|---|---|---|
| Conversion | 9146.76 | 0.00874 | 19.38 |
| Plastic articles (EoL) | 9032.38 | 0.874 | 1913.77 |

### 7.2.2 Derivation of input amount to incineration ($Q_{max}$) - regional scenario

For the regional assessment it is assumed that 20% of HALS-1 containing waste is sorted out and submitted to recycling. Of the remaining 80% of the municipal waste stream 70% is assumed to be landfilled and 30% is assumed to be incinerated. The resulting maximum amount treated by landfilling is:

$$Q_{max,incineration} = 10{,}000 * 0.912 * 0.80 * 0.30 * * 0.1 = \mathbf{218.97\ [t/a]}$$

### 7.2.3 Derivation of release factor from incineration to air

[180] The assessor may come to the conclusion that a qualitative assessment is sufficient or even more appropriate. Such assessment would assume that HALS-1 is destroyed in incineration processes operated according to EU standard.

[181] See also MCCPs example (Appendix R.18-6).

[182] See Table R.18-20 in Appendix R.18-4.

The default value of the main text is used as initial release factor to air: $\mathbf{RF_{air,initial}}$ **= 0.0001.**

The fly ash is treated before release to the environment using a wet washer. This is a worst case assumption, because this technology is less efficient than dry treatment techniques and because emissions to water are generated, which lack for dry treatment (c.f. derivation of release factor to water). The efficacy of the washer has been enquired and is approximately 95%. The release factor from treatment is $\mathbf{RF_{RMM}}$ **= 0.05.**

The initial release factor is multiplied by the release factor of the wet washer to derive the final release factor for HALS-1 from incineration plants to air:

$$RF_{air} = RF_{air,initial} * RF_{RMM} = 0.0001 * 0.05 = \mathbf{0.00005}$$

### 7.2.4 Derivation of release factor from incineration to water

According to the distribution scheme of the main text, emissions from incineration plants to water only occur from washing of waste gas: The initial release factor to water is equal to the initial release factor to air multiplied with the efficacy of the risk management measure (wet washer): $\mathbf{RF_{water,initial}}$ = 0.0001 * 0.95 **= 0.000095.**

Treatment of wastewater from washers is state-of-the-art in incineration plants. The filtration effectiveness of the wastewater treatment plant is assumed to be at least as high as for a biological treatment plant. According to simple treat, the average efficacy of the onsite WWTP for HALS-1 based on its PC-properties and degradability is assumed to be 43%. The release factor of MCCPs from the onsite WWTP is therefore: $\mathbf{RF_{RMM}}$ **= 0.57**.

The initial release factor is multiplied by the release factor from the onsite WWTP to derive the final release factor for HALS-1 from incineration plants to water:

$$\mathbf{RF_{water}} = RF_{water,initial} * RF_{RMM} = 0.000095 * 0.57 = \mathbf{0.0000542}$$

### 7.2.5 Derivation of release factor to soil

No emissions to soil are assumed to occur in accordance with the distribution scheme in the main text.

### 7.2.6 Summary of information on HALS-1 in waste incineration

**Table R.18- 73: Information to estimate releases of HALS-1 contained in wastes treated by incineration of MW**

| Parameter | Description |
|---|---|
| Assessed waste treatment process | Municipal waste incineration |
| Coverage | Waste collection, transport, temporary storage, feeding into the furnace and thermal treatment are covered. As HALS-1 is assumed to be destroyed in the plant, no processing of secondary waste is considered. |

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

| Parameter | Description | | |
|---|---|---|---|
| Types of wastes | HALS-1 containing plastic articles or articles with plastic components | | |
| Assumptions | The process is operated according to the legal requirements. | | |
| Pre-treatment | No pre-treatment of wastes, except mechanical reduction of volume and mixing | | |
| Physical form | Contained in solid wastes | | |
| Operational conditions and risk management measures | Storage of waste in closed bunkers, operating temperatures according to waste incineration directive (850 + 1100), furnace is fully closed.<br>The incinerator is equipped with wet flue-gas cleaning (washer) with an efficacy of 95% for HALS-1. | | |
| Information on installations | Operating days<br>330 d/a | Number of plants<br>600 | |
| Maximum amount treated: Local scenario | Conversion: **19.3 kg/d** | Plastic articles (EoL): **1913.77 kg/d** | |
| Maximum amount treated: Regional scenario | **218.97 t/a** | | |
| Collection rate of initial releases | 100% of flue gas enters washer<br>100% of water in washer enters WWTP | | |
| Release factor to air | **$RF_{air,initial}$ = 0.0001**<br>Justification: default value of main text | **$RF_{RMM}$ = 0.05**<br>Justification: efficacy of washer 95% | **$RF_{air}$ = 0.00005** |
| Release factor to water | **$RF_{water,initial}$ = 0.000095**<br>Justification: emissions to air multiplied with efficacy of washer | **$RF_{RMM}$ = 0.57**<br>Justification: average release factor to water in simple treat for substances which are inherently degradable and with a LogKow between 3 and 4 | **$RF_{water}$ = 0.0000542** |
| Release factor to soil | No direct emissions to soil –> 0.0 | | |

**Table R.18- 74: Summary of release factors for municipal incinerator scenario.**

| Modelling | Initial release factor | Release factor of RMM | Total release factor |
|---|---|---|---|
| Release to water | 0.000095 | 0.57 | 0.0000542 |
| Release to air | 0.0001 | 0.05 | 0.00005 |
| Release to soil | 0.0 | - | 0.0 |

**Table R.18- 75: Release amounts (kg/d) for HALS-1 in municipal incinerator for each relevant use, local scenario**

| | Conversion | Plastic articles (EoL) |
|---|---|---|
| Release to water | 0.001046 | 0.1037 |
| Release to air | 0.000965 | 0.0957 |
| Release to soil | 0 | 0 |

**Table R.18- 76: Release estimate for HALS-1 in municipal incineration, regional scenario**

| Modelling | Released amount | Unit |
|---|---|---|
| Release to water | 0.01187 | t/a |
| Release to air | 0.0109 | t/a |
| Release to soil | 0 | t/a |

## 7.3 Recycling waste

### 7.3.1 Exclusion of material recycling processes

The aim of the first step of the assessment is to check, whether all scenarios of material recycling are relevant to show adequate control of risk or if any of the scenarios can be excluded as irrelevant, based on qualitative justification.

**Table R.18- 77: Article categories and waste streams relevant for HALS-1**

| Article category | Argumentation | Relevant? |
|---|---|---|
| AC 1 Vehicles | Plastic materials are contained in vehicles and would, as part of the waste stream ELV, require potentially different material recycling scenarios as part of the light fraction of the shredder. | Yes |
| AC 2 Machinery, mechanical appliances, electrical/electronic articles | Plastic materials are frequently part of machinery and mechanical appliances as housing. As part of the light fraction of the shredder, HALS-1 may enter the respective material recycling processes | Yes |
| AC 3 Electrical batteries and accumulators | Difficult to judge: In general, plastics would not normally be contained in electrical batteries; however could be part of the housing of accumulators (e.g. cars). Hence, exclusion of the waste stream not fully possible | Yes |
| AC 4 Stone, plaster, cement, glass and ceramic articles | Plastic materials and parts are not likely to be attached to the materials of AC 4. Any contents of plastics in these would be negligible as compared to other waste streams. | No |
| AC 7 Metal articles | Plastics could be attached to metal articles (handles, coatings | Potentially |

| Article category | Argumentation | Relevant? |
|---|---|---|
| | etc.) and enter the waste stream as contamination | |
| AC 8 Paper articles | Plastics are not likely to be contained in paper articles | No |
| AC 10 Rubber articles | It is unlikely that HALS-1 containing plastics are contained in rubber articles. However, there is little knowledge of applications related to rubber articles and therefore, the generic assessment should be done. | Potentially |
| AC 13 Plastic articles | This is the main article category and main material recycling process | Yes |

Only the processes "paper recycling" and "road construction" can be excluded based on qualitative argumentation. The waste stream "plastics recycling" is obviously the most relevant one. The waste streams "ELV", "WEEE", "batteries" as well as "metal articles" and "rubber articles" are assessed as it cannot be excluded that plastics would be part of the materials as contaminations in relevant amounts.

### 7.3.2 Assessment if process is already covered earlier in the life cycle

#### Shredding and separation

Any plastic materials undergoing recycling would first be shredded in order to reduce size and perform any separation if necessary. These processes are not covered by a primary production process. If they do not result in the generation of one or several substances as such, in a mixture or in an article that has ceased to be waste.

#### Plastics recycling

HALS-1 is normally added to the polymer at an early life-cycle stage (formulation). Therefore, melting and extruding of HALS-1 is part of the primary production chain and the recycling process should have been assessed by M/I already in the CSA/CSR. The recycling process of plastics material does not differ to the processes conducted in primary production. Frequently the same installations work with primary and waste materials. The risk management measures assumed to be applied in primary production are hence also present in recycling processes. No additional assessment of the plastics recycling is performed, as adequate control of risks has already been shown earlier in the CSA.

#### Rubber recycling

HALS-1 could be contained in plastics attached or included in rubber articles and enter the recycling process as contamination. Rubber recycling only involves a shredding process. As shredding is assessed anyway, no additional scenario needs to be calculated.

#### Metal recycling

Plastics could enter scrap waste as attached to or included in metal articles (coatings, article parts etc.). The process of metal recycling is not part of the primary life cycle of HALS-1 and therefore needs to be assessed.

#### Specific end of life articles

For end-of-life articles, the recycling scenarios include as the first steps, a shredding and separation process. These are assessed for all HALS-1 entering the recycling waste stream.

The fractions separated from these processes are entered into specific recycling processes for the respective materials (metals, plastics). No additional scenarios need to be assessed for this type of article.

## 7.4 Shredding of recycling wastes

### 7.4.1 Derivation of input amount to shredding ($Q_{max}$) – local scenario

For the release estimate from shredding, wide dispersive use is assumed due to the substance being included in articles and the dispersive waste treatment infrastructure. A dispersiveness factor of 0.002 is applied. A concentration factor of 92.5 has been estimated and will be applied. The emission days of the shredders is estimated to be 330.

$$\mathbf{Q_{max,local,landfill}\ [kg/d]} = (Q_{use} * f_{waste\_landfill} * 1000 * 0.002 * 92.5) / 330$$

**Table R.18- 78: Calculation of maximum amount of substance treated per day at site.**

| Use | Total tonnage of registrant per use (t/y) | fwaste_MW_recycling | Qmax,local (kg/d) |
|---|---|---|---|
| Conversion | 9146.76 | 0.0035 | 17.947 |
| Plastic articles (EoL) | 9032.38 | 0.35 | 1772.262 |

### 7.4.2 Derivation of input amount to phase shredding ($Q_{max}$) – regional scenario

For the regional scenario it is assumed that 20% of HALS-1 containing municipal waste is sorted and enters recycling wastes. The fraction as waste at regional scale is $f_{waste,RW,regional}$ = 0.91239 * 0.2 = 0.1825

$$Q_{max,regional,shredding} = 10{,}000 * 0.1825 * 0.1 = \mathbf{182.48\ t/a}$$

### 7.4.3 Derivation of release factor from shredding to air

The initial release factor for HALS-1 from shredding is derived combining the release factor for dust from plastics of (0.1[183]) with the maximum content of HALS-1 in polymers in final articles (0.5%). This results in:

$$RF_{air,initial} = 0.1 * 0.005 = \mathbf{0.0005}$$

It is assumed that an air extraction system and dust filter exists in the shredding installation. 90% of dust emissions are assumed to be captured and the efficacy of the dust filter is assumed

183 The release rate of polymer dust is very conservative. The total loss of material during shredding does probably not exceed 3%. [F. Vadas, D. Nguyen-Ngoc, “Mechanical recycling versus incineration of PVC waste – Greenhouse gas emissions”, PE International for the European Council of Vinyl Manufacturers, Leinfelden, Germany, 2009, p. 19] Dust entering the environment is probably a small fraction of these losses.

to be 95%. This results in an efficacy of the risk management measure of 85.5% and a release factor of $\mathbf{RF_{RMM} = 0.15}$.

The combination of initial release factor and efficacy of the exhaust air treatment results in the total release factor from shredding. This is a conservative assumption, as this factor implies full evaporation of HALS-1 from the polymer dust particles. The release is estimated using

$$RF_{air} = 0.0005 * 0.15 = \mathbf{0.000075}.$$

### 7.4.4 Derivation of release factor from shredding to water

Emissions to water could only occur from shredding via leaching from dust emissions. As a realistic worst case assumption, the final release rate to air (0.000075) is multiplied with the release rate of the OECD ESD for plastic additives (outdoor service life, multiplied with 20 years of lifetime), which is 0.032. This results in $\mathbf{RF_{water,initial}}$ = 0.000075 * 0.032 **= 0.0000024.**

No risk management measures exist for releases to water, hence the initial release factor equals to the final one:

$$RF_{water} = RF_{water,initial} = \mathbf{0.0000024}$$

### 7.4.5 Derivation of release factor from shredding to soil

Release to soil could only occur due to HALS-1 containing dust settling onto soil; hence the derivation of a release factor is analogous as for water: the initial release factor equals that of air emissions via dust and is multiplied with the OECD ESD emission factor to water[184]: $\mathbf{RF_{soil} = 0.0000024}$

### 7.4.6 Summary of information for HALS-1 in shredding

**Table R.18- 79: Information to estimate releases of HALS-1 contained wastes in shredding processes**

| Parameter | Description |
|---|---|
| Assessed waste treatment | Shredding |
| Coverage | Shredding of plastic waste, including transport of waste and interim storage |
| Types of wastes | Plastic wastes from end-of-life articles sorted from municipal waste |
| Assumptions | The shredding process is operated according to the legal requirements and emission limit values are complied with. |
| Pre-treatment | Process is a pre-treatment of wastes |
| Physical form of the substance | Solid, included in polymer matrices |
| Operational | Shredding is carried out in semi-open processes, temperatures are around 20°C, dust formation |

184 There is none for soil during service life.

| Parameter | Description | | |
|---|---|---|---|
| conditions and risk management measures | occurs, no chemicals are added, no water contact occurs<br>A waste gas exhaust installation is assumed to exist with a degree of capture of dusts from shredding of at least 90%. The dust is filtered with an efficacy of 95%. | | |
| Maximum amount treated: Local scenario | Conversion: 17.947 kg/d | Plastic articles (EoL): 1772.262 kg/d | |
| Maximum amount treated: Regional scenario | 182.48 t/a | | |
| Information on the installation | Operating days<br>330 d/a | Number of installations<br>210 | |
| Collection rate of initial releases | 90% of dust in air | | |
| Release factor to air | RFair,initial = 0.0005<br>Justification: release rate of dust multiplied with maximum concentration in polymers | RFRMM = 0.15<br>Justification: 90% collection rate and 95% filtered out. | RFair = 0.000075 |
| Release factor to water | RFwater,initial = 0.0000024<br>Justification: release rate to air multiplied with leaching rate according to OECD ESD | RFRMM = 1<br>No RMMs applied | RFwater = 0.0000024 |
| Release factor to soil | RFwater,initial = 0.0000024<br>Justification: release rate to air multiplied with leaching rate according to OECD ESD | RFRMM = 1<br>No RMMs applied | RFsoil = 0.0000024 |

### 7.4.7 Release estimation for HALS-1 in shredding processes

**Table R.18- 80: Summary of release factors for shredding scenario.**

| Modelling | Initial release factor | Release factor of RMM | Total release factor |
|---|---|---|---|
| Release to water | 0.0000024 | 1 | 0.0000024 |
| Release to air | 0.0005 | 0.15 | 0.000075 |
| Release to soil | 0.0000024 | 1 | 0.0000024 |

**Table R.18- 81: Release amounts (kg/d) for HALS-1 in shredding for each relevant use, local scenario**

| | Conversion | Plastic articles |
|---|---|---|

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

| | | (EoL) |
|---|---|---|
| Release to water | 0.0000431 | 0.004253 |
| Release to air | 0.001346 | 0.133 |
| Release to soil | 0.0000431 | 0.004253 |

**Table R.18- 82: Release estimates for HALS-1 in shredding, regional scenario**

| Modelling | Released amount | Unit |
|---|---|---|
| Release to water | 0.0004379 | t/a |
| Release to air | 0.01369 | t/a |
| Release to soil | 0.0004379 | t/a |

### 7.5 Metal recycling[185]

HALS-1 is regarded as a contamination in metal scrap and the fraction becoming waste is multiplied with 1% to take account for that. The fractions as waste for each relevant use for recycling are therefore multiplied with 0.01 for deriving the amount of HALS-1 potentially entering metal recycling processes as contaminant.

#### 7.5.1 Derivation of input amount to metal recycling ($Q_{max}$) – local scenario

The amount of HALS-1 entering metal recycling processes is assumed as a dispersive use, as wastes from end-of-life articles are considered. The dispersiveness factor of 0.002 is applied and a concentration factor of 86.6 is applied[186]. The number of the operation days of the metal recycling plants are 330 d/a.

$$Q_{max,local,landfill}\ [kg/d] = (Q_{use} * f_{waste\_RW\_metal} * 1000 * 0.002 * 86.6) / 330$$

**Table R.18- 83: Calculation of maximum amount of substance treated per day at site.**

| Use | Total tonnage of registrant per use (t/y) | fwaste_RW_metal | Qmax,local (kg/d) |
|---|---|---|---|
| Conversion | 9146.76 | 0.000035 | 0.168 |
| Plastic articles (EoL) | 9032.38 | 0.0035 | 16.592 |

#### 7.5.2 Derivation of input amount to paper recycling ($Q_{max}$) – regional scenario

185 The assessor may come to the conclusion that a qualitative assessment is sufficient or even more appropriate.

186 See APPENDIX R.18-4 and Table R.18- 21 for more details and derivation of concentration factors.

The maximum amount treated at regional level is calculated with the regional fraction as waste multiplied by 0.1.

$\mathbf{Q}_{\mathbf{max,regional,paper}}$ = 10,000 * 0.00319 * 0.1 **= 3.19 [t/a]**

### 7.5.3 Derivation of release factor from metal recycling to air

The release factor is set to 0.0001 in analogy to the incineration process, as the operational conditions are similar (high temperatures). Waste gas treatment is assumed to have an efficacy for organic substances of at least 70%. Consequently the total release factor to air is $\mathbf{RF_{air}}$ = $RF_{initial}$ * $RF_{RMM}$ = 0.0001 * 0.3 = **0.00003**.

### 7.5.4 Derivation of release factor from metal recycling to water

Normally, no emissions to water would occur, as the recycling process does not involve any water contact. In order to remain conservative and in analogy to the thermal treatment of waste, the release to air is assumed to be treated with a washer and therefore the amount being emitted to water would be 70 % of the initial release to air: $\mathbf{RF_{water,initial}}$ = 0.0001 * 0.7 = **0.00007**

Wastewater from the washer is assumed to be treated at least with an efficacy of 43%, which corresponds to the removal rate from water according to simple treat. $\mathbf{RF_{RMM}}$ **= 0.57**

The resulting release factor to water is $\mathbf{RF_{water}}$= 0.00007 * 0.57 **= 0.0000399**

### 7.5.5 Derivation of release factor from metal recycling to soil

No emissions to soil occur.

### 7.5.6 Summary of information for HALS-1 in metal recycling

**Table R.18- 84: Information to estimate releases of HALS-1 contained in wastes disposed of in metal recycling**

| Parameter | Description | |
|---|---|---|
| Assessed process | Recycling of plastic wastes contaminating metal waste streams | |
| Coverage | Collection, transport, storage, feeding of furnace, melting and production of metals. | |
| Types of wastes | Metal scrap to which plastic parts are attached | |
| Assumptions | The metal recycling process is carried out in accordance with the legal requirements. | |
| Pre-treatment | No pre-sorting occurs at site | |
| Physical form | Substance is part of plastic parts attached to metal destined to be recycled | |
| Operational conditions and risk management measures | Melting of scrap in closed furnace, semi-open feeding of material into it. Operating temperatures above 1000 degrees for longer periods of time.<br>Waste gas is collected and treated with an efficacy of at least 70%. | |
| Maximum amount treated: Local scenario | Conversion: 0.168 kg/d | Plastic articles (EoL): 16.592 kg/d |
| Maximum amount treated: | 3.19 t/y | |

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

| Parameter | Description | | |
|---|---|---|---|
| Regional scenario | | | |
| Information on the installation | Operating days<br>330 d/a | Number of installations<br>231 | |
| Collection rate of initial releases | 100% of waste gas<br>100% of wastewater from washer enters on-site WWTP | | |
| Release factor to air | RFair,initial = 0.0001<br>Justification: analogous to incineration due to high operating temperatures | RFRMM = 0.3<br>Wet washer, efficacy of 70% | RFair = 0.00003 |
| Release factor to water | RFwater,initial = 0.0007<br>Justification: release to waste water from washer | RFRMM = 0.57<br>Justification: simple treat model | RFwater = 0.0000399 |
| Release factor to soil | 0 | | |

### 7.5.6 Release estimation for HALS-1 in metal recycling

**Table R.18- 85: Summary of release factors for metal recycling scenario.**

| Modelling | Initial release factor | Release factor of RMM | Total release factor |
|---|---|---|---|
| Release to water | 0.00007 | 0.57 | 0.0000399 |
| Release to air | 0.0001 | 0.3 | 0.00003 |
| Release to soil | 0.0 | - | 0.0 |

**Table R.18- 86: Release amounts (kg/d) for HALS-1 in metal recycling for each relevant use, local scenario**

| | Conversion | Plastic articles (EoL) |
|---|---|---|
| Release to water | 0.0000067 | 0.000662 |
| Release to air | 0.00000504 | 0.000498 |
| Release to soil | 0.0 | 0.0 |

**Table R.18- 87: Release estimate for HALS-1 in shredding, regional scenario**

| Modelling | Released | Unit |
|---|---|---|

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

| | amount | |
|---|---|---|
| Release to water | 0.0001273 | t/a |
| Release to air | 0.0000957 | t/a |
| Release to soil | 0.0 | t/a |

### 7.6 Hazardous waste incineration[187]

HALS-1 is not contained in any hazardous wastes from consumer mixtures. It may be contained in wastes from risk management measures (e.g. air filters), in contaminated packages and in off-specification batches at all stages of the supply chain. The relevant types of wastes and treatment scenarios are indicated in Table R.18- 88.

**Table R.18- 88: Correlation of PCs and waste treatment processes**

| **Waste treatment or disposal scenario** | **Types of wastes / relevant product categories** |
|---|---|
| Incineration / co-incineration of hazardous wastes | Solid wastes from risk management measures (spent air filters and filter cakes)<br>Contaminated packaging materials, production wastes (remaining residuals in machinery, cleaning wastes)<br>Relevant PCs: PC32 |
| Re-Distillation<br>Silver recovery | No aqueous wastes |
| Chemical physical treatment | No aqueous wastes |

Hazardous wastes related to the supply chain of HALS-1 will enter only the waste disposal route “hazardous waste incineration”. There are no aqueous or liquid wastes, which could possibly be distilled or treated by chemical-physical methods.

#### 7.6.1 Derivation of input amounts to hazardous waste incineration ($Q_{max}$) – Local scenario

Plastics are contained in several types of production wastes from manufacturing, formulation as well as from risk management measures for all of these stages and the conversion step. The hazardous waste incineration needs to be assessed for four identified uses (see Table R.18- 64). Hazardous waste incineration is assumed as industrial use. In the default assessment, it is assumed that the waste from 100% of the regional tonnage for a use is treated in one local waste treatment site.

The number of the operation days of the hazardous waste incineration plants are 330 d/a.

$$Q_{max,local,HWincineration}\ [kg/d] = (Q_{use} * f_{waste\_HW\_incineration} * 1000 * 1) / 330$$

[187] The assessor may come to the conclusion that a qualitative assessment is sufficient or even more appropriate.

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

**Table R.18- 89: Calculation of maximum amount of substance treated per day at site.**

| Use | Total tonnage of registrant per use (t/y) | fwaste_HW_incineration | Qmax,local (kg/d) |
|---|---|---|---|
| Manufacture | 10000 | 0.05 | 1515.151 |
| Formulation (master batch) | 9500 | 0.025 | 719.697 |
| Formulation (compound) | 9032.38 | 0.0125 | 342.136 |
| Conversion | 9146.72 | 0.0025 | 69.293 |

### 7.6.2 Derivation of input amount to hazardous waste incineration ($Q_{max}$) – regional scenario

$Q_{max,regional,HWincineration}$ = 10,000 * 0.0876 * 1 = **876 [t/a]**

### 7.6.3 Derivation of release factors from hazardous waste incineration

The process of hazardous waste incineration is in principle the same as for municipal waste incineration, except that the operating temperatures are to be raised higher. Therefore the same release factors are used as for municipal waste incineration.

### 7.6.4 Summary of information for HALS-1 in hazardous waste incineration

**Table R.18- 90: Information to estimate releases of HALS-1 in hazardous waste incineration processes**

<table>
<tr><th>Parameter</th><th colspan="4">Description</th></tr>
<tr><td>Assessed waste treatment process</td><td colspan="4">Hazardous waste incineration</td></tr>
<tr><td>Coverage</td><td colspan="4">Waste collection, transport, temporary storage, feeding into the furnace and thermal treatment are covered. As HALS-1 is assumed to be destroyed in the plant, no processing of secondary waste is considered.</td></tr>
<tr><td>Types of wastes</td><td colspan="4">HALS-1 containing plastic articles or articles with plastic components</td></tr>
<tr><td>Assumptions</td><td colspan="4">The process is operated according to the legal requirements.</td></tr>
<tr><td>Pre-treatment</td><td colspan="4">No pre-treatment of wastes, except mechanical reduction of volume and mixing</td></tr>
<tr><td>Physical form</td><td colspan="4">Contained in solid wastes</td></tr>
<tr><td>Operational conditions and risk management measures</td><td colspan="4">Storage of waste in closed bunkers, operating temperatures according to waste incineration directive (850 + 1100), furnace is fully closed.<br>The incinerator is equipped with wet flue-gas cleaning (washer) with an efficacy of 95% for HALS-1.</td></tr>
<tr><td>Information on installations</td><td colspan="2">Operating days<br>330 d/a</td><td colspan="2">Number of plants<br>115</td></tr>
<tr><td>Maximum amount treated: Local scenario</td><td>Manufacture: 1515.151 kg/d</td><td>Formulation (master batch): 719.967 kg/d</td><td>Formulation (compound): 342.136 kg/d</td><td>Conversion: 69.293 kg/d</td></tr>
<tr><td>Maximum amount treated: Regional</td><td colspan="4">876 t/y</td></tr>
</table>

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

| Parameter | Description | | |
|---|---|---|---|
| scenario | | | |
| Collection rate of initial releases | 100% of flue gas enters washer<br>100% of water in washer enters WWTP | | |
| Release factor to air | RFair,initial = 0.0001<br>Justification: default value of main text | RFRMM = 0.05<br>Justification: efficacy of washer 95% | RFair = 0.00005 |
| Release factor to water | RFwater,initial = 0.000095<br>Justification: emissions to air multiplied with efficacy of washer | RFRMM = 0.57<br>Justification: average release factor to water in simple treat for substances which are inherently degradable and with a LogKow between 3 and 4 | RFwater = 0.0000542 |
| Release factor to soil | No direct emissions to soil –> 0.0 | | |

### 7.6.5 Release estimation for HALS-1 in hazardous waste incineration

**Table R.18- 91: Summary of release factors for hazardous waste incinerator scenario.**

| Modelling | Initial release factor | Release factor of RMM | Total release factor |
|---|---|---|---|
| Release to water | 0.000095 | 0.57 | 0.0000542 |
| Release to air | 0.0001 | 0.05 | 0.00005 |
| Release to soil | 0.0 | n.a. | 0.0 |

**Table R.18- 92: Release amounts (kg/d) for HALS-1 in metal recycling for each relevant use, local scenario**

| | Manufacture | Formulation (master batch) | Formulation (compound) | Conversion |
|---|---|---|---|---|
| Release to water | 0.08212 | 0.039 | 0.01854 | 0.00375 |
| Release to air | 0.07575 | 0.03598 | 0.0171 | 0.00346 |
| Release to soil | 0 | 0 | 0 | 0 |

**Table R.18- 93: Release estimate for HALS-1 in shredding, regional scenario**

| Modelling | Released | Unit |
|---|---|---|

| | amount | |
|---|---|---|
| Release to water | 0.04748 | t/a |
| Release to air | 0.0438 | t/a |
| Release to soil | 0 | t/a |

## 8 Total amount of releases at regional scale

The total amount of HALS-1 emitted from waste treatment processes is equal to the sum of all releases from point source and dispersive uses at regional scale. They are summarized in the following table:

**Table R.18- 94: Amounts of HALS-1 released from waste treated in a region per year**

| Release to | Unit | landfill | incineration | shredding | metal | HW incineration | Total |
|---|---|---|---|---|---|---|---|
| Water | t/a | 0.000143 | 0.0119 | 0.000438 | 0.00001273 | 0.0474 | 0.0599 |
| Air | t/a | 1.912 | 0.0109 | 0.0137 | 0.0000957 | 0.0438 | 1.98 |
| Soil | t/a | 8.16 | 0.0 | 0.000438 | 0.0 | 0.0 | 8.16 |

## 9 Waste specific risks

As the last step of the safety assessment, waste specific risks are checked.

The checking of waste specific risks did not show any further action needs with regard to the chemical safety assessment or information provision along the supply chain.

## 10 Summary of information for release estimation

The information and values used for estimating releases to the local and regional environment are summarized in the following tables. The effectiveness of waste treatment conditions (for disposal and recycling) is expressed as overall effectiveness, considering both initial release factor driven by the technique and the additional risk management measures effectiveness on air and water pathway.

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

**Table R.18- 95: Compilation of information and values used for the local assessment**

| | Landfill | Municipal Incineration | Shredding / Recycling | Metal recyling | Hazardous waste incineration |
|---|---|---|---|---|---|
| fwaste used in local estimate | Conversion: 0.00874<br>Plastic Articles (EoL): 0.874 | Conversion: 0.00874<br>Plastic Articles (EoL): 0.874 | Conversion: 0.0035<br>Plastic Articles (EoL): 0.35 | Conversion: 0.000035<br>Plastic Articles (EoL): 0.0035 | Manuacture: 0.05<br>Formulation (master batch): 0.025<br>Formulation (compound): 0.0125<br>Conversion: 0.0025 |
| Wastes considered, reasoning for fwaste | Worst case assumption for local assessment: 8% subtracted as recycling waste, 95% of MW being landfilled. | Worst case assumption for local assessment: 8% subtracted as recycling waste, 95% of MW being incinerated | Recycling rates between 8 and 35%. 35% assumed as worst case for the local assessment. No split between processes | 1% of recycling waste could be metals contaminated with HALS-1. No split between processes | Total amount of wastes from industrial uses, based on default fractions as waste for the different lifecycle stages, assumption that all waste ist treated in one installation |
| # of installations | 8400 | 600 | 210 | 231 | not relevant |
| Days | 365 | 330 | 330 | 330 | 330 |
| Reasoning | Information by DG Env of EC | BREF waste incineration | European Shredder Group | BREF Iron & Steel 2009 | BREF Waste Incineration 2006 |
| Type of use | WD | WD | WD | WD | IND |
| Qmax | Conversion: 1.038<br>Plastic Articles (EoL): 102.95 | Conversion: 19.3<br>Plastic Articles (EoL): 1913.77 | Conversion: 17.947<br>Plastic Articles (EoL): 1772.262 | Conversion: 0.168<br>Plastic Articles (EoL): 16.592 | Manufacture: 1515.151<br>Formulation (master batch): 719.697<br>Formulation (compound): 342.136<br>Conversion: 69.293 |
| Formula | Qmax [kg/d] = (Q [t/a] * fwaste* 1000 * DF) / Temission | | | | |

| | | | | | |
|---|---|---|---|---|---|
| RFwater | 0.00000028 | 0.000095 | 0.0000024 | 0.0000399 | 0.0000542 |
| Reasoning | RFwater,initial and final = 0.00000028: study developing model based on measured data for related substances. RMMs integrated. Discharge to surface water. | RFwater,initial = 0.000095: high degree of destruction, emissions to air multiplied with efficacy of washer; Efficacy of WWTP = 43%. Discharge to surface water. | RFwater,initial = release with dust to air, multiplied with leaching rate (OECD ESD service life, outdoors).<br>Discharge with STP connection[188] | RFwater,initial = emission to air multiplied with efficacy of RMM for air (70%), RMM for water with efficacy of 43%.<br>Discharge to STP. | RFinitial = 0.000095 = emissions to air multiplied with efficacy of RMM, Wastewater treatment with efficacy of 47% according to simplified simple treat model.<br>Discharge to surface water. |
| RFair | 0.00375 | 0.00005 | 0.000075 | 0.00003 | 0.00005 |
| Reasoning | RFair,initial = 0.005: ESD plastic additives (service life, outdoors); RMM: capture 50% destruction 50% --> efficacy of 0.25% | RFair,initial = 0.0001: high degree of decomposition, residual release in fly ash Assumed efficacy of washer 95% plant | RFwater,initial = release of dust to air (0.001) multiplied with max concentration in polymer (0.5) = 0.0005, RMM collects 90%, efficacy of 95% | RFair,initial analogous to thermal treatment (0.001), efficacy of RMM is 70% | Derivation of factor same as for municipal waste incineration due to very similar operating conditions |
| RFsoil | 0.016 | 0 | 0.0000024 | 0 | 0 |
| Reasoning | OECD ESD (service life outdoors) | No emissions to soil | Justification as for water | No emissions to soil | No emissions to soil |

[188] Diffuse emissions would settle and be partly washed off to the sewage

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

### Table R.18- 96: Information and values used for the regional assessment

| | Landfill | Incineration | Shredding / Recycling | Metal recycling | HW incineration |
|---|---|---|---|---|---|
| Fraction of reg. volume becoming waste | Conversion: 0.00914<br>Plastic Articles (EoL): 0.903 | | | Conversion: 0.000032<br>Plastic Articles (EoL): 0.00316 | Manufacture: 0.05<br>Formulation (master batch): 0.025<br>Formulation (compound): 0.0125<br>Conversion: 0.0025 |
| Reasoning | Total municipal waste minus fraction recycled at regional scale | | Average assumption on recycling of plastics at regional level | Assumption that maximum 1% of plastics could be attached to metals and subjected to metal recycling | Total share of hazardous waste generated |
| Split into different processes | 0.8 * 0.7 | 0.8 * 0.3 | 0.2 | 1 | 1 |
| Reasoning | Realistic worst case assumption on split of waste | | All recycling waste would undergo shredding | Only applicable process | Only applicable process |
| fwaste used in regional estimate | 0.510 | 0.218 | 0.1824 | 0.00319 | 0.0876 |
| Type of use | Dispersive | Dispersive | Dispersive | Dispersive | Industrial |
| Qmax | 510 | 218.97 | 182.48 | 1.825 | 876.00 |
| Reasoning | Qmax,regional,DW = Q * fwaste * 0.1 | | | | Qmax,regional,ind =<br>Q * fwaste * 1 |
| RFwater, air, soil | See information on local assessment | | | | |

## 11 Documentation in the registration dossier – Section 3.6

HALS-1 is used in industrial and professional applications and included into polymer matrices for the production of articles. Articles may be handled by consumers and workers

The following tables include the information that may be presented in section 3.6 of IUCLID and possibly also under section 2 (manufacture and use) of the CSR.

**Table R.18- 97: Waste types, amounts and waste treatment processes from manufacturing of HALS-1**

| Waste from | Type of waste | Amount [t/a] | Composition | Recycling | Information source |
|---|---|---|---|---|---|
| Manufacture | Solid: production rests, off-specifications, cleaning materials | 400 | HALS-1 content app. 80% | No recycling | In-house (waste documentation) |
| | Solid: Air filters | 100 | HALS-1 content app. 75% | No recycling | |

**Table R.18- 98: Waste types, amounts and waste treatment processes from identified uses**

| Waste from | Type of waste | Amounts [t/a] | HALS-1 content [%] | Waste treatment process / recycling | Information source |
|---|---|---|---|---|---|
| Formulation (master batch) | Solid / liquid: rests, off-specifications, packaging,<br>air filters | 237.5 | 50<br>Max. 10 | HW incineration | Info on max. HALS-1 concentration in polymers, air filters: assumption |
| Formulation compounds | Solid / liquid: rests, off-specifications, packaging<br>Absorbers | 115.78 | 0.5<br>Max. 1 | HW incineration | Info on max. HALS-1 concentration in polymers, absorbers: assumption |
| Conversion | Residues from production<br>Solid: Air filters, “empty packaging” | 114.34 | < 0.5<br>Max 1 | Municipal waste<br>HW incineration | Info on max. HALS-1 concentration in final articles.<br>Air filters, packaging: assumption |

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

**Table R.18- 99: Waste types, amounts and treatment of waste from service life stage subsequent to the identified uses**

| Waste from | Type of waste | Amount [t/a] | HALS-1 content [%] | Waste treatment process / recycling | Information source |
|---|---|---|---|---|---|
| EoL articles | Any articles consisting of plastics or having plastics part included or attached | 9,032.38 | Max 0.5 | Landfill, Incineration<br>Plastic recycling (could be collected separately, but more likely to be extracted from municipal waste.<br>Recycling rates between 8% and 35% reported from EU | Common sense, waste statistics |

# 12 Documentation in the CSRs Section 9 (exposure assessment)

## 12.1 Exposure scenario section for formulation (master batches, compounds)

| **2.2 Control of environmental exposure** |
|---|
| **Organizational measures to prevent/limit release from site** |
| *Wastes from onsite risk management measures and solid or liquid wastes from production and cleaning processes should be disposed of separately to hazardous waste incineration plants as hazardous waste. Dust formation should be prevented.* |
| **Conditions and measures related to external treatment of waste for disposal** |
| ***Fraction of annual/daily use expected in waste**: 0.025 (formulation of master-batches) and 0.0125 (compounding)*<br>***Appropriate waste codes**: Aqueous washing liquids and mother liquors 07 02 01*, other still bottoms and reaction residues 07 02 08**<br>***Suitable disposal** : All wastes are hazardous wastes and assumed to be disposed of to authorized hazardous waste incineration plants, operated according to Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and Best Available Techniques for Waste Incineration as described in the respective BREF of August 2006.* |
| **Conditions and measures related to external recovery of waste** |
| *No recovery of HALS-1 should be performed.* |

## 12.2 Exposure scenario section for use of polymer compounds (conversion)

## Appendix R.18- 7: Exemplification of exposure assessment of the life waste cycle stage for plastic additive

| 2.2 Control of environmental exposure |
| --- |
| **Organizational measures to prevent/limit release from site** |
| *Off-specifications from production could be directly recycled on-site or be disposed of as non-hazardous production wastes or disposed of as plastic wastes for external recycling or recovery.* |
| **Conditions and measures related to external treatment of waste for disposal** |
| ***Fraction of annual/daily use amount expected in waste****: 0.0125*<br>***Appropriate waste codes:*** *waste plastic 07 02 13*<br>***Suitable disposal****: Wastes from onsite risk management measures (e.g. air filters) are to be collected and disposed of as hazardous wastes to hazardous waste incineration plants, operated according to Directive 2000/76/EC on the incineration of waste, Council Directive 2008/98/EC on waste and Best Available Techniques for Waste Incineration as described in the respective BREF of August 2006Disposal of production wastes is possible via municipal waste incineration (operated according to Directive 2000/76/EC on the incineration of waste and according to Reference Document on the Best available Techniques for Waste Industries of August 2006 ) or municipal land filsl (operated according to Council Directive 1999/31/EC and Council Decision 19 December 2002, and Best Avail-able Techniques for Waste Treatment Industries of August 2006.* |
| **Conditions and measures related to external recovery of waste** |
| *Shredders pre-treating plastic wastes should be equipped with a dust collection and air filtration system, with a degree of capture of at least 90% and a filtration efficacy of 95% (assumed overall effectiveness 85%).* |

## 12.3 Exposure scenario section for service life of articles (handling by workers and consumers)

| 2.2 Control of environmental exposure |
| --- |
| **Organizational measures to prevent/limit release from site** |
| |
| **Conditions and measures related to external treatment of waste for disposal** |
| ***Fraction of annual/daily use amount expected in waste****: up to 1.*<br>***Appropriate waste codes****: (codes to be selected according to the type of article the substance is used in )*<br>***Suitable disposal****: Wastes from end-of-life articles can be disposed of as municipal waste, except when they are separately regulated, like electronic devices.*<br>*Disposal of wastes is possible via incineration (operated according to Directive 2000/76/EC on the incineration of waste) or land filling (operated according to Reference Document on the Best available Techniques for Waste Industries of August 2006 and Council Directive 1999/31/EC and Council Decision 19 December 2002).* |
| **Conditions and measures related to external recovery of waste** |
| *Shredders pre-treating plastic wastes should be equipped with a dust collection and filtration system, with a degree of capture of at least 90% and a filtration efficacy of 95% (assumed overall effectiveness 85%)* |

## 13 Information to include in the extended SDS

Parts of the information documented in the CSR is also to be communicated to downstream users, in Section 13 of the extended SDS and/or in the exposure scenarios attached to the extended SDS; Suitable or required waste treatment techniques, and in specific cases also the required effectiveness of such waste treatment. It may be considered desirable to specify the suitable waste codes

The following list of information is not yet expressed in standard phrases which may need to be developed for standardised communication.

**Section 13: Disposal considerations, (especially sub-section 13.1 "waste treatment methods")**

Waste from production of master-batches and polymer compounds, including residues of substance as such: All wastes should be disposed of as hazardous waste to authorized hazardous waste incineration plants, operated according to Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and Best Available Techniques for Waste Incineration as described in the respective BREF of August 2006.

Waste from conversion: No specific measures need to be implemented to ensure control of risks. Dispose of as municipal waste disposal (incineration or landfill). Waste from end-of –life articles can be disposed of as municipal waste (to incineration, landfill or recycling) except when they are separately regulated. Waste containing HALS-1 disposed of to milling processes (e.g. pre-treatment for recycling): Shredders should be equipped with dust collection and subsequent air filtration system with a minimum effectiveness of 85%.

Contaminated packaging: Contaminated packaging should be emptied as far as possible and disposed of as hazardous waste to incineration plants in accordance with Directive 2000/76/EC.

Clean packaging material should be subjected to waste management schemes (recovery, recycling, re-use) according to local legislation."

**Suitable waste codes for formulation and conversion**

- aqueous washing liquids and mother liquors 07 02 01
- other still bottoms and reaction residues 07 02 08
- other filter cakes and spent absorbents 07 02 10
- waste plastic 07 02 13
- wastes from additives containing dangerous substances 07 02 14
- packaging containing residues of or contaminated by dangerous substances 15 01 10
- absorbents, filter materials (including oil filters not otherwise specified) wiping cloths, protective clothing (contaminated by dangerous substances) 15 02 02
- absorbents, filter materials, wiping cloths and protective clothing (other than those mentioned in 15 02 02) 15 02 03