ZINC SULPHATE

CAS No: 7733-02-0

EINECS No: 231-793-3

SUMMARY RISK ASSESSMENT REPORT

PART I - ENVIRONMENT

Final report, May 2008

The Netherlands

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NOTE:

Part II (Human Health) of the Summary Risk Report for zinc sulphate has been published already in 2004 by the European Commission (see http://ecb.jrc.it).

PREFACE

This report provides a summary, with conclusions, of the risk assessment report of the substance zinc sulphate that has been prepared by The Netherlands in the context of Council Regulation (EEC) No. 793/93 on the evaluation and control of existing substances.

For detailed information on the risk assessment principles and procedures followed, the underlying data and the literature references the reader is referred to the comprehensive Final Risk Assessment Report (Final RAR) that can be obtained from the European Chemicals Bureau[1]. The Final RAR should be used for citation purposes rather than this present Summary Report.

It is noted that in the context of Council Regulation (EEC) No. 793/93 risk assessments were carried out for zinc metal (CAS No. 7440-66-6), zinc distearate (CAS No. 557-05-1 / 91051-01-3), zinc oxide (CAS No.1314-13-2), zinc chloride (CAS No.7646-85-7), zinc sulphate (CAS No.7733-02-0) and trizinc bis(orthophosphate) (CAS No.7779-90-0). All six substances are EU priority substances within Council Regulation (EEC) No. 793/93. For each compound a separate RAR and Summary RAR have been prepared. It should be noted, however, that the RAR Zinc metal contains specific sections (as well in the exposure part as in the effect part) that are relevant for the other zinc compounds as well. For these aspects, the reader is referred to the RAR Zinc metal.

[1] European Chemicals Bureau – Existing Chemicals – http://ecb.jrc.it

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TABLES

1 GENERAL SUBSTANCE INFORMATION

See Part II – Human Health for data on 'identification', purity, impurities and additives' and 'physico-chemical properties' of the substance.

CLASSIFICATION AND LABELLING

Annex 1 of Directive 67/548/EEC contains a list of harmonised classifications and labellings for substances or groups of substances, which are legally binding within the EU.
For zinc sulphate the current Annex 1 classification and labelling (29^{th} ATP, 2004) is as follows:

Classification
Xn; R22
R41
N; R50-53

Labelling
Xn; N
R: 22-41-50/53
S: (2-)22-26-39-46-60-61

The above classification and labelling is for hydrous forms of zinc sulphate (mono-, hexa-, and hepta-hydrate) and for anhydrous zinc sulphate.

2 GENERAL INFORMATION ON EXPOSURE

2.1 PRODUCTION

Zinc sulphate is produced (>1000 t/y) at five known sites in the European Union.

The total production volume of zinc sulphate in the EU for 1994 is confidential. The same is true for export figures outside the EU. Zinc sulphate was imported from outside the EU by at least one company. The import volume is unknown. Based on production, export and import data the total use volume within the EU is estimated to be circa 28,000 tonnes per year.

2.2 USE PATTERN

Table 2.1 shows the industrial and use categories of zinc sulphate. Zinc sulphate is mainly used for the production of fertilisers and pesticides (60%). The remaining part is used for agriculture pharmaceutical purposes such as feedstuff additives (20%) and the chemical industry (20%).

Minor usages of zinc sulphate are applications in the viscose production as flotation agent in the mining industry, as corrosion inhibitor in the galvanising industry and in water treatment processes. The main type of use category of zinc sulphate can be characterised as wide dispersive.

Table 2.1 Industrial and use categories of zinc sulphate in the EU

Industrial category	EC no.	Use category	EC no
Agricultural	1	Fertilisers Feedstuff additive (pharmaceutical)	19 41
Basic chemicals	2	Laboratory chemicals Others	34 55
Agrochemical industry	3	Intermediate for pesticides production	33
Metal extraction, refining and processing industry	8	Flotation agents	23
Others	15/0	Corrosion inhibitors Others: viscose production	14 55

3 ENVIRONMENT

3.1 ENVIRONMENTAL EXPOSURE

3.1.1 General introduction

The EU Technical Guidance Document (TGD, 2003) on risk assessment does not provide detailed information on how to deal with (essential) elements that have a natural background concentration in the environment, such as zinc. In the risk assessment reports (RARs) for zinc metal and zinc compounds, including the RAR for zinc sulphate, the “added risk approach” has been used. In this approach both the "Predicted Environmental Concentration" (PEC) and the "Predicted No Effect Concentration" (PNEC) are determined on the basis of the added amount of zinc, resulting in an “*added* Predicted Environmental Concentration” (PEC_{add}) and “*added* Predicted No Effect Concentration” ($PNEC_{add}$), respectively.

In the present environmental exposure assessment, the use of the added risk approach implies that the PEC_{add} values have been calculated from zinc emissions due to anthropogenic activities. In the local exposure scenarios for zinc sulphate that are presented in this RAR, the PEC_{add} values (which are expressed as zinc, not as zinc sulphate) are based on the local zinc emissions due to the production or use of zinc sulphate.
In the environmental effect assessment, the use of the added risk approach implies that the $PNEC_{add}$ values have been derived from toxicity data that are based on the added zinc concentration in the tests. Thus, the $PNEC_{add}$ is the maximum permissible addition to the background concentration. From the background concentration (Cb) and the $PNEC_{add}$, the PNEC can be calculated: $PNEC = Cb + PNEC_{add}$. It is emphasised that the $PNEC_{add}$ values were not derived from ecotoxicity data for zinc sulphate alone, but derived from the combined ecotoxicity data for zinc sulphate and other soluble zinc compounds, see further section 3.2.
Finally, in the environmental risk characterisation, the use of the added risk approach implies the evaluation of the PEC_{add} / $PNEC_{add}$ ratios. In case measured environmental concentrations are used in the risk characterisation, either the background concentration has to be subtracted from the measured environmental concentration (resulting in a "PEC_{add} / $PNEC_{add}$" ratio) or the background concentration has to be added to the $PNEC_{add}$ (resulting in a traditional "PEC / PNEC" ratio). See section 3.3.1 for additional explanation on the application of the added risk approach in the risk characterisation.

3.1.2 Environmental releases and fate

A general description about the release and fate of zinc in the environmental compartment is presented only in the RAR Zinc metal, but those data are applicable to all zinc compounds.

3.1.3 Local exposure assessment

Table 3.3 (included in section 3.3) shows the added Predicted Environmental Concentrations, i.e $Clocal_{add}$ and $PEClocal_{add}$ values ($(PE)C_{add}$s) for STP effluent, surface water, sediment and agricultural soil, based on the local exposure scenarios on the emissions of zinc due to the production or use of zinc sulphate. The $(PE)C_{add}$s are derived from either modelling or measured exposure data. All concentrations are expressed as zinc and not as zinc sulphate. These $(PE)C_{add}$s have been used in the risk characterisation to calculate the $(PE)C_{add}$ / $PNEC_{add}$ ratios (see section 3.3).

It is noted that the PEC_{add}s for agricultural soil include the added regional background concentration ($PECregional_{add}$), according to the TGD equation $PEClocal_{add} = Clocal_{add} + PECregional_{add}$. The $PECregional_{add}$ for soil is 0.5 mg/kg wwt (calculated value). For STP effluent, the PEC_{add} is equal to the $Clocal_{add}$, as there is no regional PEC_{add} for STP effluent. For water and sediment, the $Clocal_{add}$ values (thus without the regional PEC_{add}) are listed in **Table 3.3,** as in the risk characterisation for water and sediment initially only the $Clocal_{add}$ values have been compared with the corresponding $PNEC_{add}$. See section 3.3.1 for further explanation of the local risk characterisation.
The $Clocal_{add}$s for air (atmosphere) have been left out of consideration in the environmental part of the Summary RAR, as no $PNEC_{add}$ could be derived for air (there are no useful data on the effects of airborne zinc on environmental organisms. The $Clocal_{add}$s for air have been used in the risk assessment of man indirectly exposed via the environment (see Human Health part).

3.1.4 Regional exposure assessment

A regional exposure assessment is described only in the RAR Zinc metal. The regional exposure assessment includes the industrial and diffuse emissions of all six current EU priority zinc compounds. In case of diffuse emissions it is not possible to distinguish between emissions from current EU priority zinc compounds and non-EU priority list zinc compounds. The diffuse emissions may thus also comprise emissions from other zinc compounds.

3.2 EFFECTS ASSESSMENT

3.2.1 Aquatic and terrestrial compartment

The ecotoxicity of zinc sulphate has been studied extensively in laboratory tests, both with aquatic organisms and terrestrial organisms. The data include many short-term toxicity studies (used to derive acute LC50 and EC50 values for zinc) and many long-term toxicity studies (used to derive chronic NOEC values for zinc). A number of the ecotoxicity data for zinc sulphate were submitted by Industry ($ZnSO_4$ IUCLID data sheet, *Grillo-version of 7 March 1997*). The further data were retrieved from reviews and updates (literature searches) made by Industry and the rapporteur. For a comprehensive overview of the aquatic and terrestrial toxicity of (soluble) zinc, including zinc sulphate, see the RAR Zinc metal and especially the Annexes of that report; the Annexes include detailed data on the ecotoxicity data bases for (soluble) zinc.

Once emitted into the environment, zinc sulphate, which has a high water solubility, will dissociate into the zinc cation and the sulphate anion. The further speciation of zinc, which includes complexation, precipitation and sorption, depends on the environmental conditions. Therefore, emitted zinc sulphate as well as other emitted zinc species (e.g. zinc chloride) will contribute to the effect of the total amount of zinc in the environment, regardless of the original source or chemical form. For this reason the risk characterisation for zinc sulphate is based on zinc, not on zinc sulphate as such, as explained earlier in section 3.1 and in the RAR Zinc metal.

In the Risk Assessment Report on Zinc metal, $PNEC_{add}$ values have been derived for zinc, on the basis of tests with soluble zinc salts (especially zinc sulphate or zinc chloride), using the "added risk approach" (see also earlier in section 3.1 of the present report for an explanation of the added risk approach). These $PNEC_{add}$ values for zinc are listed in **Table 3.1** and used in the risk characterisation (see section 3.3).

Table 3.1 $PNEC_{add}$ values for zinc (from RAR Zinc metal)

Environmental compartment	**$PNEC_{add}$**	**$PNEC_{add}$ value, as Zn**	**Remark**
Freshwater (Hardness ≥ 24 mg/L) (1)	$PNEC_{add,\ aquatic}$	7.8 µg/l 21 µg /l	Dissolved zinc Total zinc (2)
Freshwater (Hardness <24 mg/L) (1)	$PNEC_{add,\ aquatic}$ softwater	3.1 µg/l	Dissolved zinc
Freshwater sediment	$PNEC_{add,\ sediment}$	49 mg/kg dwt 11 mg/kg wwt	Dry weight of sediment (3) Wet weight of sediment (3)
STP effluent	$PNEC_{add,\ microorganisms}$	52 µg/l	Dissolved zinc
Soil	$PNEC_{add,\ terrestrial}$	26 mg/kg dwt 23 mg/kg wwt	Dry weight of soil (4) Wet weight of soil (4)

(1) Total hardness (mg/l), as $CaCO_3$.

(2) Total-Zn concentration: calculated from the $PNEC_{add,\ aquatic}$ of 7.8 µg/l for dissolved zinc, a C_{susp} of 15 mg/l (according to the TGD, 2003) and a Kp_{susp} of 110,000 l/kg.

(3) For the dry to wet weight normalisation of the $PNEC_{add,\ sediment}$ it is assumed that wet sediment contains 10% solids (density 2500 kg/m^3) and 90% water (density 1000 kg/m^3) by volume, i.e. 22% solids by weight. These properties are set equal to those of suspended matter, thus the $PNEC_{add,\ suspended\ matter}$ equals the $PNEC_{add,\ sediment}$ (according to the TGD, 2003).

(4) For the dry to wet weight normalisation of the $PNEC_{add,\ terrestrial}$ it is assumed that wet soil contains 60% solids (density 2500 kg/m^3) and 20% water (density 1000 kg/m^3) by volume, i.e. 88% solids by weight.

3.2.2 Atmosphere

There are no data to derive an ecotoxicological $PNEC_{(add)}$ for zinc in the air compartment.

3.2.3 Secondary poisoning

Based on data on bioaccumulation of zinc in animals and on biomagnification (i.e. accumulation and transfer through the food chain), secondary poisoning is considered to be not relevant in the effect assessment of zinc, see further the RAR Zinc metal.

3.3 RISK CHARACTERISATION

3.3.1 Local risk characterisation

3.3.1.1 Local risk characterisation – methods

In the first step of the risk characterisation, the local added Predicted Environmental Concentrations ($PEClocal_{add}$s) in the various environmental compartments are compared with the corresponding added Predicted No Effect Concentrations ($PNEC_{add}$s). In case this yields a PEC_{add} / $PNEC_{add}$ ratio above 1, the risk characterisation includes (if possible) a second step in which a bioavailability correction is made, see **Table 3.2** for a summary of the bioavailability correction methods applied and see RAR Zinc metal sections 3.3.2.1.1 (water), 3.3.2.2.1 (sediment) and 3.3.3.1.1 (soil) for a comprehensive explanation of the derivation and application of these bioavailability correction methods[2]. In all cases the bioavailability correction is applied to the PEC_{add}, not to the generic $PNEC_{add}$, although for the resulting corrected PEC_{add} / $PNEC_{add}$ ratio it makes no difference whether the correction is applied to the PEC_{add} or to the $PNEC_{add}$.

- For water there is only a site-specific bioavailability correction, i.e. a bioavailability correction is only applied in case there are reliable site-specific data on the abiotic water characteristics that are needed to apply the BLM models. Bioavailability factors are being derived for two scenarios of abiotic conditions. One scenario refers to an average setting and the second one to a 'realistic worst case' setting. The highest bioavailability factor ($BioF_{water}$) is subsequently used in the risk characterisation by multiplying the original $(PE)C_{add}$ with this $BioF_{water}$. If a site has a discharge to seawater, no bioavailability correction is performed, as the BLM models were developed for freshwaters.
- For sediment the bioavailability correction is either site-specific (preference) or generic.
- For soil the bioavailability correction starts with the application of the generic lab-to-field correction factor (R_{L-F}) and if the corrected PEC_{add} / $PNEC_{add}$ ratio still is >1, then a further, site-specific bioavailability correction is applied.

Final conclusions of the risk assessment are based on the corresponding 'corrected' PEC_{add} / $PNEC_{add}$ ratios.

Table 3.2 Bioavailability corrections as applied in the EU RARs on zinc and zinc compounds

Compartment	***Added* Predicted Environmental Concentration (PEC_{add})**	
	Bioavailability correction (generic)	**Bioavailability correction (site-specific or region-specific)**
Water	None	Biotic Ligand Models (BLMs) for algae, Daphnia and fish (a)
Sediment	Factor of 2 (b)	Acid Volatile Sulphide (AVS) method (c)
Soil	Factor of 3 (d) (R_{L-F})	Regression lines for invertebrates, plants and microbial processes (e)

2 No bioavailability correction is done for the PEC_{add} in STP effluent. It is noted that in the main report (RAR Zinc sulphate) the notation PEC_{STP} has been used as synonym for the PEC_{add} in STP effluent.

(a) Water – BLMs: Based on the relationship between toxicity of zinc and water characteristics, e.g. pH, dissolved organic carbon (DOC) and hardness (see RAR Zinc metal Section 3.3.2.1.1 for further explanation).
(b) The PEC_{add} (or measured concentration) for zinc in sediment is divided by a generic, AVS-related correction factor of 2 to obtain the bioavailable concentration of zinc (note that in the original description of this method in section 3.3.2.2.1 of the RAR Zinc metal it is stated that the PEC_{add} is multiplied with a factor of 0.5). The corrected PEC_{add} is subsequently used in the assessment of the PEC_{add} / $PNEC_{add}$ ratio.
(c) Sediment – AVS method: Based on the inverse relationship between toxicity of zinc and AVS content in sediment (see RAR Zinc metal Section 3.3.2.2.1 for further explanation). This method is also described as the SEM/AVS-method, as also the toxicity of other metals, i.e. Cd, Cu, Ni, Hg and Pb, referred to as Simultaneously Extracted Metals (SEM) is reduced by AVS.
(d) The PEC_{add} (or measured concentration) for zinc in soil is divided by a generic, ageing-related lab-to-field correction factor (R_{L-F}) of 3 to obtain the bioavailable concentration of zinc. The corrected PEC_{add} is subsequently used in the assessment of the PEC_{add} / $PNEC_{add}$ ratio.
(e) Soil – Regression lines: Based on the relationship between toxicity of zinc and soil characteristics, e.g. pH and cation exchange capacity (CEC) (see RAR Zinc metal Section 3.3.3.1.1 for further explanation).

For STP effluent and soil, the PEC_{add}s are compared in the first step of the risk characterisation with the corresponding $PNEC_{add}$s, as stated above.

For water and sediment, initially only the $Clocal_{add}$ values (thus without the $PECregional_{add}$) are compared in the first step of the risk characterisation with the corresponding $PNEC_{add}$s. At first the local aquatic risk characterisation thus focuses on the contribution of point sources to the potential risks, thereby neglecting the contribution of diffuse sources. If the regional PEC_{add} would have been added for sediment, all local scenarios would have resulted in PEC_{add}/$PNEC_{add}$ ratios larger than 1. This because the regional PEC_{add} for sediment already exceeds the $PNEC_{add}$ of 11 mg/kg wwt. This holds for both calculated and measured sediment concentrations. For this reason for sediment for all scenarios with a $Clocal_{add}$/$PNEC_{add}$ ratio between 0 and 1 a **conclusion iii*** will be drawn, indicating that due to (possibly) high added regional background concentrations a risk for sediment at local scale cannot be excluded. It has to be noted that this conclusion would not be influenced by applying the generic sediment bioavailability correction factor (BioF) of 0.5 in the second step of the risk assessment.

The situation is somewhat less pronounced for the surface water compartment. With a $PNEC_{add}$ of 7.8 µg/l the regional PEC_{add} / $PNEC_{add}$ would lie between 0.8 (regional PEC_{add} of 6.7 µg/l) and 1.1 (regional PEC_{add} of 8.8 µg/l). When using an (arbitrary) average bioavailability correction factor (BioF) of 0.6[3] in the second step of the risk assessment, these ratios would become, respectively 0.5 and 0.7. As a result of this, it is decided that for $Clocal_{add}$/$PNEC_{add}$ ratios between 0.5[4] and 1 a **conclusion iii*** will be drawn, indicating that due to (possibly) high (added) regional background concentrations a local risk for water cannot be excluded. For scenarios with a surface water $Clocal_{add}$ / $PNEC_{add}$ ratio < 0.5 the local contribution to the (added) regional background is assumed to be negligible (**conclusion ii**).

For those scenarios in which the involved process type does intrinsically not result in water emissions a **conclusion ii)** is drawn for water and sediment.

3 See data in RAR Zinc Metal. Average of realistic worst case and average BioF for average NL data.

4 A $Clocal_{add}$ / $PNEC_{add}$ of between 0.5 and 1 should theoretically also be corrected for bioavailability. This would give ratios between 0.3 and 0.6 when using the correction factor of 0.6. Such ratios could just raise the overall PEC_{add} / $PNEC_{add}$ ratio, thus including the regional background, to levels above one.

It is important to note that the above-mentioned distinction between a (normal) conclusion iii) and a conclusion iii*) is not only made because of transparency, but also because the regional background is due to a variety of zinc compounds (and thus not only the zinc compound specifically addressed in the local risk characterisation).

In the RAR zinc metal a general reflection is given on the uncertainties in the zinc risk assessments.

3.3.1.2 Local risk characterisation - results

Table 3.3 shows the local C_{add} and PEC_{add} values ($(PE)C_{add}$ values) and the corresponding $(PE)C_{add}$ / $PNEC_{add}$ ratios for STP effluent, surface water, sediment and agricultural soil, based on the local exposure scenarios. It is emphasised that the $(PE)C_{add}$ values and thus the $(PE)C_{add}$ / $PNEC_{add}$ ratios in **Table 3.3** were not corrected for bioavailability. Subsequent corrections for the bioavailability of zinc in water, sediment and soil (if allowed) were then applied on the $(PE)C_{add}$ values in case the uncorrected $(PE)C_{add}$ / PEC_{add} ratio is above 1.
No bioavailability correction is done for the PEC_{add} STP.
Table 3.4 presents the overall results of the local risk characterisation after the various bioavailability correction steps (if relevant). The conclusions of the risk assessment for the different local scenarios are based on the data in this table.

Aquatic compartment (including sediment)

STP-effluent
Production:
At the production sites there is no emission to waste water, hence the PEC_{add} values for STP effluent and subsequently the PEC_{add} / $PNEC_{add}$ values are 0, thus <1 (**conclusion ii**)[5].
Use categories:
The PEC_{add} exceeds the $PNEC_{add}$ in three scenarios (‘agricultural pesticide industry processing’, ‘agricultural fertiliser industry formulation’ and ‘chemical industry processing’) (**conclusion iii**). All these scenarios are based on generic release estimates.
For the remaining two scenarios the PEC_{add} / $PNEC_{add}$ values are <1 (**conclusion ii**).

Surface water
Production:
At the production sites there is no emission to waste water, hence the PEC_{add} values for surface water and subsequently the PEC_{add} / $PNEC_{add}$ values are 0, thus <1 (**conclusion ii**)[4].
Use categories:
The $Clocal_{add}$ exceeds the $PNEC_{add}$ in the generic scenario ‘agricultural fertiliser industry formulation’. There are no site-specific data that allow a bioavailability correction, thus the $Clocal_{add}$ / $PNEC_{add}$ ratio remains unchanged and >1 (**conclusion iii**).
The $Clocal_{add}$ / $PNEC_{add}$ ratio for the generic scenario ‘agricultural feed industry formulation’ is 1, indicating that due to (possibly) high regional background concentrations a potential risk at local scale cannot be excluded **(conclusion iii*),** see section 3.3.1.1. for explanation of **conclusion iii***).

[5] For zinc sulphate production site No. 3 (company 3) the risk assessment is included in the RAR Zn Metal, as this company produces both zinc sulphate and zinc metal. Hence, the results for this production site are not discussed in the RAR Zinc sulphate.

For the remaining scenarios the $Clocal_{add}$ / $PNEC_{add}$ values are <0.5 **(conclusion ii)**.

Sediment

Production:

At the production sites there is no emission to waste water, hence the PEC_{add} values for sediment and subsequently the PEC_{add} / $PNEC_{add}$ values are 0, thus <1 (**conclusion ii**)[4].

Use categories:

The $Clocal_{add}$ exceeds the $PNEC_{add}$ in four scenarios ('agricultural pesticide industry processing', 'agricultural fertiliser industry formulation', 'agricultural feed industry formulation (generic)' and 'chemical industry processing'). There are no site-specific data that allow a site-specific bioavailability correction, thus only the generic sediment bioavailability correction factor of 0.5 can be applied in these scenarios. This implies that the corrected $Clocal_{add}$ / $PNEC_{add}$ values are 2-times lower than the uncorrected values (as the $Clocal_{add}$ values are multiplied with a factor of 0.5). After this correction the $Clocal_{add}$ / $PNEC_{add}$ values remain >1 for these scenarios (**conclusion iii**), except for 'agricultural pesticide industry processing' (corrected $Clocal_{add}$ / $PNEC_{add}$ is 1). In this case (i.e. scenario 'agricultural pesticide industry processing') a potential risk at the local scale cannot be excluded due to (possibly) high regional background concentrations (**conclusion iii***), see section 3.3.1.1 for explanation of **conclusion iii*.**
For the remaining scenario, i.e. 'agricultural feed industry formulation' (site specific) the $Clocal_{add}$ / $PNEC_{add}$ is 0 (no local emission to waste water, thus no local emission to surface water or sediment, resulting in a **conclusion ii)** for this site.

Terrestrial compartment

Production:

At the production sites the PEC_{add} / $PNEC_{add}$ values are <1 (**conclusion ii**).

Use categories:

The PEC_{add} exceeds the $PNEC_{add}$ in four scenarios ('agricultural pesticide industry processing', 'agricultural fertiliser industry formulation', 'agricultural feed industry formulation (generic)' and 'chemical industry processing'). For these scenarios there are no site-specific data that allow a site-specific bioavailability correction on the basis of soil type characteristics, thus only the generic soil correction factor of 3 ((R_{L-F}: ageing aspects) can be applied. This implies that the corrected PEC_{add} / $PNEC_{add}$ values are 3-times lower than the uncorrected values (as the PEC_{add} values are divided by a factor of 3). After this correction the PEC_{add} / $PNEC_{add}$ values remains >1 for three scenarios ('agricultural pesticide industry processing', agricultural fertiliser industry formulation' and ' chemical industry processing'). (**conclusion iii**). The corrected PEC_{add} /$PNEC_{add}$ for scenario 'agricultural feed industry formulation (generic)' is <1 (**conclusion ii**).
The (uncorrected) PEC_{add} / $PNEC_{add}$ for the fifth scenario, 'agricultural feed industry formulation (site specific) is also <1 **(conclusion ii).**

Atmosphere

Not applicable, as no ecotoxicological $PNEC_{(add)}$ for the air compartment could be derived.

3.3.2 Regional risk characterisation

See RAR Zinc metal.

3.3.3 Secondary poisoning

Not relevant (see section 3.2.3).

Table 3.3 Local exposure assessment – (PE)C_{add}s and (PE)C_{add}/$PNEC_{add}$ ratios for the different scenarios (no correction for bioavailability)

Company	PEC_{add} effluent STP (dissolved)	C_{add} water (dissolved)	C_{add} sediment	PEC_{add} agricultural soil	PEC_{add} / $PNEC_{add}$ STP	C_{add} / $PNEC_{add}$ water	C_{add} / $PNEC_{add}$ sediment	PEC_{add} / $PNEC_{add}$ agr. soil
	(µg/l)	**(µg/l)**	**(mg/kgwwt)**	**(mg/kgwwt)**				
Production companies:								
Company 1	0	0	0	0.529	0	0	0	0.02
Company 2	0	0	0	0.5	0	0	0	0.02
Company 3	-	-	-	-	-	-	-	-
Company 4	0	0	0	0.516	0	0	0	0.02
Company 5	0	0	0	0.513	0	0	0	0.02
Use categories:								
Agricultural pesticide industry: processing	1,369	0.856	20.5	768	26	0.11	2	32
Agricultural fertiliser industry: formulation	940	152	3,640	527	18	19	350	22
Agricultural feed industry: formulation (site specific)	0	0	0	0.5	0	0	0	0.02
Agricultural feed industry: formulation (generic)	49.1	7.98	191	28.4	0.94	1	18	1.2
Chemical industry: processing	2,419	1.51	36.2	1,357	47	0.19	3.5	57

Table 3.4 Local exposure assessment –uncorrected and corrected (PE)C_{add} / $PNEC_{add}$ ratios for the different scenarios

	Uncorrected				Corrected	
Company	**PEC_{add} / $PNEC_{add}$ STP**	**C_{add} / $PNEC_{add}$ water**	**C_{add} / $PNEC_{add}$ sediment**	**PEC_{add} / $PNEC_{add}$ agr. soil**	**C_{add} / $PNEC_{add}$ sediment**	**PEC_{add} / $PNEC_{add}$ agr. soil**
Production companies:						
Company 1	0	0	0	0.02		
Company 2	0	0	0	0.02		
Company 3	-	-	-	-		
Company 4	0	0	0	0.02		
Company 5	0	0	0	0.02		
Use categories:						
Agricultural pesticide industry: processing	**26**	0.11	2	32	1	**11**
Agricultural fertiliser industry: formulation	**18**	**19**	350	22	**175**	**7.3**
Agricultural feed industry: formulation (site specific)	0	0	0	0.02	0	
Agricultural feed industry: formulation (generic)	0.94	1	18	1.2	**9**	0.40
Chemical industry: processing	**47**	0.19	3.5	57	**1.7**	**19**

4 HUMAN HEALTH

See Part II – Human Health

5 RESULTS

5.1 ENVIRONMENT

(X) ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already

(X) iii) There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account

(X) iii*) A conclusion applied to local scenarios in which the local scenario merits conclusion (ii) but where (possibly) due to high regional background concentrations a local risk cannot be excluded.

5.1.1 Local

Conclusion (ii) is drawn for all local scenarios, including secondary poisoning, except those listed below.

Conclusion (iii) or (iii*) is drawn for the specified scenarios, because:

STP

- the PEC_{add} in STP effluent exceeds the $PNEC_{add}$ for microorganisms for three processing scenarios of zinc sulphate listed in **Table 3.4** (**conclusion iii**).

Surface water

- the calculated $Clocal_{add}$ in water is greater than the $PNEC_{add}$ in surface water for one processing scenario for zinc sulphate listed in **Table 3.4** (**conclusion iii**).
- the $Clocal_{add}$ / $PNEC_{add}$ ratio is 1 **(conclusion ii**) for one other processing scenario for zinc sulphate listed in **Table 3.4,** but a potential risk at local scale cannot be excluded due to the possible existence of high regional background concentrations **(conclusion iii***).

Sediment

- the $Clocal_{add}$ in sediment exceeds the $PNEC_{add}$ in sediment for three processing scenarios listed in **Table 3.4** (**conclusion iii**).
- the $Clocal_{add}$ / $PNEC_{add}$ ratio is 1 for one other processing scenario for zinc sulphate listed in **Table 3.4 (conclusion ii**), but a potential risk at local scale cannot be excluded due to the possible existence of high regional background concentrations **(conclusion iii*).**

Soil

- $PEClocal_{add}$ / $PNEC_{add}$ ratios >1 exist for the terrestrial compartment for three processing scenarios of zinc sulphate listed in **Table 3.4 (conclusion iii).**

5.1.2 Regional

The regional risk characterisation is discussed in the RAR on Zinc Metal.

5.2 HUMAN HEALTH

See Part II – Human Health