federal public service
HEALTH, FOOD CHAIN SAFETY
AND ENVIRONMENT

SUBSTANCE EVALUATION CONCLUSION

as required by REACH Article 48

and

EVALUATION REPORT

for

N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine

EC No 221-375-9

CAS No 3081-14-9

Evaluating Member State : Belgium

Dated: June 2018

Template Version 2.1
March 2015

Evaluating Member State Competent Authority

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Year of evaluation in CoRAP: 2012

A decision in accordance with articles 50 and 52 of the Reach Regulation was notified to the concerned registrant(s) on 21 February 2014. On 17 February 2016 the required information was submitted by the registrant(s) according to article 46(2) of REACH. The evaluating Member State examined the submitted information in accordance with article 46(3) of the REACH Regulation and concluded the evaluation without any further need to ask more information from the registrant(s).

Further information on registered substances here:

http://echa.europa.eu/web/guest/information-on-chemicals/registered-substances

DISCLAIMER

This document has been prepared by the evaluating Member State as a part of the substance evaluation process under the REACH Regulation (EC) No 1907/2006. The information and views set out in this document are those of the author and do not necessarily reflect the position or opinion of the European Chemicals Agency or other Member States. The Agency does not guarantee the accuracy of the information included in the document. Neither the Agency nor the evaluating Member State nor any person acting on either of their behalves may be held liable for the use which may be made of the information contained therein. Statements made or information contained in the document are without prejudice to any further regulatory work that the Agency or Member States may initiate at a later stage.

Foreword

Substance evaluation is an evaluation process under REACH Regulation (EC) No. 1907/2006. Under this process the Member States perform the evaluation and ECHA secretariat coordinates the work. The Community rolling action plan (CoRAP) of substances subject to evaluation, is updated and published annually on the ECHA web site[1].

Substance evaluation is a concern driven process, which aims to clarify whether a substance constitutes a risk to human health or the environment. Member States evaluate assigned substances in the CoRAP with the objective to clarify the potential concern and, if necessary, to request further information from the registrant(s) concerning the substance. If the evaluating Member State concludes that no further information needs to be requested, the substance evaluation is completed. If additional information is required, this is sought by the evaluating Member State. The evaluating Member State then draws conclusions on how to use the existing and obtained information for the safe use of the substance.

This Conclusion document, as required by Article 48 of the REACH Regulation, provides the final outcome of the Substance Evaluation carried out by the evaluating Member State. The document consists of two parts i.e. A) the conclusion and B) the evaluation report. In the conclusion part A, the evaluating Member State considers how the information on the substance can be used for the purposes of regulatory risk management such as identification of substances of very high concern (SVHC), restriction and/or classification and labelling. In the evaluation report part B the document provides explanation how the evaluating Member State assessed and drew the conclusions from the information available.

With this Conclusion document the substance evaluation process is finished and the Commission, the registrant(s) of the substance and the Competent Authorities of the other Member States are informed of the considerations of the evaluating Member State. In case the evaluating Member State proposes further regulatory risk management measures, this document shall not be considered initiating those other measures or processes. Further analyses may need to be performed which may change the proposed regulatory measures in this document. Since this document only reflects the views of the evaluating Member State, it does not preclude other Member States or the European Commission from initiating regulatory risk management measures which they deem appropriate.

[1] http://echa.europa.eu/regulations/reach/evaluation/substance-evaluation/community-rolling-action-plan

Contents

Part A. Conclusion

1. CONCERN(S) SUBJECT TO EVALUATION

N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine, commonly identified by its trade name 77PD, was originally selected for substance evaluation in order to clarify concerns relating to:

- Suspected PBT/vPvB
- High aggregated tonnage

2. OVERVIEW OF OTHER PROCESSES / EU LEGISLATION

There are no other completed or ongoing processes for N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine (77PD) within the framework of the EU chemicals legislation.

It should however be noted that two analogous phenylenediamine substances are also listed in CoRAP:

1 N-(1,4-dimethylpentyl)-N'-phenylbenzene-1,4-diamine (7PPD), EC 221-374-3, CAS 3081-01-4 (2012, Austria: the evaluation is still ongoing)
2 mixture of two components: 1. N-(1,3-dimethylbutyl)-N´-phenyl-p-phenylenediamine 2. N1-(1,3-dimethylbutyl)-N4-(4-(1-methyl-1-phenylethyl)phenyl)benzene-1,4-diamine, EC 448-020-2 (2013, Slovakia: the assessment was ended since there are currently no active registrations).

The conclusion of this substance evaluation does not pre-judge the outcome of the ongoing substance evaluation for 7PPD, EC 221-374-3, CAS 3081-01-4.

3. CONCLUSION OF SUBSTANCE EVALUATION

The evaluation of the available information on the substance has led the evaluating Member State (eMSCA) to the following conclusions, as summarised in the table below.

Table 1

CONCLUSION OF SUBSTANCE EVALUATION Conclusions	Tick box
Need for follow-up regulatory action at EU level *[if a specific regulatory action is already identified then, please, select one or more of the specific follow-up actions mentioned below]*	
Harmonised Classification and Labelling	
Identification as SVHC (authorisation)	
Restrictions	
Other EU-wide measures	
No need for regulatory follow-up action at EU level, based on the current information	X

4. FOLLOW-UP AT EU LEVEL

4.1. Need for follow-up regulatory action at EU level

Not applicable. The eMSCA agrees with the following self-classification applied by the registrant(s):

- Acute Tox 4; H302: Harmful if swallowed
- Skin Sens. 1; H317: May cause an allergic skin reaction
- Aquatic Acute 1 (M=10); H400: Very toxic to aquatic life
- Aquatic Chronic 1 (M=10); H410: Very toxic to aquatic life with long lasting effects.

The eMSCA considers that it is currently not a high priority to propose a harmonised classification.

Further data may be requested for 7PPD. This data may be helpful for the PBT assessment of 77PD and can be considered when/if it becomes available.

5. CURRENTLY NO FOLLOW-UP FORESEEN AT EU LEVEL

5.1. No need for regulatory follow-up at EU level

Table 2

REASON FOR REMOVED CONCERN The concern could be removed because	Tick box
Clarification of hazard properties/exposure (but it is not possible to currently conclude definitively on the persistency in soil and in sediment and on the bioaccumulation potential)	X
Actions by the registrant(s) to ensure safety, as reflected in the registration dossiers (e.g. change in supported uses, applied risk management measures, etc.)	

The substance was under evaluation for suspected PBT/vPvB properties in 2012. As a result of the ECHA Decision notified to the registrant(s) on 21 February 2014 requiring further information, the registrant(s) provided information on hydrolysis of the analogue substance p-phenylenediamine 44PD (EC 202-992-2) and on biodegradation in a soil simulation test with the analogue substance p-phenylenediamine 7PPD. The eMSCA examined the submitted information in accordance with article 46(3) of the REACH Regulation.

In order to come to a conclusion on the PBT/vPvB character of 77PD, the fate of the parent compound 77PD and its degradation products was assessed for all the relevant environmental compartments and also the fate and the properties of structurally similar p-phenylenediamines were taken into account.

In water, 77PD is probably not persistent as it hydrolyses rapidly (measured half-life = 5.3 h at pH 7, which is 181 times faster than the threshold value for the half-life in fresh water). None of the degradation products meet the screening criteria for P and B and they are considered not relevant in the further PBT/vPvB assessment.

For the soil and sediment compartments, it is not feasible to come to a definitive conclusion due to the remaining uncertainty regarding whether the P criterion is fulfilled or not as a result of the substantial NER formation in the soil simulation study on the analogue 7PPD. Nevertheless, it is noted that:

- Under aerobic conditions the eMSCA considers it unlikely that 77PD meets the persistence criterion in soil.

- No testing on sediment is available. No conclusion is reached on degradation in sediment as there is no information on the adsorption rate compared to the rate of hydrolysis.

- Under anaerobic (flooded) conditions, the eMSCA considers that 77PD is very persistent in soil and probably also in sediment.

- The eMSCA considers that the impact of the anaerobic (flooded) part of the soil and the sediment is less important because higher organisms hardly reside in such soil and sediment layers.

- Direct environmental release of 77PD will be to water and air and in these oxygen rich environments substantial degradation will occur. Further, the 77PD fraction that enters the soil or the sediment compartment passes via a zone that is in close contact with air or water and in these aerobic zones further degradation of 77PD is expected to take place. However, some uncertainty remains as a comparison between the adsorption potential and the hydrolysis rate of the substance is missing.

Aquatic bioaccumulation data are not available for 77PD and they are considered of lesser relevance due to the instability of 77PD in water. None of the hydrolysis products meet the screening criteria for P and B and they are considered not relevant in the further PBT/vPvB assessment.

There are indications that 77PD may bioaccumulate in air-breathing organisms (log K_{ow} = 6.3 and log K_{oa} = 11.7) but measured bioaccumulation data for terrestrial organisms are not available.

If further data relevant for the bioaccumulation assessment become available for the analogue substance 7PPD, this data can be considered for the bioaccumulation assessment of 77PD.

The T criterion is fulfilled based on a long-term aquatic toxicity study in fish with the analogous substance 6PPD (NOEC = 0.0037 mg/L).

Based on the currently available information, the eMSCA concludes that 77PD is not persistent in the aquatic compartment. For soil and sediment the persistence depends on the presence of oxygen and so a generally valid conclusion on persistence of 77PD cannot be drawn for these compartments. Also regarding the bioaccumulation potential a definitive conclusion cannot be drawn. However, taking into account all the relevant information (on hazard and exposure), the eMSCA estimates that risks associated with the potential PBT/vPvB properties of 77PD are limited and in absence of an effective approach to evaluate NERs further testing is considered not appropriate for the moment. However, any new data provided for the ongoing assessment of the related substance 7PPD may be helpful for the PBT/vPvB assessment of 77PD.

5.2. Other actions

Not applicable.

6. TENTATIVE PLAN FOR FOLLOW-UP ACTIONS (IF NECESSARY)

Not applicable.

Part B. Substance evaluation

7. EVALUATION REPORT

7.1. Overview of the substance evaluation performed

77PD was originally selected for substance evaluation in order to clarify concerns with regard to:

- Suspected PBT/vPvB
- High aggregated tonnage

Table 3

EVALUATED ENDPOINTS Endpoint evaluated	Outcome/conclusion
Persistence	77PD is probably not persistent in water as it hydrolyses quickly (half-life of 5.3 hours at pH 7). None of the hydrolysis products meet the screening criteria for P and B and they are considered not relevant in the further PBT/vPvB assessment. 77PD is not readily biodegradable, but biodegradation is less relevant for the aquatic compartment due to the fast hydrolysis. 77PD seems unlikely to be persistent under aerobic conditions in soil, but a definitive conclusion cannot be reached currently. 77PD is very persistent under anaerobic (flooded) conditions in soil and probably also in sediment. Some uncertainty remains however for the sediment compartment as no testing in this compartment is available. <u>Conclusion</u> The eMSCA considers that the vP criterion is fulfilled under anaerobic (flooded) conditions, but it seems unlikely that the P criterion is fulfilled under aerobic conditions. These conclusions are valid for the soil compartment while some uncertainty remains for the sediment compartment. Before 77PD can reach the anaerobic part of the soil/sediment, it must pass via soil/sediment layers in contact with water and/or air. Therefore, in real field conditions, the fate of 77PD in

	the aerobic part of the soil/sediment is considered by the eMSCA to be much more relevant than in the anaerobic part.
Bioaccumulation	A QSAR estimated BCF-value of 6692 L/kg is determined indicating a potential to bioaccumulate in aquatic organisms. However, due to the instability of 77PD in water, aquatic bioaccumulation is considered to be of lesser relevance. The hydrolysis products do not meet the screening criteria for B. There are indications that 77PD may bioaccumulate in air-breathing organisms (log K_{ow} = 6.3 and log K_{oa} = 11.7) but measured bioaccumulation data for terrestrial organisms are not available. Because it is concluded that 77PD is probably only persistent under anaerobic (flooded) conditions and higher organisms hardly reside in anaerobic conditions, potential risks triggered by terrestrial bioaccumulation seem limited. If further data relevant for the bioaccumulation assessment become available for the analogue substance 7PPD, this data can be considered for the bioaccumulation assessment of 77PD.
Toxicity	A long-term aquatic toxicity study in fish with the analogous substance 6PPD provides an NOEC-value of 0.0037 mg/L. Therefore, according to Annex XIII 1.1.3 (a) of the REACH Regulation, the T criterion is fulfilled.

7.2. Procedure

Pursuant to Article 45(4) of the REACH Regulation the Competent Authority of Belgium has initiated substance evaluation for N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine, CAS No 3081-14-9 (EC No 221-375-9) based on registration dossiers submitted by the concerned registrant(s) and prepared the present decision in accordance with Article 46(1) of the REACH Regulation.

On the basis of an opinion of the ECHA Member State Committee and due to initial grounds for concern relating to suspected PBT and high aggregated tonnage N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine was included in the Community rolling action plan (CoRAP) for substance evaluation pursuant to Article 44(2) of the REACH Regulation to be evaluated in 2012. The CoRAP was published on the ECHA website on 29 February 2012. The Competent Authority of Belgium was appointed to carry out the evaluation.

The evaluating MSCA considered that further information was required to clarify the abovementioned concerns. Therefore, it prepared a draft decision pursuant to Article 46(1) of the REACH Regulation to request further information and submitted the draft decision to ECHA on 28 February 2013.

After discussion in the Member State Committee on 4-8 November 2013, a unanimous agreement of the Member State Committee on the draft decision was reached. ECHA notified the registrant(s) of the decision pursuant to Article 51(6) of the REACH Regulation on 21 February 2014 requesting the robust summary of a completed hydrolysis test with the analogue substance 44PD and a soil simulation test at 12 °C with 77PD or with the analogue substance 7PPD.

In accordance with Article 46(2) the registrant(s) updated their dossier on 17 February 2016 with the requested information.

In accordance with Article 46(3), the evaluating Member State started the second round of the evaluation without undue delay.

In accordance with Article 46(4), the evaluating Member State finished its evaluation activities within 12 months of the information being submitted.

7.3. Identity of the substance

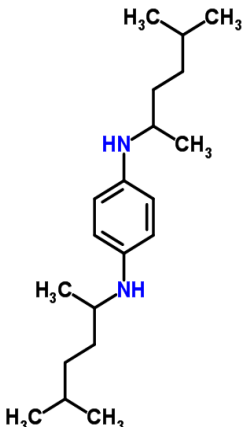
Identity of evaluated substance

Table 4

SUBSTANCE IDENTITY	
Public name:	N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine; 77PD
EC number:	221-375-9
CAS number:	3081-14-9
Index number in Annex VI of the CLP Regulation:	Not applicable
Molecular formula:	$C_{20}H_{36}N_2$
Molecular weight range:	304.5 g/mol
Synonyms:	77PD Santoflex 77PD liq Flexzone®4L Naugard®I-2 Vulkanox 4030

Type of substance X Mono-constituent ☐ Multi-constituent ☐ UVCB

Structural formula of 77PD:



Identity of relevant analogous substances

Table 5

SUBSTANCE IDENTITY	
Public name:	N-(1,4-dimethylpentyl)-N'-phenylbenzene-1,4-diamine; 7PPD
EC number:	221-374-3
CAS number:	3081-01-4
Index number in Annex VI of the CLP Regulation:	not listed in annex VI
Molecular formula:	$C_{19}H_{26}N_2$
Molecular weight range:	282.4 g/mol
Synonyms:	7PPD

Type of substance X Mono-constituent ☐ Multi-constituent ☐ UVCB

Structural formula of 7PPD:

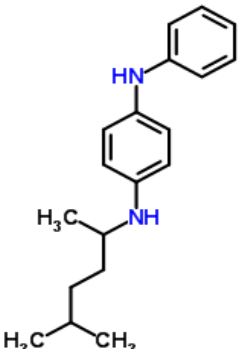


Table 6

SUBSTANCE IDENTITY	
Public name:	N,N'-di-*sec*-butyl-p-phenylenediamine; 44PD
EC number:	202-992-2
CAS number:	101-96-2
Index number in Annex VI of the CLP Regulation:	not listed in annex VI
Molecular formula:	$C_{14}H_{24}N_2$
Molecular weight range:	220.4 g/mol
Synonyms:	44PD Ethanox ® 4720 Antioxidant Santoflex 44PD liq

Type of substance X Mono-constituent ☐ Multi-constituent ☐ UVCB

Structural formula of 44PD:

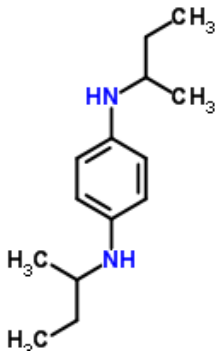
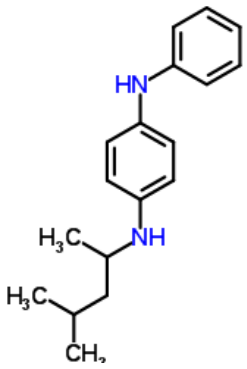


Table 7

SUBSTANCE IDENTITY	
Public name:	N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine; 6PPD
EC number:	212-344-0
CAS number:	793-24-8
Index number in Annex VI of the CLP Regulation:	not listed in annex VI
Molecular formula:	$C_{18}H_{24}N_2$
Molecular weight range:	268.4 g/mol
Synonyms:	6PPD

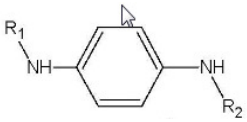
Type of substance X Mono-constituent ☐ Multi-constituent ☐ UVCB

Structural formula of 6PPD:



The following elements indicate that read-across between the 4 analogues is plausible:

1. The common moiety which is the para-phenylenediamine structure:



2. The main physico-chemical properties (source = ECHA dissemination website) are in the same range:

	6PPD	**7PPD**	**77PD**	**44PD**
Melting point	49.2 °C	32.4 °C	<-50 °C	17 °C
Boiling point	163-165 °C @ 133 Pa	230 °C @ 466 Pa	164-169 °C @ 120 Pa	310 °C @ 1 atm
Vapour pressure	0.001-0.004 Pa*@ 25 °C	0.000281 Pa*@ 25 °C	< 0.00015 Pa @ 25 °C	0.207 Pa*
Partition coefficient (log K_{ow})	2.46-4.68	5.17*	6.3**	3.5**
Water solubility	ca 1 mg/L @ 50 °C	0.67 mg/L @ pH 7	0.8 mg/L @ pH 9	32-35 mg/L**
Dissociation	6.7*	6.7*	8.59*	7.5

constant (pK_a)				

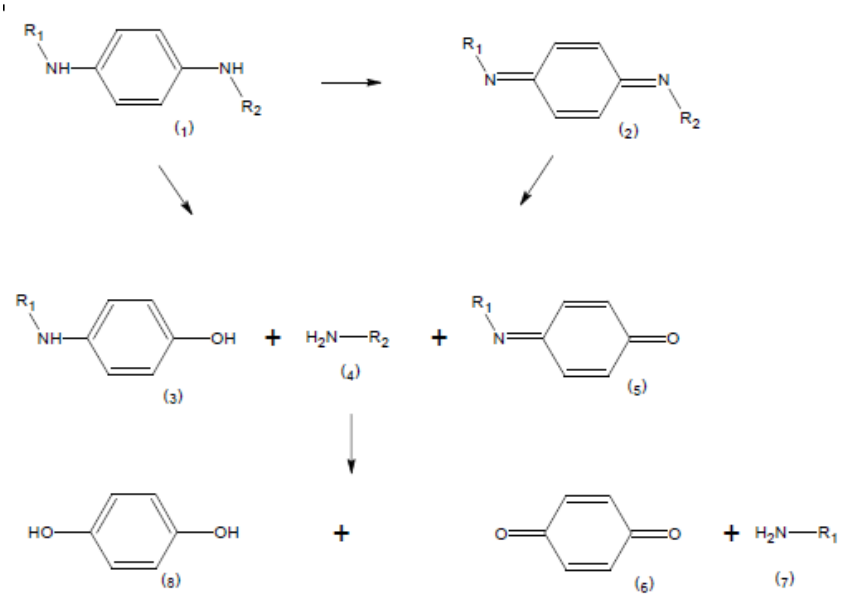
* Calculated value

** Calculated value with EPISuite

3. Similar degradation results, distribution in the environment and hydrolysis pathway:

	6PPD	**7PPD**	**77PD**	**44PD**
% degradation in ready test (dissemination website, key study result)	2 % O_2 consumption, 28 days	0 % CO_2 evolution, 35 days	12 % O_2 consumption, 28 days	No measured data
Biowin v4.10 estimations (default values)	Biowin 2: 0.0564 Biowin 3: 2.3581 Biowin 6: 0.0018	Biowin 2: 0.0467 Biowin 3: 2.3271 Biowin 6: 0.0019	Biowin 2: 0.0059 Biowin 3: 2.2563 Biowin 6: 0.0011	Biowin 2: 0.0192 Biowin 3: 2.4423 Biowin 6: 0.0062
Level III Fugacity (EPISuite v4.1, default values)	Soil: 75 % Sed: 14.2 % Water: 10.8 %	Soil: 67.9 % Sed: 22.5 % Water: 9.6%	Soil: 66 % Sed: 21.7 % Water: 12.3%	Soil: 83.5 % Sed: 1.13 % Water:15.3%

Figure 1: Degradation pathways of para-phenylenediamines



4. Similar range of short-term LC_{50}-values in fish and aquatic invertebrates (source = ECHA dissemination website key experimental study):

	6PPD	7PPD	77PD	44PD
Short-term toxicity to fish	0.028 mg/L (96h LC_{50})	0.028 mg/L (read-across to 6PPD)	0.06 mg/L (96h LC_{50})	0.13 mg/L (96h LC_{50})
Short-term toxicity to aquatic invertebrates	0.23 mg/L (48h EC_{50})	0.2 mg/L (48h LC_{50})	0.37 mg/L (48h LC_{50})*	0.54 mg/L 48h EC_{50})

*Supporting study 007 dissemination website

Based on these comparisons, the eMSCA concludes that a read-across approach between 77PD and 6PPD, 7PPD and 44PD is a useful evaluation method.

7.4. Physico-chemical properties

Table 8

OVERVIEW OF PHYSICOCHEMICAL PROPERTIES OF 77PD	
Property	**Value**
Physical state at 20 °C and 101.3 kPa	Dark red liquid
Vapour pressure	$<1.5 \times 10^{-4}$ Pa @ 25 °C (OECD 104)
Water solubility	21 mg/L @ pH 5 - 22 °C 0.8 mg/L @ pH 9 - 22 °C Parent compound is not stable in water (OECD 105)
Partition coefficient n-octanol/water (log K_{ow})	6.30, calculated with KOWWIN v1.67 Parent compound is not stable in water
Flammability	Not flammable
Explosive properties	No potential for explosivity
Oxidising properties	No oxidising potential
Stability in organic solvents and identity of relevant degradation products	Not available, but instability with solvents as acetone, DMSO, hydrocarbons, ethers is not expected.
Dissociation constant	pK_a = 7.5 (HL^+ / H^+ + L)

	Value is based on read-across from 44PD. Calculated pK_a = 8.59 Both the neutral and the mono-protonated form is expected to be present at pH 7.
Viscosity	28.6 mPa*s @ 37.8 °C (DIN 53015)
Soil adsorption coefficient (log K_{oc})	4.53 (KOCWIN v2.00) 4.76 (Sabljic) 4.94 (Gerstl) 5.11 (PCKOC v1.66) Value for CSA = 4.76

7.5. Manufacture and uses

7.5.1. Quantities

Table 9

AGGREGATED TONNAGE (PER YEAR)				
☐ 1 – 10 t	☐ 10 – 100 t	☐ 100 – 1000 t	☒ 1000- 10,000 t	☐ 10,000-50,000 t
☐ 50,000 – 100,000 t	☐ 100,000 – 500,000 t	☐ 500,000 – 1000,000 t	☐ > 1000,000 t	☐ Confidential

7.5.2. Overview of uses

Table 10

USES	
Uses as intermediate	/
Formulation	Antioxidant use in acrylate Production of tyres and general rubber goods Antioxidant use in fuel-refineries Formulation into solid matrix
Uses at industrial sites	Antioxidant use in acrylate Antioxidant use in fuel-refineries Production of tyres and general rubber goods
Uses by professional workers	Retreading and recycling Tyre mounting and dismounting and handling of technical rubber goods

Consumer Uses	Use of tyres or technical rubber goods
Article service life	Tyre mounting and dismounting, handling of technical rubber goods and retreading and recycling Use of tyres or technical rubber goods

7.6. Classification and Labelling

7.6.1. Harmonised Classification (Annex VI of CLP)

Not applicable.

7.6.2. Self-classification

- In the registration(s):

Acute Tox 4; H302: Harmful if swallowed

Skin Sens. 1; H317: May cause an allergic skin reaction

Aquatic Acute 1 (M=10); H400: Very toxic to aquatic life

Aquatic Chronic 1 (M=10); H410: Very toxic to aquatic life with long lasting effects.

- The following hazard classes are notified in addition to the self-classification in the registration dossier(s) among the aggregated self-classifications in the C&L Inventory:

Acute Tox 3; H302: Harmful if swallowed

7.7. Environmental fate properties

7.7.1. Degradation

7.7.2. Abiotic degradation

7.7.2.1. Hydrolysis

Two hydrolysis studies are analysed on alkyl substituted PD-compounds, one study with 77PD itself (Registration dossier (Study report,1986)) and one study with the analogue 44PD (Registration dossier (Study report, 2012)).

The available hydrolysis study with 77PD is executed similar to OECD Guideline 111, and is considered reliable with restrictions. In this test the focus was on the chemical analysis of the parent compound 77PD but a detailed identification of the hydrolysis products was

not performed. The hydrolysis rate was monitored at pH 7 and at 25 °C. Depending on the kinetic model used to interpret the experimental data hydrolysis half-lives of 3.6 to 12 hours are determined. This study allows to conclude that 77PD hydrolyses quickly and that the parent compound is probably not persistent in water.

Because this hydrolysis study with 77PD did not allow to conclude on the hydrolysis pattern of 77PD and on the identity of the hydrolysis products, a more recent hydrolysis study according to OECD Guideline 111 was analysed with the analogous substance 44PD. This study is accepted as key study for the assessment of the hydrolysis of 77PD.

From the test results it is concluded that the half-life for hydrolysis of the parent compound 44PD is 5.3 hours at 20 °C. It is noted that hydrolysis proceeds faster as the pH of the solution increases: at pH 4 and 20 °C the DT_{50} is 230 hours, while at pH 9 and 20 °C the DT_{50} is around 1.5 hours. This indicates that protonated forms of phenylenediamine (PD) compounds hydrolyse more slowly.

Nevertheless, all these values are far below the threshold value for persistence in water (i.e. 960 hours). Therefore, the eMSCA concludes that the parent compound 77PD is not persistent in the aquatic compartment.

In addition, this hydrolysis study with 44PD allowed a detailed analysis of the hydrolysis pattern of alkyl substituted PD-compounds in general. Various hydrolysis products were chemically identified by HPLC-UV and HPLC-MS and as a result the hydrolysis reaction mechanism could be clarified. In a first instance equilibrium is established between the reduced form of the substance (=77PD) and the oxidized form (=77QDI). This is a common process that readily takes place whenever O_2 is present. (2 77PD + O_2 ⇽⇾ 2 77QDI + 2 H_2O). The study demonstrates that both the oxidized and the reduced form react away and after 2 days none of the two forms could be detected anymore. The first detectable hydrolysis product is an alkylaminophenol that is formed as a result of the substitution of one of the alkylamino chains by a hydroxyl group. In the case of 77PD this intermediate hydrolysis product is 4-(1,4-dimethylpentylamino)phenol (7PM-OH). Also the second alkylamino group splits off quite readily and after 3 days no 7PM-OH could be detected anymore. At the same time levels of p-benzoquinone and p-hydroquinone are rising and reach a maximum after a few days: the maximum for p-benzoquinone is reached after 2 days and for p-hydroquinone it is reached after 7 days. Also 1,4-dimethylpentylamine is detected. Afterwards a slow decrease of both levels is observed.

Based on the above elements the eMSCA concludes that 77PD and its hydrolysis products are not persistent in water.

The following QSAR results are obtained with EPISuite v4.10 for the main hydrolysis products:

Table 11 Estimated values with EpiSuite

	Readily biodegradable?	BCF-value (regression-based method)
7PM-OH	No	108.8 L/kg wwt
p-benzoquinone (CAS n°: 106-51-4)	Yes	3.162 L/kg wwt
p-hydroquinone (CAS n°: 123-31-9)	Yes	3.162 L/kg wwt
1,4-dimethylpentylamine (CAS n°: 28292-43-5)	No	12.38 L/kg wwt

Based on these results, the eMSCA concludes that there is no concern for any of the hydrolysis products to be persistent and bioaccumulative.

7.7.2.2. Phototransformation/photolysis

Phototransformation in air

The half-life of 77PD in the atmosphere was calculated with the AOPWIN program (v.1.92). In this way the rate constant is estimated for the atmospheric gas-phase reaction between photochemically produced hydroxyl radicals and organic compounds. Taking into account an average OH radicals concentration of 500,000 radicals/cm³, a half-life in air of 1.021 hour is estimated. It should be noted that according to the registered data set the half-life, determined with the same QSAR program, is 3.1 hours.

The eMSCA concludes that phototransformation in air is of low relevance for the assessment of the fate of 77PD due to the low vapour pressure (< $1.5x10^{-4}$ Pa at 25 °C).

Phototransformation in water

In a direct photolysis study (Registration dossier (Study report, 1980)) the parent compound 77PD was exposed to sunlight at midday at a concentration of 5 mg/L in sterile pure water. At 0 °C a half-life of approximately 2 hours was established while controls that were kept in the dark at 23 °C showed a half-life of approximately 4 hours. The result shows that phototransformation in water can be a relevant degradation pathway.

Phototransformation in soil

No relevant data available.

7.7.3. Biodegradation

7.7.3.1. Biodegradation in water

Estimated data

Estimated data were not provided by the registrant(s).

According to Biowin v4.10 estimation performed by the eMSCA the parent compound 77PD is not readily biodegradable. The various submodules of this QSAR model provide the following quantitative predictions for ready biodegradability:

- Biowin 1, linear model : 0.1351
- Biowin 2, non-linear model : 0.0059
- Biowin 3, ultimate survey model : 2.2563 (weeks-months)
- Biowin 4, primary survey model : 3.1916 (weeks)
- Biowin 5, MITI linear model: -0.4789
- Biowin 6, MITI non-linear model : 0.0011
- Biowin 7, anaerobic linear model : -1.1381
- Prediction of ready biodegradability : no

The REACH guidance on PBT assessment (Guidance on Information Requirements and Chemical Safety Assessment Chapter R.11: PBT/vPvB assessment, v3.0, June 2017, Table R.11-4) states that a combination of the estimated values of Biowin 2, 3 and 6 provides a screening indication of the persistent character of a substance. As the estimated values with Biowin 2 and 6 are < 0.5, the probability of fast biodegradation is very low. As the estimated value with Biowin 3 is very close to the cut-off value of 2.25, it is not possible to come to a conclusion with regard to the timeframe for ultimate biodegradation.

Considering that 77PD hydrolyses quickly in water, biodegradation in water is considered less relevant.

Screening tests

A ready biodegradability test was conducted with 77PD according to OECD Guideline 301C (Ready Biodegradability Modified MITI Test (I)(Registration dossier (Study report, 1990)). After 28 days, 12% degradation measured as O_2 consumption was observed. Thus, 77PD is not readily biodegradable.

In an inherent biodegradability study comparable to OECD Guideline 301B (Registration dossier (Study report, 1979), the parent compound 77PD showed 50 % degradation measured as CO_2 evolution, after 35 days. Consequently, the parent compound should be considered as not inherently biodegradable. In this test a considerable amount of CO_2 formation is observed which may result from ultimate biodegradation of hydrolysis products.

Simulation tests (water and sediments)

For 77PD no simulation tests in water or sediment are available.

A simulation test in water is however available for the analogue substance 6PPD (Registration dossier of 7PPD (EC 221-374-3) (Study report, 1981)).

A water die-away test in natural surface water is available for 6PPD:

The primary degradation for biological and chemical transformations of 6PPD was studied using Mississippi river water under aerobic conditions. Sterile and deionized water served as controls in this biodegradation study. After 22 h, when the experiment was finished, 97 % of 6PPD had disappeared from the active river water, 96 % from the sterile river water, and 88 % from the deionized water. The estimated half-lives due to primary transformation ranged from 2.9 to 6.8 hours. No transformation products were identified. The study is not comparable to a full test according to OECD guidelines. The test duration was only 22h. Thus only abiotic degradation can be observed. Taking information from ready biodegradation tests into account, biodegradation is not expected under the test conditions.

This study with 6PPD confirms again that in water abiotic degradation processes such as hydrolysis take place at much higher rates than biodegradation reactions.

Summary and discussion of biodegradation in water and sediment

The eMSCA concludes that biodegradation is less relevant in water due to the quick abiotic degradation of 77PD in this compartment.

It is common practice to evaluate the results of a simulation study performed with sediments together with the results from a simulation study in water as the degradation processes in the two compartments show common characteristics.

For 77PD or its analogues, simulation tests in sediment are not available and it is not justified to extrapolate results from studies in water to the sediment compartment as 77PD shows a high adsorption capacity to organic carbon. Therefore it is not possible to conclude in a reliable way on the persistence of 77PD in sediment based on studies carried out in water.

7.7.3.2. Biodegradation in soil

The eMSCA considers the fate of 77PD in soil relevant as the substance distributes mainly to the soil compartment (see section 7.7.4).

An OECD 307 soil simulation test is available with the analogous substance 7PPD (Registration dossier (Study report, 2015)). Section 7.3 describes the basis of the accepting the read across and compares the molecular structures. A read-across approach in the 77PD evaluation with the analogue substance 7PPD is considered valid as the experimentally measured water solubility of 7PPD is even a little lower than that of 77PD (0.67 mg/L @ pH 7 vs. 0.8 mg/L @ pH 9) and the estimated adsorption capacity of 7PPD is also a bit higher than that of 77PD (estimated log K_{oc}-values are 4.62 for 7PPD and 4.53 for 77PD). Also Biowin 4 predictions estimating primary biodegradation capacities are very similar (3.19 for 77PD and 3.23 for 7PPD). Therefore the degradation of 7PPD in soil is expected to be at least as slow as the degradation of 77PD and

consequently this read-across approach for the endpoint persistence in soil is considered to be sufficiently conservative.

As required by the OECD 307 Guideline, transformation and (bio)degradation processes under both aerobic (non-flooded) and anaerobic, flooded circumstances were monitored. The study clearly showed that these varying circumstances have a substantial influence and that (bio)degradation proceeds faster under aerobic conditions than under anaerobic, flooded conditions. Consequently, it is appropriate to evaluate both parts of this OECD 307 study separately, although a comparison of the results from the two parts (mainly a chemical analysis of the extractable residues) can lead to more insight on the degradation processes taking place under aerobic and anaerobic conditions.

(Bio)degradation in soil under aerobic circumstances

As required by the OECD 307 Test Guideline and in order to get a reliable picture of the rate of decline of 7PPD under aerobic conditions in various soil types, four different soils were used to monitor degradation of 7PPD. These four soil types are characterized as sand-loamy sand (soil I, pH = 3.9), sandy loam (soil II, pH = 5.8), clay (soil III, pH = 7.2) and silt loam (soil IV, pH = 6.5). These soils mainly differ in the average diameter of their constituting particles and in their pH.

After the soils were treated with the test substance and incubated in the dark, the degradation pattern of 7PPD was monitored by applying various extraction techniques: the mixture of acetone and dichloromethane was considered by the registrant(s) to be an efficient extraction solvent for 7PPD and its potential degradation products, so this mixture was selected to start extraction. In a first instance the extraction was executed at ambient temperature, in a second step extraction was performed at reflux temperature in a Soxhlet apparatus. After these two extractions, an alkaline extraction was tried with ammonium hydroxide, acetonitrile and dichloromethane, but this approach was discontinued due to the small residue fractions that were released. Finally, acidic reflux with a hydrogen chloride solution was performed and by doing so radiolabeled material could be further collected, but it was also observed that this technique caused a chemical alteration of the extracted residues. Because this last extraction technique thus did not provide reliable information on the fate of the test substance, it was decided to consider this fraction as belonging to the non-extractable fraction and to add the measured radioactivity with the radioactivity retrieved after full combustion of the soils.

Considering the respective distributions of the applied radioactive material over the extractable fraction, the non-extractable fraction and the CO_2-fraction and taking into account the respective fractions of parent compound retrieved in the extracts, the eMSCA concludes that the soil type has only minor influence on the test results. The quantitative results for the four soils are very similar and the same conclusion regarding the (bio)degradation potential of 7PPD under aerobic circumstances is thus valid for the four soil types that were tested.

The results for soil type II are presented in the table below and the observed kinetic pattern is considered typical for all soils tested in this study:

Table 12

	% Applied Radioactivity						
	0 d	**1 d**	**3 d**	**7 d**	**15 d**	**28 d**	**56 d**
total extractables	77.1	45.7	32.6	14.0	15.2	7.7	9.1
total non-extractables	26.9	49.9	60.4	77.6	77.1	81.9	76.4
CO_2	0	1.2	4.2	3.5	8.0	9.7	8.1
7PPD	68.4	37.4	25.7	9.0	6.3	2.0	-
quinones(hydro+benzo)	6.6	5.7	4.9	1.3	1.3	0.3	-
4-nitroaniline	0.7	0.5	-	-	-	-	-
non-assigned extract.	1.3	2.0	2.0	3.8	7.6	5.4	-
sum extractables	77.0	45.6	32.6	14.1	15.2	7.7	9.1
% (7PPD / sum extract)	89	82	79	64	41	26	-
non-extract. + 7PPD	95.3	87.3	86.1	86.6	83.4	83.9	76.4

Considering the outcome of this test, three important observations can immediately be made. Firstly, non-extractable residue (NER) formation in this test is substantial, already 50 % of the applied radioactive material is non-extractable after 1 day, and the NER-formation increases afterwards, up to 82 % after 4 weeks. There is currently no method available to establish unequivocally the chemical identity of these NERs and so this NER-formation will increase the uncertainty on the calculated degradation rate of 7PPD.

Secondly, it is clear that the rate of the degradation of extractable 7PPD does not follow a first order reaction rate pattern and that the mathematical analysis of the results should be carried out with a biphasic kinetic model.

Thirdly, it seems that several disappearance mechanisms are taking place simultaneously. One may foresee that hydrolysis takes place, just as it does in water. Further, there is substantial NER-formation and possibly even volatilisation as the parent compound may partially degrade and form more volatile degradation products that don't contain the radiolabel. In recent scientific literature (Kästner *et al.*, 2014) it is generally accepted that NER-formation can be caused by three fundamentally different types of processes:

- Type I NERs are physically bound or sequestered residues; the most common binding modes are adsorption and entrapment and these processes affect the substance distribution between solid and liquid phases in the soil. This type of association is

considered to be mostly reversible. It is assumed that an equilibrium is established between sequestered and solubilized substance. The substance is considered to be not degraded.

- Type II NERs are covalently bound and consist of parent compound and transformation products that have reacted chemically with humic substances in the soil.

- Type III NERs or biogenic NERs are formed as a result of microbial activity; microorganisms use the xenobiotic as an energy source or as a carbon source and they can do so directly or indirectly via CO_2 fixation. Biogenic NER cannot be distinguished from other biogenic residues or organic matter.

It is found that in the tests under aerobic conditions the decline of extractable 7PPD follows a hockey stick like curve: a fast decline is seen in a first period (0-3 days) and afterwards (3-28 days) the decline proceeds considerably slower. This kinetic pattern suggests that not only irreversible (degradation) reactions play a role but also a reversible process that tends to reach an equilibrium like type I NER formation. If only irreversible processes would take place, the decline of extractable 7PPD would follow a first order kinetic pattern.

The mathematical analysis of the decline of extractable 7PPD was carried out with CAKE v2.0 software. Two kinetic models seem appropriate for this purpose as they both allow to derive first order reaction rate constants and half-lives from the experimental results. The double-first-order in parallel (DFOP) model provides two DT_{50}-values, one for a "faster" process and one for a "slower" process. The respective DT_{50}-values are 0.231 day and 3.68 day. The hockey stick (HS) model provides higher DT_{50}-values: 1.81 day and 11.3 day. Both models point out that even in the slower phase the decline of extractable 7PPD proceeds rather quickly. The greatest DT_{50}-value amounts to 11.3 day and as this value is much smaller than the threshold value for persistence in soil (120 day), it seems that 7PPD is not persistent in (aerobic) soil.

However, this analysis assumes implicitly that NERs do not contain non-degraded 7PPD and as that is unlikely to be the case here this half-life determination is deemed to be not conservative enough.

The crucial element in the correct determination of the 7PPD half-life is the estimation of the fraction of the NERs that consist of non-degraded 7PPD. It seems reasonable to assume that adsorption proceeds quickly and looking at the breakpoint in the decline curve, around 50 % of the NERs consist of non-degraded 7PPD. This estimate is in line with the results of the test in anaerobic conditions where we see that there is around 40 % NER-formation after 1 day and where the NER-formation does not increase later on in the test. If more than 50 % of the NERs would consist of non-degraded adsorbed 7PPD, one may expect to find also more than 50 % NER-formation in the anaerobic (flooded) test and that is not the case.

In order to explore the potential persistent character of 7PPD in aerobic soil further, the following analysis can be developed. As regards the persistence in soil the extreme worst case situation would be that all NERs consist of non-degraded 7PPD. Based on this hypothesis, the amount of extractable 7PPD and the amount of NERs should be added when analysing the data mathematically. Proceeding in this way for the data collected

after 28 days, the amount of remaining 7PPD would be 83.9 % (81.9 % + 2.0 %). Using first order kinetics, the corresponding half-life value would be 111 days, which is still lower than the cut-off value for persistence in soil. Although this reasoning relies on a rough approximate mathematical approach, it indicates that it is unlikely that 7PPD meets the persistence criterion in soil.

Currently, the eMSCA cannot present a definitive conclusion regarding the soil simulation test under aerobic conditions and cannot derive a reliable half-life value for 7PPD due to the remaining NER uncertainties. Nevertheless, the eMSCA concludes that chemical transformation of 7PPD (formation of type II and III NER) takes place to a reasonable extent and it seems likely that mainly type II NER formation occurs. Besides the arguments presented in the previous paragraphs, three further observations can be made to support this conclusion:

- in the aerobic part of the study the amount of extractable 7PPD decreases continuously in the period between day 3 and 28 (day 3 = 25.7 % ➔ day 28 = 2.0 %), while such a decline is not seen at all in the anaerobic study. This indicates that the decline observed in the aerobic study is caused by chemical transformation and not by adsorption or entrapment. Assuming first order kinetics the observed decline corresponds with a half-life of 6.8 days, which is far below the threshold value for persistence.

- the ratio between the amount of extractable 7PPD and the total amount of extractables decreases between day 3 and day 28 from 0.79 to 0.26. If one assumes that the test item adsorbs to the same extent as its degradation products, then potential adsorption does not influence these values anymore and the decrease can be fully attributed to chemical transformation. Again assuming first order kinetics the observed decline corresponds with a half-life of 15.6 days, which is also below the threshold value for persistence.

- it should be noted that soil III mainly consists of clay while the other soils used in the aerobic part of the study contain a much smaller fraction of clay. Clay consists of particles with diameters smaller than 2 µm and consequently the adsorption capacity of soil III is expected to be greater than the adsorption capacity of the other soils. If the NERs are mainly formed by adsorption, soil III should show substantially more NER formation than the other soils. As this is not the case, adsorption is probably not the main driver of the NER formation in the test under aerobic conditions.

Based on all these elements the eMSCA concludes that it is likely that under aerobic conditions NERs only partly consist of non-degraded 7PPD and that chemical transformation takes place at a relevant rate. Therefore it seems unlikely that 7PPD, and thus also 77PD, meet the persistence criterion in soil under aerobic conditions.

<u>(Bio)degradation in soil under anaerobic (flooded) circumstances</u>

For the soil simulation test under anaerobic (flooded) conditions only one soil type has been used, i.e. a sandy loam soil (cf. soil type II in the aerobic study) mainly containing large particles with a diameter >50 µm.

The main raw data obtained from the anaerobic (flooded) part of the soil simulation study are summarised in the following table:

Table 13

	% Applied Radioactivity							
	4 h	**1 d**	**3 d**	**7 d**	**15 d**	**28 d**	**56 d**	**120d**
flood water	n.a.	2.8	3.5	2.1	2.7	2.0	2.0	1.9
extractables	49.5	50.0	59.4	55.3	57.9	57.3	55.6	53.6
non-extractables	45.6	41.9	33.3	35.4	36.0	40.1	43.6	37.7
CO_2	-	<0.1	0.1	0.3	0.4	0.4	0.7	0.7
extractable 7PPD	36.9	23.2	13.1	13.1	17.7	19.4	13.5	17.0
extractable 7PQDI	5.7	20.5	38.1	35.8	33.9	30.9	26.4	7.5
"other" extractables	6.9	6.3	8.2	6.4	6.3	7.0	15.7	29.1
% 7PPD/sum extract.	75	46	22	24	31	34	24	32

If the raw data from this anaerobic part of the study are compared with the results from the aerobic part, it is clear that the degradation patterns differ completely.

In this part of the study, the soil is flooded 4 hours after the parent compound had been applied. The transition from the aerobic stage to the anaerobic stage proceeds progressively and this process may take a few hours up to a few days. This assessment is supported by the observation that the concentration of the oxidized form (= 7PQDI) of the test item reaches its maximum level after 3 days.

In strong contrast to the aerobic part of the study, it is observed that the amounts of extractables, non-extractables and CO_2 remain stable during the whole period of the test. Further it is also noted that the amount of parent compound 7PPD does not seem to decrease anymore after 3 days. The measured levels after 14, 28, 56 and 120 days are even higher than after 3 or 7 days and this forms a strong indication of the highly recalcitrant character of 7PPD under these conditions. This observation is supported by the fact that only 0.7 % radiolabelled CO_2 is formed after 120 days.

As long as oxygen is present, 7PPD is susceptible to oxidation and 7PQDI (= oxidized form) is easily formed. Once oxygen has disappeared from the medium, the remaining 7PPD does not react any further and the concentration of 7PQDI, which is considered to be less stable than 7PPD, decreases as further degradation reactions with this form take place. Overall, these elements show that 7PPD seems to be very persistent under anaerobic conditions in soil.

In order to get a quantitative indication of the (bio)degradation under anaerobic conditions, kinetic simulation models were applied. Two models seem to be most appropriate as they both allow to calculate two first order rate constants. These models are the Double First Order in Parallel model (DFOP) and the hockey stick model (HS). In contrast, the First Order Multi Compartment model (FOMC), also known as the Gustafson

and Holden model, determines parameters (alpha/beta) that cannot be interpreted as rate constants and therefore they are less appropriate for this analysis.

The DFOP model predicts k_1 and k_2-values of respectively 1.18 and $1.91x10^{-15}$. The hockey stick model predicts k_1 and k_2-values of respectively 0.464 and $6.14x10^{-13}$. The eMSCA considers that the k_1-values can be interpreted as rate constants for disappearance under aerobic conditions and k_2-values can in turn be interpreted as rate constants for degradation under anaerobic (flooded) conditions. The estimated k_1-values are around 1 and are in line with the k_1-values found in the aerobic tests. This is to be expected as the conditions during the first hours and days are similar in both tests. These k_1-values around 1 would suggest the non-persistent character of 7PPD under aerobic circumstances.

The respective k_2-values $1.91x10^{-15}$ (DFOP model) and $6.14x10^{-13}$ (HS model) correspond respectively with DT_{50}-values of $3.6x10^{14}$ and $1.1x10^{12}$ days. These enormous half-life values indicate extreme persistence.

Based on these elements, the eMSCA concludes that 7PPD, and thus also 77PD, are very persistent in soil under anaerobic (flooded) conditions.

Summary and discussion on degradation

Aquatic Compartment

It is concluded that abiotic degradation of 77PD in aquatic solution occurs fast. The experimental hydrolysis half-life is found to be around 5.3 hours. The parent compound 77PD is not proven to be readily or inherently biodegradable. This is considered less relevant however due to the fast hydrolysis. Moreover, none of the hydrolysis products screen to be potential PBT/vPvB substances.

Therefore, in view of the rapid hydrolysis 77PD is considered to be probably not persistent in the aquatic compartment.

Soil and Sediment Compartment

Based on the results from the soil simulation study on 7PPD, the eMSCA concludes that 77PD seems unlikely to be persistent in soil and sediment under aerobic conditions. In contrast, under anaerobic (flooded) conditions 77PD is very persistent in soil and probably also in sediment although no definite conclusions can be taken for the sediment compartment. In Annex XIII of the Reach Regulation only one threshold value for persistence in soil and sediment is mentioned and different behavior under aerobic and anaerobic conditions is not considered. Therefore, the relevance of these conditions in field situations should be taken into account when presenting an overall conclusion.

Firstly, substances that enter the soil and sediment compartment always pass via a zone that is in close contact with air or water and these upper layers in soil and sediment constitute an oxygen rich area. Therefore, considering the likely non persistent character of 77PD in these aerobic layers only a minor fraction of the substance could reach the anaerobic part of the soil or the sediment but this depends on the comparison between the rate of hydrolysis and the rate of adsorption for which no data are available.

Even if the substance accumulates in anaerobic sewage sludge, when this sludge is disposed of, for example as fertilizer in agriculture, re-exposure to aerobic conditions is likely to allow degradation to occur again.

Further, the eMSCA considers that aerobic environments are intrinsically more relevant than anaerobic environments in the framework of environmental risk assessment because higher species do not live permanently in anaerobic environments.

Therefore, the eMSCA concludes that in field situations aerobic conditions are much more relevant than anaerobic conditions in the assessment of the persistence of 77PD. Although a definitive conclusion cannot be presented, the eMSCA estimates that in field conditions 77PD seems unlikely to be persistent in soil and sediment.

7.7.4. Environmental distribution

The registrant(s) provided an environmental distribution estimation according to a Mackay Level I fugacity model:

- Air : 0.00024 %
- Water : 0.31 %
- Soil : 49.4 %
- Sediment : 49.9 %

The eMSCA applied the Mackay level III fugacity model (EPISuite v4.1)) and found a comparable result applying a log K_{ow} of 6.3 and water solubility of 0.8 mg/L:

- Air : 0.063 %
- Water : 12.2 %
- Soil : 65.4 %
- Sediment : 22.4 %

The Mackay level I fugacity model does not take transformation (e.g. photolysis, biodegradation) and active transport into account (closed system in equilibrium). In contrast, the level III model takes these processes into account and is considered a more realistic estimation of the environmental fate of the substance (open system in steady state).

The eMSCA concludes that the parent compound 77PD mainly distributes to soil and sediment.

7.7.5. Bioaccumulation

Aquatic bioaccumulation

There is no experimental bioaccumulation study in aquatic species available for 77PD.

The estimation program BCFBAF v3.01 using the regression method predicts a BCF-value of 6692 L/kg, indicating that 77PD potentially meets the vB criterion. Because the parent compound 77PD is not stable in water, the experimental determination of a BCF-value for 77PD is considered to be of less relevance.

Further, none of the degradation products of 77PD show the potential to bioaccumulate in the aquatic environment (see section 7.7.2.1).

It is noted that an OECD 305 fish bioaccumulation study recently became available for the analogue substance N-1-methylheptyl-N'-phenyl-p-phenylenediamine, 8PPD (EC 239-281-1, CAS 15233-47-3). The study was provided in the registration dossier of 7PPD and used by the registrant(s) of 7PPD in a weight of evidence approach. It has not been evaluated by the Belgian CA as it was provided at the end of the follow-up process for 77PD. However, the 8PPD study is being evaluated by the Austrian Competent Authority in the context of their ongoing substance evaluation of 7PPD.

8PPD has branched alkyl side chains with 8 carbon atoms and can be expected to be more lipophilic than 77PD:

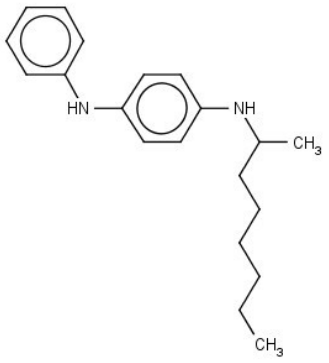


Figure 2: Structure of 8PPD

According to the registration dossiers for 7PPD, the BCF of 8PPD is 1700. If further data relevant for the bioaccumulation assessment become available for the analogue substance 7PPD, this data can be considered for the bioaccumulation assessment of 77PD.

Terrestrial bioaccumulation

For the parent compound 77PD no terrestrial bioaccumulation studies are available. The following QSAR estimated data are available: BCF-value (in water) = 6692 L/kg; log K_{ow} = 6.3 (via KOWWIN v1.68); log K_{oa} = 11.7 (via KOAWIN v1.10). As indicated in the

Guidance on Information Requirements and Chemical Safety Assessment (Chapter R.7.10.12, v3.0, June 2017), respiratory elimination in air-breathing organisms occurs via lipid-air exchange, and such exchange declines as the octanol-air partition coefficient (K_{oa}) increases, with biomagnification predicted to occur in mammals at a log K_{oa} above 5. In the guidance on PBT/vPvB assessment it is noted that substances with a combination of log K_{ow} > 2 and log K_{oa} > 4.5 have the potential to accumulate more preferably into air-breathing organisms than in aquatic organisms. Therefore, the eMSCA concludes that 77PD shows a potential to bioaccumulate in terrestrial organisms.

The registrant(s) further indicate that the data suggest that intestinal absorption subsequent to oral ingestion takes place. Moreover, they indicate that this assumption is confirmed by data from acute oral toxicity studies and a repeated dose toxicity study. (see section 7.9.1)

Summary and discussion of bioaccumulation

For the aquatic compartment, bioaccumulation of 77PD is considered less relevant due to the instability of 77PD in water. The hydrolysis products do not meet the screening criteria for B.

For the terrestrial compartment no definitive conclusion on bioaccumulation potential can be drawn. The eMSCA considers it disproportionate to request further testing on this endpoint for 77PD given the remaining uncertainty related to the (bio)degradation in soil (see 7.7.3).

If further data relevant for the bioaccumulation assessment become available for the analogue substance 7PPD, this data can be considered for the bioaccumulation assessment of 77PD.

7.8. Environmental hazard assessment

7.8.1. Aquatic compartment (including sediment)

Due to the quick hydrolysis of 77PD in water, the effect of the secondary metabolites p-benzoquinone, p-hydroquinone and 1,4-dimethylpentylamine on aquatic organisms is also considered. No measured data on 1,4-dimethylpentylamine is available, but read-across results with butylamine and octylamine show that the effect values of the aliphatic amine components are higher (than the aromatic effect values) and therefore covered by the ecotoxicity of the parent substances and the aromatic degradation products. Therefore, only the effects of p-hydroquinone and p-benzoquinone are elaborated more in detail below. The eMSCA limited its assessment below regarding p-hydroquinone (CAS 123-31-9) and benzoquinone to the test results provided in the registration(s) of 77PD as supporting studies.

7.8.1.1. Fish

7.8.1.1.1. Short-term toxicity to fish

Method	Results	Remarks	Reference
Pimephales promelas freshwater flow-through equivalent or similar to OECD Guideline 204 (Fish, Prolonged Toxicity Test: 14-day Study)	LC_{50} (14 d): 0.05 mg/L test mat. (meas. (geom. mean)) based on: mortality (C.L. 0.048-0.061 mg/L) LC_{50} (96 h): 0.06 mg/L test mat. (meas. (geom. mean)) based on: mortality	Reliability 2 (reliable with restrictions) Test material: 77PD	Registration dossier (Study Report,1981)
Pimephales promelas freshwater flow-through equivalent or similar to OECD Guideline 204 (Fish, Prolonged Toxicity Test: 14-day Study)	LC_{50} (14 d): 0.067 mg/L test mat. (meas. (geom. mean)) based on: mortality (C.L. 0.048-0.061 mg/L)	Reliability 2 (reliable with restrictions) Test material: 77PD	Registration dossier (Study Report, 1981)

The acute toxicity of 77PD towards fish was examined in two tests (Registration dossier (Study Reports, 1981)). Both studies (equivalent to OECD Guideline 204) were conducted with a flow-through test set-up and were run for 14 days. LC_{50}-values after 96 hour were found to be 0.14 mg/L and 0.06 mg/L. At the end of the studies, LC_{50}-values decreased further to 0.067 mg/L and 0.05 mg/L.

Method	Results	Remarks	Reference
Pimephales promelas freshwater flow-through EPA((Fish acute toxicity test) 1974)	LC_{50} (96 h) : 0.044 mg/L (nominal) based on mortality	Reliability 2 (reliable with restrictions) Test material: p-hydroquinone	Registration dossier (Study Report,1980)
Brachydanio rerio static equivalent or similar to OECD Guideline 203 (Fish, Acute Toxicity Test)	LC_{50} (96 h) : 0.17 mg/L	Reliability 2 (reliable with restrictions) Test material: p-hydroquinone	Registration dossier (Study Report, 1982)
Pimephales promelas Freshwater	LC_{50} (96 h) : 0.045 mg/L (nominal) based on mortality	Reliability 2 (reliable with restrictions)	Registration dossier (Study Report, 1980)

Method	Results	Remarks	Reference
flow-through EPA((Fish acute toxicity test) 1974)		Test material: p-benzoquinone	

It is noted that both p-hydroquinone and p-benzoquinone have LC_{50}-values of respectively 0.044 mg/L and 0.045 mg/L which are close to the value of 0.06 mg/L for 77PD itself. The registrant(s) concluded to use the LC_{50}-value of 0.06 mg/L for its CSA and the eMSCA agrees to this.

7.8.1.1.2. Long-term toxicity to fish

Method	Results	Remarks	Reference
Oryzias latipes freshwater flow-through OECD 210 (Fish, early-life stage toxicity test)	NOEC (30 d): 0.0037 mg/L LOEC (30 d): 0.011 mg/L (meas. arithm. mean) Based on: behaviour, feeding activity, hatching rate, survival, body weight gain and length	1 (reliable with restrictions) Test material: 6PPD	Registration dossier (Study Report, 2003)

For 77PD, two 14-day studies following a protocol equivalent to OECD Guideline 204 are available (see 7.8.1.1.1). These studies only allow to derive LC_{50}-values, but no NOEC-values.

A flow-through study according to OECD Guideline 210 is carried out with the analogue substance 6PPD (Registration dossier (Study Report, 2003)). In this 30-day study, an NOEC of 0.0037 mg/L and an LOEC of 0.011 mg/L were determined.

7.8.1.2. Aquatic invertebrates

7.8.1.2.1. Short-term toxicity to aquatic invertebrates

Method	Results	Remarks	Reference
Paranytarsus partenogenetica freshwater Static	LC_{50} (48 h) : 1.7 mg/L test mat. (nominal) based on: mobility	2 (reliable with restrictions) Test material: 77PD	Registration dossier (Study Report, 1981)

equivalent or similar to EPA 660/3-75-009			
Daphnia magna freshwater Static equivalent or similar to EPA 660/3-75-009	LC_{50} (48 h) : 0.37 mg/L test mat. (nominal) based on: mobility	2 (reliable with restrictions) Test material: 77PD	Registration dossier (Study Report, 1981)

Two short-term toxicity studies are available with 77PD on aquatic invertebrates. The LC_{50} values were found to be 1.7 mg/L (*Paranytarsus partenogenetica*) and 0.37 mg/L (*Daphnia magna*). It is concluded that 77PD is less acutely toxic to invertebrates than to fish.

Method	Results	Remarks	Reference
Daphnia magna Static ISO 6341 15	EC_{50} (48 h): 0.13 mg/L test mat	2 (reliable with restrictions) Published data Test material : p-hydroquinone	Registration dossier (Study report (1994))

A short-term toxicity study with *Daphnia magna* on the hydrolysis product p-hydroquinone is also available. The EC_{50}-value (48 h) was found to be 0.13 mg/L.

7.8.1.2.2. Long-term toxicity to aquatic invertebrates

Method	Results	Remarks	Reference
Daphnia magna Semi-static OECD 211: Daphnia magna reproduction test	NOEC (21 d): 0.0029 mg/L (reproduction) 0.039 mg/L (body length of parent daphnids) >0.076 mg/L (first day of birth) Values are measured TWA	2 (reliable with restrictions) Test material : p-hydroquinone	Registration dosser (Study report, 2008)

Long-term studies on aquatic invertebrates are not available for 77PD. For the relevant hydrolysis product p-hydroquinone, a 21-day semi-static daphnia magna reproduction study is presented resulting in a 21d NOEC of 0.0029 mg/L.

7.8.1.3. Algae and aquatic plants

Method	Results	Remarks	Reference
Selenastrum capricornutum freshwater ISO 6341 15	EC_{50} (72 h): 0.335 mg/L (growth rate)	2 (reliable with restrictions) Test material : p-hydroquinone	Registration dossier (Study Report, 1990)

Method	Results	Remarks	Reference
Pseudokirchnerella subcapitata Freshwater Static OECD Guideline 201 (Alga, Growth Inhibition test)	EC_{50} (72 h):0.939 mg/L (growth rate) NOEC: 0.0958 mg/L	2 (reliable with restrictions) Test material :44PD	Registration dossier (Study Report, 2008)

Toxicity studies with algae are not available for 77PD, therefore the studies with the analogous substance 44PD and the hydrolysis product p-hydroquinone were analysed. The respective EC_{50}-values are 0.939 mg/L and 0.335 mg/L. The study with 44PD allowed to determine an NOEC-value: 0.0958 mg/L. Based on these results, it is concluded that 77PD is less toxic to algae than to fish or daphnia.

7.8.1.4. Sediment organisms

No data available for 77PD.

7.8.1.5. Other aquatic organisms

No data available for 77PD.

7.8.2. Terrestrial compartment

No data available for 77PD.

7.8.3. Microbiological activity in sewage treatment systems

Method	Results	Remarks	Reference
Activated sludge (static, freshwater) ISO 8192 (Inhibition of oxygen consumption by activated sludge)	EC_{50} (3 h): 57 mg/L (based on respiration rate)	2 (reliable with restrictions) Test material: 77PD	Registration dossier (Study Report, 1990)

An activated sludge test according to the OECD Guideline 209 was carried out with 77PD. In this test a 3h EC_{50}-value of 57 mg/L was determined.

Two studies with the hydrolysis product p-hydroquinone are also available in the registration dossier, showing that p-hydroquinone is relatively toxic to organisms (NOEC = 1 mg/L; IC_{50} = 71 mg/L).

The registrant(s) used the EC_{50}-value of 57 mg/L for their CSA and the eMSCA agrees to this.

7.8.4. PNEC derivation and other hazard conclusions

7.8.4.1. PNEC water

The following study results covering three trophic levels are taken into account for the PNEC derivation in water: NOEC value for fish with 6PPD = 0.0037 mg/L; NOEC value for daphnia with p-hydroquinone = 0.0029 mg/L; NOEC value for algae with 44PD = 0.0958 mg/L. Since fish were determined to be the most sensitive species based on the acute tox tests, an assessment factor of 10 was applied to the NOEC-value for fish leading to a freshwater PNEC of 0.37 µg/L.

For the determination of a saltwater PNEC the same aquatic toxicity data can be used. For the marine environment the assessment factor is 100 and this leads to a saltwater PNEC of 0.037 µg/L.

7.8.4.2. PNEC sediment

No tests are available on sediment organisms with 77PD or its hydrolysis products. Applying the equilibrium partitioning approach based on a freshwater $PNEC_{aqua}$ of 0.37 µg/L, a K_{oc} of 57544 and a Henry's Law constant of 0.00985 $Pa.m^3$/mole, a freshwater $PNEC_{sed}$ of 0.463 mg/kgwwt is determined.

7.8.4.3. PNEC for sewage treatment plant

Considering that residence times in sewage treatment plants are relatively short, it is appropriate to base the PNEC-value on the EC_{50}-value from the toxicity test with 77PD (See 7.8.3). The $PNEC_{stp}$ is 0.57 mg/L by applying an assessment factor of 100.

7.8.5. Conclusions for classification and labelling

The registrant(s) classify the substance as:

Aquatic Acute 1 (M=10); H400: Very toxic to aquatic life

Aquatic Chronic 1 (M=10); H410: Very toxic to aquatic life with long lasting effects.

The eMSCA agrees with this classification.

7.9. Human Health hazard assessment

7.9.1. Toxicokinetics

A toxicokinetic study is not available for 77PD.

It is indicated that 77PD is a dark red/magenta liquid with a low vapour pressure, a molecular mass of 304.5 g/mol and calculated log K_{ow}-value of 6.3 which suggests intestinal absorption subsequent to oral ingestion. Data from acute oral toxicity studies and a repeated dose toxicity study support this assumption:

- Moderate acute oral toxicity is indicated by an oral LD_{50}-value of 730 mg/kg bw in Sprague-Dawley rats: systemic availability indicated by clinical signs like reduced appetite and activity, increased weakness, collapse and death (Registration dossier (Study report, 1973)).
- In a subacute feeding study bioavailability was indicated by decrease in body weight and body weight gain and changes in haematology and in clinical chemistry (Registration dossier (Study report, 1989)).
- In a subchronic feeding study, rats treated with 77PD showed changes in body weight, body weight gain and clinical parameters (Registration dossier (Study report, 1989)).
- In a limited early two-year chronic feeding study with rats, changes in body weight and body weight gain were observed in treated animals (Registration dossier (Study report, 1978)).

Therefore, the eMSCA concludes that the data from repeated dose toxicity studies indicated bioavailability of 77PD via oral route.

Moreover, the acute dermal toxicity is low (LD_{50} = 3160 mg/kg bw) and the occurrence of clinical signs after dermal application (reduced appetite and activity, increasing weakness, collapse and death) indicate systemic availability after dermal exposure.

7.9.2. Acute toxicity and Corrosion/Irritation

Acute toxicity by oral route

The acute oral toxicity of 77PD was evaluated in various acute oral toxicity studies in rats and mice. In the key study, Sprague-Dawley rats were exposed by gavage to 77PD. The oral LD_{50} was 730 mg/kg bw (Registration dossier (Study report, 1973)). This moderate toxicity of 77PD is confirmed by the results found in the other studies.

Based on the results of the studies, the substance 77PD is classified by the registrant(s) as Acute Tox. 4, harmful if swallowed - H302.

Based on the available information, the eMSCA supports this conclusion and considers that there is no further concern for acute oral toxicity and thus no further testing is needed.

Acute toxicity by inhalation route

Only studies with minimal description of methods and results (reliability 3 or 4) are available. No mortality is observed in these studies.

The eMSCA concludes that based on the available information there is no concern for acute inhalation toxicity and thus no further testing is needed.

Acute toxicity by dermal route

The acute toxicity of 77PD was evaluated in an acute dermal toxicity study with New Zealand rabbits. The dermal LD_{50} was >3160 mg/kg bw (Registration dossier (Study report, 1973)).

Considering the available information, the eMSCA considers that there is no concern for acute dermal toxicity and thus no further testing is needed.

Skin irritation

The skin irritating potential of 77PD was evaluated in a study with rabbits according to OECD Guideline 404 (Registration dossier (Study report, 1990)). The erythema and edema scores were always 0 of maximum 4.

The eMSCA considers that there is no concern for skin irritation and thus no further testing is needed.

Eye irritation

The eye irritating potential of 77PD was evaluated in a study performed in rabbits according to OECD Guideline 405.The scores were always 0 (Registration dossier (Study report, 1990)). In an older study (Registration dossier (Study report, 1973)), a very slight irritation was observed with a score of 8.5 on 110.

The eMSCA considers that there is no concern for eye irritation and thus no further testing is needed.

7.9.3. Sensitisation

There are several animal studies available relating to the sensitizing potential of 77PD. Unfortunately, the data are limited in documentation and also have some deficiencies concerning the study design and are not comparable with current guideline studies. However, the registrant(s) concluded that the test substance is sensitizing and therefore they classify the substance as Skin Sens. 1, May cause an allergic skin reaction, H317.

The eMSCA supports this classification and concludes that there is no further concern for skin sensitisation and thus no further testing is needed.

7.9.4. Repeated dose toxicity

By oral route

Method	Results	Rel.	Reference
Subchronic oral toxicity study in SD rats Equivalent to OECD 408 Doses : in males : 0, 100, 250 and 500 ppm (ca. 0, 6.6, 15.9, 32.4 mg/kg bw/d) and in females : 0, 250, 500 and 750 ppm (ca. 0, 18.1, 36.0, 54.5 mg/kg bw/d) Exposure : 92 to 93 days Test material : 77PD	No treatment related clinical signs, gross lesions or histological alterations Slight bw reduction NOAEL (male) : 100 ppm LOAEL (male/female) : 250 ppm (slight bw reduction)	1	Registration dossier (Study report, 1989)
Subacute oral toxicity study in SD rats Doses : 0, 100, 300, 500, 1000 and 2000 ppm (ca. 0, 8.0/9.3, 24.4/26.1, 37.7/43.3, 73.0/79.2 and 142.7/153.8 mg/kg bw/d respectively in males/females) Test material : 77PD	No treatment related clinical signs or histological alterations At 500 ppm : slight bw reduction At ≥ 1000 ppm : increased mean platelets counts NOAEL : 300 ppm LOAEL : 500 ppm (slight bw reduction)	1	Registration dossier (Study report, 1989)
Early 2 year chronic oral toxicity study	No treatment related	2	Registration dossier

in Charles River rats Doses : 0, 30, 100, 300 ppm (ca. 0, 2.25, 7.5, 22.5 mg/kg bw/d) Test material : 77PD	clinical signs, gross lesions or histological alterations At 300 ppm : slight bw reduction NOAEL : 100 ppm LOAEL : 300 ppm		(Study report, 1978)

Several oral repeated dose toxicity studies were performed to evaluate the toxicity of the test substance 77PD. Based on the available information, the suggested NOAEL of 100 ppm (6.6 mg/kg bw/d) is used for DNEL calculation.

Based on the available information, eMSCA considers that there is no concern for repeated dose toxicity via oral route and thus no further testing is needed.

By dermal route

No information available for 77PD.

By inhalation route

Method	Results	Rel.	Reference
Subacute inhalation study in CR rats; 6h/d; 5d/w for 28 d Doses : 50, 250, 500 mg/m³	No treatment related clinical signs, gross lesions or histological alterations	3	Registration dossier (study report, 1979)

Based on the little available information, the eMSCA considers that there is no concern for repeated dose toxicity via inhalation route and thus no further testing is needed.

7.9.5. Mutagenicity

Method	Results	Rel.	Reference
Mammalian cell gene mutation assay (gene mutation) Chinses hamster ovary With and without S9 Test material : 77PD OECD 476	Genotoxicity : negative Cytotoxicity : yes	1	Registration dossier (Study report, 1986)
In vitro mammalian chromosome aberration test Chinese hamster ovary With and without S9 Test material : 77PD OECD 473	Genotoxicity : negative Cytotoxicity : not specified	2	National Toxicology Program, N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine, Fiscal Year 1989, Annual plan.
Bacterial reverse mutation assay (Ames test) *S. Typh* TA98, TA100, TA1535, TA1537 With and without S9 Test material : 77PD OECD 471	Genotoxicity : negative Cytotoxicity : yes	1	Registration dossier (Study report, 1986)
Bacterial reverse mutation assay (Ames test) *S Typh* TA98, TA100, TA1535, TA1537, TA1538 With and without S9 Test material : 77PD	Genotoxicity : negative Cytotoxicity : yes	2	Registration dossier (study report, 1977)
Bacterial reverse mutation assay (Ames test) *S. Typh* TA98, TA100, TA1535, TA1537, TA1538 With and without S9 Test material : 77PD	Genotoxicity : negative Cytotoxicity : yes	2	Registration dossier (study report, 1977)
Bacterial reverse mutation assay (Ames test) *S. Typh* TA98, TA100, TA1535, TA1537, TA1538 Test material : 77PD	Genotoxicity : negative Cytotoxicity : yes	2	Registration dossier (study report, 1976)
Sister chromatide exchange assay in mammalian cells With and without S9 Test material : 77PD	Negative	2	National Toxicology Program, N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine, Fiscal Year 1989, Annual plan.
DNA damage and repair assay, unscheduled DNA synthesis Rat : hepatocytes With met. act. Test material : 77PD	Genotoxicity : negative Cytotoxicity : yes	2	Registration dossier (study report, 1986)

Data from various bacterial mutation assays indicated no genotoxic potential of 77PD. This negative finding is confirmed by the results from mammalian cell mutation assays, *in vitro* chromosomal aberration assay and sister chromatid exchange assay.

Based on the available information, the eMSCA concludes that there is no concern for mutagenicity and thus no further testing is needed.

7.9.6. Carcinogenicity

Method	Results	Rel.	Reference
2-year in rats (Charles River) Feed Doses : 30, 100, 300 ppm (ca. 2.25, 7.5, 22.5 mg/kg bw/d) Test material : 77PD	NOAEL(carcinogenicity) : 300 ppm No increase incidences of neoplasms At 300 ppm : decrease bw and bwg No gross lesions or histological lesions observed	2	Registration dossier (Study report, 1978)

The carcinogenic potential of 77PD was evaluated in an early and limited chronic feeding study in rats (Registration dossier (study report, 1978).

The NOAEL of 22.5 mg/kg bw/d can be used for DNEL.

The eMSCA concludes that based on the available information there is no concern for carcinogenicity and thus no additional testing is needed.

7.9.7. Toxicity to reproduction (effects on fertility and developmental toxicity)

Effects on fertility

Method	Results	Rel.	Reference
3-Generation in rats (Charles River) Feed Doses : 30, 100, 300 ppm Test material : 77PD	NOAEL (fertility) : 300 ppm (highest dose) No adverse effect on fertility observed NOAEL (parental toxicity) : 300 ppm (only slight bw reduction, and liver and kidney weights decreased)	2	Registration dossier (Study report, 1980)

The effect of 77PD on fertility was evaluated in an early three-generation study (Registration dossier (study report, 1980)). No adverse effects on foetal survival or on mating or on fertility indices were indicated.

Developmental toxicity

Method	Results	Rel.	Reference
OECD 414 In rats (Charles River) Gavage Doses : 0, 25, 75 and 100 mg/kg bw/d Exposure : GD 6 to 15 Test material : 77PD	NOAEL (developmental toxicity) : 150 mg/kg bw/d No effect on developmental toxicity NOAEL (maternal toxicity) : 25 mg/kg bw/d At ≥75 mg/kg bw/d : slight bw reduction, increase incidence of ptyalism	1	Registration dossier (Study report, 1986)
Teratogenic study In rabbits (New Zealand White) Doses : 0, 3, 10 mg/kg bw/d Exposure : GD 6 to 18 Test material : 77PD	No difference on the developmental parameters and on the incidence of abnormalities	2	Registration dossier (Study report, 1978)

The developmental toxicity of 77PD was evaluated in a prenatal study (registration dossier (study report, 1986)) and in a teratogenic study (Registration dossier (study report, 1978)). No adverse developmental effect was observed in these two studies.

The eMSCA concludes that based on the available information there is no concern for toxicity to reproduction (fertility or development) and thus no further testing is needed.

7.9.8. Hazard assessment of physico-chemical properties

The substance has no potential for explosivity, is not flammable and does not contain a chemical moiety suggesting an oxidising potential.

7.9.9. Selection of the critical DNEL(s)/DMEL(s) and/or qualitative/semi-quantitative descriptors for critical health effects

In view of the initial concern for 77PD the eMSCA has not evaluated human health effects in detail. According to the registrant(s) the most critical DNEL-value is 0.133 mg/kg bw/d, the value for oral and dermal long-term systemic effects. It should also be noted that the most prominent effect of the substance for workers is skin sensitization for which no DNEL can be derived.

7.9.10. Conclusions of the human health hazard assessment and related classification and labelling

Some indications of effects in haematology and body weight reduction are seen in repeated dose studies but because of the limitations of this evidence no classification STOT RE is proposed. Therefore based on the available human toxicology data the eMSCA agrees with the classification as proposed in the registration dossier(s):

Acute Tox 4; H302: Harmful if swallowed

Skin Sens. 1; H317: May cause an allergic skin reaction

7.10. Assessment of endocrine disrupting (ED) properties

Not evaluated.

7.11. PBT and vPvB assessment

7.11.1. Persistence assessment

Due to the fast hydrolysis the eMSCA considers that 77PD is probably not persistent in the aquatic compartment. For none of the degradation products the screening criterion for P is met.

A soil simulation study is available for the analogue substance 7PPD. For the soil and sediment compartments, it is not feasible to come to a definitive conclusion due to the remaining uncertainty regarding whether the P criterion is fulfilled or not as a result of the substantial NER formation in the soil simulation study.

In anaerobic (flooded) soil 77PD is very persistent. A DT_{50}-value of $2.35x10^{12}$ days is derived.

However, it should be noted that before the substance can enter the anaerobic layers of the soil in field situations, it must pass via zones that are in close contact with air and therefore it is assumed that only small fractions of 77PD can reside in the anaerobic zone of the soil. However, some uncertainty remains as a comparison between the adsorption potential and the hydrolysis rate of the substance is missing. In addition, the aerobic environment is more relevant than the anaerobic environment as no higher species live permanently in anaerobic conditions.

Regarding the sediment compartment, some uncertainty remains as a study according to OECD Guideline 308 is not available for 7PPD and 77PD. Nevertheless in view of the similarities between the soil and sediment compartment, the eMSCA considers it reasonable to provisionally conclude that 77PD is probably not persistent in aerobic sediment and probably very persistent in anaerobic sediment.

7.11.2. Bioaccumulation assessment

Experimental bioaccumulation studies with 77PD are not available.

For the aquatic compartment, the bioaccumulation potential of 77PD is deemed to be less relevant as the parent compound is not stable in water. Based on QSAR estimations, it is shown that none of the various degradation products in water meet the B screening criterion. They all show a sufficient hydrophilic character.

There are indications that 77PD might bioaccumulate in air-breathing organisms (log K_{ow} = 6.3 and log K_{oa} = 11.7). For the terrestrial compartment no definitive conclusion on bioaccumulation potential can be drawn. Experimental studies for this endpoint are not available. The eMSCA considers it disproportionate to request further testing on this endpoint for 77PD given the remaining uncertainty related to the (bio)degradation in soil (see 7.7.3).

If further data relevant for bioaccumulation assessment become available for the analogue substance 7PPD, this data can be considered for the bioaccumulation assessment of 77PD.

7.11.3. Toxicity assessment

A long-term aquatic toxicity study with the analogous substance 6PPD provides an NOEC-value of 0.0037 mg/L. Consequently, as this NOEC-value is lower than 0.01 mg/L, the eMSCA concludes that 77PD meets the T-criterion according to Annex XIII, 1.1.3(a).

7.11.4. Summary and overall conclusions on PBT and vPvB Properties

For the aquatic compartment, the eMSCA considers that it is highly unlikely that 77PD meets the P-criterion due to the rapid hydrolysis.

For the soil and sediment compartment, it is not feasible to come to a definitive conclusion due to the remaining uncertainty resulting from substantial NER formation.

Nevertheless, the eMSCA estimates that it seems unlikely that 77PD meets the persistence criterion in aerobic soil. In contrast, 77PD is very persistent in anaerobic soil and probably also in anaerobic sediment although uncertainty remains as no test in sediment is available

Because aerobic conditions are much more relevant than anaerobic conditions for higher organisms and because only minor fractions of 77PD are expected by the eMSCA to reach anaerobic environments, the eMSCA concludes that no further assessment is needed on the PBT properties. Moreover, in absence of an effective approach to evaluate NERs further testing on 77PD is considered not appropriate for the moment.

The conclusion of this substance evaluation does not pre-judge the outcome of the ongoing substance evaluation for 7PPD, EC 221-374-3, CAS 3081-01-4.

7.12. Exposure assessment

7.12.1. Human health

7.12.1.1. Worker

In view of the initial concern for 77PD the exposure of workers is not evaluated.

7.12.1.2. Consumer

In view of the initial concern for 77PD the exposure of consumers is not evaluated.

7.12.2. Environment

In view of the initial concern for 77PD environmental exposure is not evaluated in detail. This is because environmental exposure is not directly relevant to the PBT concern.

7.12.3. Combined exposure assessment

In view of the initial concern for 77PD combined exposure is not evaluated.

7.13. Risk characterisation

In view of the initial concern for 77PD determination of RCRs is not performed by the eMSCA.

7.14. References

Information from the REACH registration dossiers of 77PD and 7PPD, non-confidential information is available at: https://echa.europa.eu/information-on-chemicals

Kästner Matthias, Karolina M. Nowak, Anja Miltner, Stefan Trapp & Andreas Schäffer (2014) Classification and Modelling of Nonextractable Residue (NER) Formation of Xenobiotics in Soil – A Synthesis, Critical Reviews in Environmental Science and Technology. 44:19, 2107-2171, DOI: 10.1080/10643389.2013.82870

7.15. Abbreviations

44PD : N,N'-di-*sec*-butyl-p-phenylenediamine

44QDI : N,N'-di-*sec*-butyl-1,4-benzoquinone diimine

4PM-OH : 4-(*sec*-butylamino)phenol

6PPD : N-(1,3-dimethylbutyl)-N'-phenylbenzene-1,4-diamine

6PQDI : N-(1,3-dimethylbutyl)-N'-phenyl-1,4-benzoquinone diimine

77PD : N,N'-bis(1,4-dimethylpentyl)-p-phenylenediamine (CAS No 3081-14-9)

77QDI : N,N'-bis(1,4-dimethylpentyl)-1,4-benzoquinone diimine

7PM-OH : 4-(1,4-dimethylpentylamino)phenol

7PPD : N-(1,4-dimethylpentyl)-N'-phenylbenzene-1,4-diamine (CAS No 3081-01-4)

7PQDI : N-(1,4-dimethylpentyl)-N'-phenyl-1,4-benzoquinone diimine

B : bioaccumulative

bw : body weight

CAS No : Chemical Abstracts Service registry number

DNEL : Derived No Effect Level

dw : dry weight

EC_{50} : Effective Concentration, 50 %

EC No : European Community number

ECHA : European Chemicals Agency

eMSCA : evaluating Member State Competent Authority

GD : gestational day

LC_{50} : Lethal Concentration, 50 %

LD_{50} : Lethal Dose, 50 %

LOAEL : Lowest Observed Adverse Effect Level

NER : non-extractable residue

NOAEL : No Observed Adverse Effect Level

OECD :	Organisation for Economic Co-operation and Development
P :	persistent
PBT :	persistent, bioaccumulative and toxic
PD :	phenylenediamine
RCR :	Risk Characterisation Ratio
REACH :	Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning Registration, Evaluation, Authorisation and Restriction of Chemicals
Rel. :	Reliability
SD :	Sprague-Dawley
T :	toxic
vB :	very bioaccumulative
vP :	very persistent
wwt	wet weight