Regulatory Management Option Analysis Conclusion Document

Substance Name: 6PPD and its metabolite 6PPD-quinone
EC Number: 6PPD (212-344-0), 6PPD-quinone (893-269-6)
CAS Number: 6PPD (793-24-8), 6PPD-quinone (2754428-18-5)

Authority: The Netherlands
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Foreword

The purpose of Risk Management Option analysis (RMOA) is to help authorities decide whether further regulatory risk management activities are required for a substance and to identify the most appropriate instrument to address a concern.

RMOA is a voluntary step, i.e., it is not part of the processes as defined in the legislation. For authorities, documenting the RMOA allows the sharing of information and promoting early discussion, which helps lead to a common understanding on the action pursued. A Member State or ECHA (at the request of the Commission) can carry out this case-by-case analysis in order to conclude whether a substance is a 'relevant substance of very high concern (SVHC)' in the sense of the SVHC Roadmap to 2020[1].

An RMOA can conclude that regulatory risk management at EU level is required for a substance (e.g. harmonised classification and labelling, Candidate List inclusion, restriction, other EU legislation) or that no regulatory action is required at EU level. Any subsequent regulatory processes under the REACH Regulation include consultation of interested parties and appropriate decision making involving Member State Competent Authorities and the European Commission as defined in REACH.

This Conclusion document provides the outcome of the RMOA carried out by the author authority. In this conclusion document, the authority considers how the available information collected on the substance can be used to conclude whether regulatory risk management activities are required for a substance and which is the most appropriate instrument to address a concern. With this Conclusion document the Commission, the competent authorities of the other Member States and stakeholders are informed of the considerations of the author authority. In case the author authority proposes in this conclusion document further regulatory risk management measures, this shall not be considered initiating those other measures or processes. Since this document only reflects the views of the author authority, it does not preclude Member States or the European Commission from considering or initiating regulatory risk management measures which they deem appropriate.

[1] For more information on the SVHC Roadmap: http://echa.europa.eu/addressing-chemicals-of-concern/substances-of-potential-concern/svhc-roadmap-to-2020-implementation

1. OVERVIEW OF OTHER PROCESSES / EU LEGISLATION

Recently, (Tian et al., 2021) linked the acute mortality of adult coho salmon (*Oncorhynchus kisutch*) in urban creeks to the exposure to a highly toxic quinone transformation product of N-(1,3-dimethylbutyl)-N′-phenyl-p-phenylenediamine (6PPD), a substance that is globally ubiquitously used as an anti-oxidant compound in rubber tyres and other rubber products. The toxic transformation product was identified as N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine-quinone (6PPD-quinone). An LC_{50} value of 0.79 µg/L was reported. The research group performed a follow-up study to confirm the toxicity estimates. This study reported a lower LC_{50} value of 0.095 µg/L for *O. kisutch* (Tian et al., 2022). Interestingly, the acute toxicity of 6PPD-quinone varies significantly between fish species and even within the Salmonidae family. Still, phylogenetic proximity is not a predictor for acute toxicity, but research is ongoing to elucidate the mode of action and interspecies variation in toxicity. LC_{50} values range from 41 ng/L for *O. kisutch* to > 67 mg/L for *O. tshawytscha* (Lo et al., 2023).

Due to its antioxidant properties and its adequate resistance to mechanical stress, 6PPD is widely used as a protective agent in rubber tyres. Still, via tyre abrasion, 6PPD is widespread released in tyre wear particles over time into the environment, where it can be degraded in a variety of different transformation products (Seiwert et al., 2022). Specifically in reaction with ozone (in air and surface water), 6PPD-quinone can be formed (among various other degradation products). The potential total annual widespread emission of 6PPD from rubber tyres into the environment is estimated to be approximately 130 tonnes in Europe (Emission Analytics, 2022).

The occurrence of 6PPD and 6PPD-quinone has been reported in different regions in urban road soil, air, dust, runoff water, sediments and snow (Jin et al., 2023; Zhao et al., 2023). In 2020, the Norwegian Institute for Water Research (NIVA) and Norwegian Institute for Air Research (NILU) conducted a large screening project in which many known widespread compounds were monitored in water and air samples on different locations (NIVA, 2021). 6PPD-quinone was found in high concentrations in rubber granules from artificial rubber turfs (such as football fields) in all samples (1,900-2,500 ng/g), as well as in untreated tunnel wash water (2,500 – 18,000 ng/L; all samples), WWTP effluent water samples (<10-160 ng/L; 50% of samples), sediment from the marinas (<1 – 1,500 ng/g; 40% of samples), in vehicle wash (<10 – 1,200 ng/m^2; 50% of samples), and dust from artificial turfs (<23-110 ng/sample; 57% of samples). These results demonstrate that 6PPD-quinone is widespread released from tyres and other general rubber goods into the environment.

The CSR of 6PPD on rubber uses by the registrant demonstrates that risks of 6PPD and its degradation products (4-HDPA, aniline, p-benzoquinone and p-hydroquinone) to the aquatic environment (including soil, sediment and STP) are controlled. However, the calculated PEC values are much lower when compared with the (European) measured environmental concentrations. The PNECs derived in the CSR by the registrants for the aquatic compartment are 37 and 370 ng/L for the marine and fresh water compartment, respectively. Those are based on a limited number of aquatic toxicity tests and not sufficiently protective considering the aquatic toxicity of 6PPD-quinone.

The current REACH registration dossier of 6PPD does not mention 6PPD-quinone as a potential degradation product. The hydrolysis section only describes the hydrolytic degradation of 6PPD at pH 7, while hydrolytic transformation to 6PPD-quinone has been shown to occur only at pH 4 (Di et al., 2022). However, the most likely route for transformation from 6PPD to 6PPD-quinone is by ozonation and phototransformation, which has not been assessed in the REACH registration dossier. As the degradation profile of 6PPD is not fully assessed by the registrant, the formation of highly toxic 6PPD-quinone has been overlooked, creating a gap in the risk assessment.

An ARN for a group of Amino-substituted diarylamines was drafted by ECHA in 2023. The group consists of 17 substances including 6PPD and 7PPD.

For 6PPD, a decision on compliance check was sent to registrant(s) 03/2017 with the request to submit information on pre-natal developmental toxicity (OECD 414) and extended one-generation reproductive toxicity (OECD 443). The studies have been provided by registrant(s).

Austria has submitted a CLH-proposal, which proposes the following hazard classes:

- Acute Tox. 4, H302
- Skin Sens. 1A, H317
- Repr. 1B, H360FD
- Aquatic Acute 1, H400
- Aquatic Acute 1, M-factor=10 000
- Aquatic Chronic 1, H410
- Aquatic Chronic 1, M-factor=10

For structural analogue 7PPD, a PBT-assessment and substance evaluation by Austria are ongoing.

Actions not under REACH/CLP

Under the previous EU chemicals legislation, 6PPD has been assessed for PBT- and vPvB properties by the TC NES sub-group on identification of PBT and vPvB substances. It was concluded that 6PPD does not meet the P criteria, and was therefore not considered a PBT substance according to the EU criteria in force at that time. However, it should be noted that these conclusions may no longer be valid given the latest regulatory requirements and scientific knowledge.

6PPD was added to the OSPAR List of Chemicals for Priority Action in 2002 due to its high production volumes >1000 t/y and possible risks to the environment (OSPAR Commission, 2004). OSPAR therefore directs further measures to avoid future risks resulting from production and/or continued use of 6PPD.

In the US state of California, the state Department of Toxic Substances Control (DTSC) has adopted 6PPD on its list of priority products (DTSC, 2022). This requires tyre manufacturers marketing tyres in California to evaluate safer alternatives.

2. CONCLUSION OF RMOA

Considering the below outlined concerns, NL-CA agrees with ECHA's proposal for a restriction for use in tyres to prevent an EU-wide environmental risk as the most suitable regulatory management option. This is the most effective way to tackle the widespread release of 6PPD and its degradation products to the environment.

Furthermore, NL-CA is of the opinion that additional information on the environmental fate of 6PPD and its degradation products is necessary in order to decide on whether an SVHC identification procedure (based on PMT properties) is advisable. Regarding the mobility of 6PPD, relevant information can be obtained via CCH (for example by requesting OECD TG 106). Additional data on P, B and M will result in a final conclusion, but we think it will be a borderline case.

To overcome the problem of regrettable substitution with respect to the replacement of 6PPD with other substances of the same group it is suggested by the NL-CA to determine group members and to combine those substances in a restriction proposal. A suggested grouping approach is described in Annex 5 of the RMOA (Background Document; not for publication). Given the high environmental concern of 6PPD it is suggested not to await test results for other potential group members but to start with the aquatic toxic and reprotoxic substances, among which 6PPD. The NL-CA comes to a slightly different proposal compared to the ARN of ECHA and suggests to combine 6PPD, 7PPD, 8PPD, IPPD, DPPD, EC 448-020-2, BENPAT 44PD and 77PD in a restriction dossier.

Conclusions	**Tick box**
Need for follow-up regulatory action at EU level:	
Harmonised classification and labelling	
Identification as SVHC (authorisation)	
Restriction under REACH	x
Other EU-wide regulatory measures	
Need for action other than EU regulatory action	
No action needed at this time	

3. NEED FOR FOLLOW-UP REGULATORY ACTION AT EU LEVEL

Based on the available information (including scientific literature), the risk characterisation of 6PPD by the registrant does not cover the environmental concerns as raised in the RMOA sufficiently. NL-CA is of the opinion that the aquatic toxicity, high tonnage volumes and wide-dispersive use of 6PPD from rubber goods result in an unacceptable risk to the environment, which allows for a justification for an EU-wide restriction. This can be supported by recently published monitoring studies demonstrating a risk to the environment/human health that is not adequately controlled.

In the ARN on amino substituted arylamines, ECHA proposes a restriction for use in tyres to prevent an EU-wide environmental risk for 6PPD and similar substances. It is however noted by the NL-CA that the very high toxicity to fish is rather specific for 6PPD-quinone (the main metabolite that is formed under environmental relevant conditions) in comparison to other group members. Although, comparable aquatic toxicity is predicted by ECOSAR for other quinones (see Annex 5). The PBT/PMT concern for the group of substances is still under investigation and it seems questionable, even for the group members with the highest concern, if they fulfil the criteria.

NL-CA agrees with the proposed restriction by ECHA, specifically for 6PPD. To overcome

the problem of regrettable substitution it should be assessed in more detail which group members could be added to the restriction proposal based on similar environmental concern (very high aquatic toxicity). At the same time, also Repro 1B. seems a basis for further regulatory action. It is therefore suggested to select the most relevant substances of ARN 298 and to group the highly toxic substances for the aquatic compartment, with the Repro. 1B substances (and the proven PBT/PMT substances) in a restriction proposal.

4. TENTATIVE PLAN FOR FOLLOW-UP ACTIONS IF NECESSARY

An indication of a tentative plan is provided below.

Follow-up action	Date for follow-up	Actor
CCH (on physical-chemical/ PMT properties for 6PPD and its degradation products)		ECHA
A restriction proposal should be drafted for 6PPD and (8) other Repro 1B and Aquat acute 1 amino substituted arylamines		

References

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