

HAZARD IDENTIFICATION FOR 3,5-DICHLOROPHENOL IN THE AQUATIC ENVIRONMENT

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Abstract: The risk assessment of substances in various environmental compartments is essential for their proper, safe and environmentally friendly production, handling, use and final deposition or destruction. Hazard identification is an important part of risk assessment. The aim of our research was to present a methodology for the hazard identification of substances dangerous to the aquatic environment according to the 93/21/EEC Directive relating to the classification, packaging and labelling of dangerous substances, from the adverse effect assessment of chemicals in European Union. A battery of toxicity tests and biodegradability studies with 3,5-dichlorophenol were performed. The substance was classified as toxic to aquatic organisms with possible long-term adverse effects. The presented methodology assures reliable data for the classification and labelling of substances according to their harmful effect on aquatic biota, suitable for the competent authorities at the national and EU level.

Key Words: Hazardous Substance, Hazard Identification, Ecotoxicity, Biodegradability, Aquatic Environment

INTRODUCTION

Various chemicals often enter the environment, causing different adverse effects on plants, animals and man. The accuracy of risk assessment depends on how precise each step of risk assessment (hazard identification, dose-response relationship, exposure assessment and risk characterization) is performed [1]. Thus reliable hazard identification employing a variety of biotests for toxicity and biodegradability evaluation is a prerequisite for adequate risk assessment. In the European Union, the assessment of effects of chemicals is performed as per the 93/21/EEC Directive [2]. Substances that are dangerous for the aquatic environment are classified according to their environmental properties (toxicity, biodegradability and bioaccumulation) and labelled with the symbols N and R. The data required for reliable classification could be gathered from existing databases, experimental work or mathematical modelling (QSAR-Quantitative Structure Activity Relationship).

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MATERIALS AND METHODS

Hazard identification was performed for 3,5-dichlorophenol ($C_6H_4OCl_2$). Its ready biodegradability was assessed using a closed manometric respirometer by measuring oxygen consumption over 28 days [3]. Activated sludge from the aeration tank of the laboratory waste-water treatment plant at a concentration of 30 mg/l was used as an inoculum. Toxicity was determined using a battery of biotests (algae, daphnids, fish) accomplished according to EC Directive demands [2, 4]. The growth of the green algae *Scenedesmus subspicatus* Chodat 1926 was determined by counting cells after 0, 24, 48, and 72 hours. The immobility of the daphnid *Daphnia magna* Straus 1820 was determined after a 48 hours of exposure. The endpoint of the toxicity test with the zebrafish *Brachydanio rerio* Hamilton-Buchanan was the mortality rate after 96 hours. Linear regression analysis was used to establish the 72h EC₅₀ for algae, and the probit analysis was used to provide the 48h EC₅₀ for daphnids and the 96h LC₅₀ for zebrafish.

RESULTS AND CONCLUSIONS

The final level of biodegradation, only 5% after 28 days, indicated that 3,5-dichlorophenol was not readily biodegradable. Its octanol/water partition coefficient, $\log K_{OW}$ 3.62 - 3.68 according to the literature [5], means that it is more soluble in the organic phase than in water phase, leading to possible bioaccumulation in aquatic organisms. The substance exerted toxicity to all the tested organisms: the 72h IC₅₀ value obtained for algae was 2.8 mg/l, the 48h EC₅₀ was 2.8 mg/l for daphnids and the 96h LC₅₀ was 2.9 mg/l for fish.

According to obtained results, 3,5-dichlorophenol was classified as toxic to aquatic organisms with possible long-term adverse effects for the aquatic environment. In our opinion the substance could be labelled as an N R51/R53 substance. Further chronic toxicity testing and microcosm and mesocosm studies, as well as the simulation of biodegradation of the chemical in natural compartments, such as rivers, lakes, sediments, etc. or even field studies, would lead to more ecologically relevant hazard identification.

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