CURRENT ISSUES IN THE ECOTOXICOLOGY OF CHLORINATED PARAFFINS

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Introduction

Chlorinated paraffins (CPs, polychlorinated *n*-alkanes) are a group of complex mixtures with carbon chain-lengths from C_{10} to C_{30} and, typically, from 40 to 70% chlorination[1]. The chlorination process results in a large number of possible congeners, increasing with carbon chain length[2]. However, commercial CPs fall into 3 main categories, based on the alkane feedstock: C_{10} - C_{13} (short-chain, SCCPs), C_{14} - C_{17} (medium-chain, MCCPs) and C_{18} - C_{30} (long-chain, LCCPs). The discrete distribution of chainlengths within each grade imparts particular properties for their different industrial applications, and this is reflected in their different environmental and ecotoxicological characteristics[2]. These differences appear to be largely associated with differences in hydrophobicity and molecular weight.

Comparative ecotoxicology

Previous studies at this laboratory and elsewhere show that SCCPs exhibit chronic toxicity to various algae, aquatic invertebrates and fish at levels down to approximately 10 µg/l (for *Daphnia magna*). Under comparable exposure conditions, up to and exceeding the solubility limit, MCCPs and LCCPs have shown no toxicity to algae, fish and (prior to the present work) various invertebrates[2,3]. The absence of effects on fish of the medium and long-chain grades is supported by data showing reducing bioconcentration with increasing chain length, although the differing test conditions has limited the comparability. The present work aimed to improve the database for MCCPs, by determination of bioconcentration by rainbow trout (*Oncorhynchus mykiss*) and chronic toxicity to *Daphnia magna*.

Bioconcentration

Rainbow trout were exposed, under flow-through conditions, to ^{14}C-labelled, 51% chlorinated n-pentadecane at 1 and 5 µg/l for 35 days, followed by 42 days depuration in clean water. Fish were sampled at intervals for determination of radiolabelled tissue residues. Based on measured water concentrations, the bioconcentration factor (BCF) at the lower exposure level was 860 after 35 days (the kinetic estimate of the steady-state BCF was approximately 1000). BCFs at the higher exposure level were lower, suggesting that the water solubility may have been exceeded. These results confirm that MCCPs bioconcentrate to a significantly lower degree than SCCPs (BCF under comparable conditions[4] of 5300) despite their higher octanol-water partition coefficient.

Daphnia toxicity

The effects of 52% chlorinated MCCP on the survival, reproduction and growth of *Daphnia magna* was assessed over a 21-day exposure, starting with neonates, under semi-static conditions with confirmatory analysis by radiochemistry. Acetone was used as a carrier solvent at 0.025 ml/l. Based on measured concentrations, the lowest observed effect concentration (LOEC) was 18 µg/l, with a NOEC of 10µg/l. These effect levels are comparable with the those for SCCPs.

Thus to date, *Daphnia* is the only species of aquatic organism to have shown any adverse effects from exposure to MCCPs. Because the *Daphnia* NOEC is close to (or possibly above) the water solubility of MCCPs, the result raises questions regarding the bioavailability to *Daphnia* of undissolved CP, and the environmental realism of particulate dispersions of the substance which may be induced by the use of carrier solvents when solubility is exceeded.

References

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