Aquatic toxicity of PAHs and PAH mixtures at saturation to benthic amphipods: Linking toxic effects to chemical activity

Organisms in marine sediments are usually exposed to mixtures of polycyclic aromatic hydrocarbons (PAHs), whereas risk assessment and management typically focus on the effects of single PAHs. This can lead to an underestimation of risk if the effects of single compounds are additive or synergistic. Because of the virtually infinite number of mixture-combinations, and the many different targeted organisms, it would be advantageous to have a model for the assessment of mixture effects. In this study we tested whether chemical activity, which drives the partitioning of PAHs into organisms, can be used to model the baseline toxicity of mixtures. Experiments were performed with two benthic amphipod species (Orchomonaella pinguis and Corophium volutator), using passive dosing to control the external exposure of single PAHs and mixtures of three and four PAHs. The baseline toxicity of individual PAHs at water saturation generally increased with increasing chemical activity of the PAHs. For O. pinguis, the baseline toxicity of PAH mixtures was successfully described by the sum of chemical activities. Some compounds and mixtures showed a delayed expression of toxicity, highlighting the need to adjust the length of the experiment depending on the organism. On the other hand, some of the single compounds had a higher toxicity than expected, possibly due to the toxicity of PAH metabolites. We suggest that chemical activity of mixtures can, and should, be used in addition to toxicity data for single compounds in environmental risk assessment. (C) 2011 Elsevier B.V. All rights reserved.