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Biodegradation of phenanthrene in an improved water-sediment systems (OECD 308) – effect of test setup

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OECD 308 is a higher tiered standard test used to simulate biodegradation of chemicals in water-sediment systems. Volatile chemicals are generally recommended to be tested using closed setup (OECD 308). Significant depletion of oxygen conditions within the closed setup due to the use of higher co-solvent concentration (0.25% V/V) and stagnant water-sediment systems has been reported in previous studies. Our own studies suggested, improvement in oxygen conditions in the closed setups with the use of larger test system geometries, agitation of the water sediment sample (shaking /overhead stirring) and lower co-solvent (0.01% V/V) concentratiotn. The present study, aims 1) to investigate the influence of different test setups and agitation techniques on the degradation, distribution and non extractable residue (NER) formation of ^{14}C labelled phenanthrene 2) to determine an appropriate closed setup for conducting OECD 308 tests with phenanthrene. 500mL cylindrical flasks were used to prepare different closed setups (Setup 1: diameter Ø = 5.5cm and Setup 2: Ø=7.5cm). The water sediment samples were prepared using sediment:water (S:W) ratio of 1:3 (V/V) in both the setups. Setup 1 were kept stagnant whereas the setup 2 was agitated using different approaches (shaking at 80rpm/40rpm and overhead stirring of water phase). The samples prepared in this way were applied with ^{14}C labelled phenanthrene with a starting test substance and co-solvent (acetone) concentration of 0.07mg/L and 0.01% (V/V) respectively. In parallel, parameter control samples prepared for oxygen, DOC and turbidity measurements. When the oxygen saturation measured were <15%, the samples were aereated for 20sec. Additional, abiotic control samples were also prepared. The results showed stable oxygen saturation in the water phase throughout the test with improved biodegradation and faster partitioning processes in samples under setup 2. Although the degradation and the oxygen conditions in samples with overhead stirring and shaken samples were quite comparable, the shaking approach was more robust and reproducible, and easier to establish. The degradation and distribution varied considerbly with different shaking speed (80 and 40rpm). However, shaking with 80rpm resulted in more stable oxygen concentration in the water phase and showed no influence in abiotic NER formation. Thus, these results suggest a promising approach for testing volatile hydrophobic chemicals using OECD 308 guideline.