Improved strategies for the assessment of chemical persistence at the water-sediment interface – experimental approach

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Keywords: OECD guideline 308/309, biodegradation, sorption, Non Extractable Residue (NER)

While performing chemical risk assessment, data on biodegradation of chemicals are necessary and are obtained using simulation tests with different environmental compartments. These data are used for the assessment of chemical persistence and exposure modelling in different regulatory frameworks. OECD 308 guideline, a higher tier test, is used to assess aerobic and anaerobic biodegradation of chemicals in water-sediment systems. Although the guideline is extensively used, it faces several criticisms regarding the low Water:Sediment (W:S) ratio (4:1 – 3:1) which has been associated with rapid partitioning of chemicals into the sediment phase and formation of high NER. In addition, the data generated from these tests do not allow for a clear distinction between the different processes (anaerobic and aerobic degradation, reversible and irreversible sorption) in the system, thus failing to provide robust degradation data.

The OECD 309 guideline is currently used more and more for the study of aerobic biodegradation of chemicals in the surface water. The guideline allows either a pelagic (without sediment) or suspended sediment (W:S ratio 1000:1 to 100000:1) test set-up. The latter version is related to OECD 308 and may provide better conditions for biodegradation due to enhanced bioavailability and sediment accessibility. Also, the NER formation is expected to be lower. However, due to lack of data determined across both systems, a comparison between these studies was not possible so far.

The aim of the current study was to close the gap between OECD 308 and 309 tests and to develop improved strategies to obtain robust degradation data for the water-sediment interface. A series of tests was carried out namely OECD 308, modified 308, modified 309 and 309 with a range of W:S ratio of 3:1, 10:1, 100:1 and 1000:1 (W/W) respectively. The modified 308 included a stirred water phase and for both 309 and modified 309 approaches a suspended sediment test was performed. Four different test substances with different biodegradation and sorption properties were run through all four test systems.

The results showed a higher degradation and NER formation in modified systems in comparison to standard systems which provides further information about competing role of two processes, i.e., sorption to sediment and availability of active microbial biomass taking place in the systems. For less degradable substances, a high NER formation was observed in modified 309 and 309 tests which could be attributed to grinding of sediment over time due to stirring. Therefore, an additional shaking version of 309 was conducted with one of the test substance. The stirred and shaken 309 approaches showed significant differences in NER formation and degradation.

Data evaluation with advanced parameter estimation techniques is applied in a second part of the project (Honti and Fenner 2015) to develop a new tool for risk assessment of substances in the water-sediment interface.

REFERENCES

Honti and Fenner (submitted to ICCE 2015) Bridging across OECD 308 and 309 data in search of a robust transformation indicator