Biodegradation Screening Tools for Water, Water-Sediment and Soil – An Alternative Approach for Screening Persistence

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The persistence of an organic compound is an essential factor determining its environmental fate. For the compartments water, sediment and soil, biodegradation is often the main transformation process influencing the persistence of a substance.

In the context of the European chemicals legislation (REACH) the persistence evaluation strategy normally starts with a persistence screening to exempt substances that are (readily) biodegradable from a full definitive persistence assessment. The persistence screening is based on data mainly derived from ready biodegradability tests (RBTs) and QSAR models. In case a definitive persistence assessment is required, degradation half-lives derived from laboratory simulation studies for surface water (OECD TG 309), water-sediment (OECD TG 308) or soil (OECD TG 307), are compared with persistence criteria of Annex XIII of the REACH regulation. Since these simulation studies are time-consuming, expensive, and only required for chemicals with a production volume of ≥ 100 tons per year, half-lives from simulation test are often missing. While it may be possible to calculate biodegradation half-lives from screening data (RBTs and QSAR models), such values should not be compared to the persistence criteria of Annex XIII in the context of a definitive persistence assessment. On the other hand, such data might be used within a persistence screening, since it is often not necessary to know the exact degradation half-life but it is sufficient to know whether it is below or above the trigger values of Annex XIII. Several approaches have been developed within the last decade to derive half-lives from screening data. However, screening information are almost exclusively based on qualitative experimental biodegradation data (ready biodegradable or not) related to water-only test systems, whereas quantitative biodegradation data (e.g. degradation half-lives) for sediment and soil are missing. To overcome this deficiency, screening tools for water-sediment (WSST; Water-Sediment Screening Tool) and soil (SST; Soil Screening Tool) have been developed based on the water-only test system according to OECD TG 301C (MITI-Test). These new screening tools were successfully applied to determine experimental mineralization half-lives for fifteen organic chemicals in water (MITI), water-sediment (WSST) and soil (SST). Based on these data, different persistence screening approaches are compared, that might be applied under REACH by using (a) experimentally determined half-lives from MITI, WSST and SST, (b) alternative methods to derive half-lives from RBTs, and (c) QSAR models and related approaches.