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Improving REACH tests for estimating chemical toxic risks

The official criteria used to assess how easily a chemical is taken up by biological organisms, known as the bioaccumulation potential, are considered reliable for most types of chemical. However, according to a new analysis, the criteria need updating to include uptake from contaminated sediment and food in order to reflect the realistic bioaccumulation risk for all chemicals.

Chemicals that are easily taken up by organisms but not easily eliminated, leading to toxic effects, are known as 'PBTs' – persistent, bioaccumulative and toxic. The current EU REACH[1] test to identify if a chemical is a PBT measures the concentration in the fatty tissue of fish after being exposed to contaminated water for 28 days. The result is known as the bioconcentration factor (BCF).

Scientists have found this test to be reliable for most chemicals. However, PBTs that do not dissolve well in water or do not bind with fatty tissue are not detected by this method and as a result, risk being categorised as non-hazardous. This subset of chemicals includes aromatic substances present in petrol residue and polyfluorinated compounds widely used in the manufacture of textiles, paper, leather and cosmetics.

PBTs that do not dissolve well in water (hydrophobic) can either sink to the bottom and accumulate in sediment or bind to particles of organic carbon in the water, i.e. microscopic plants and animals. As a result, the main sources of bioaccumulation of hydrophobic PBTs are exposure to contaminated sediment and ingesting contaminated prey. These sources of bioaccumulation in fish are slower than direct uptake from the water through the gills, which the REACH test accounts for. This means they may not be detected during the test exposure period, leading to an underestimation of the BCF. For these reasons, the scientists recommended that two additional tests should become part of the REACH assessment criteria.

The first test measures PBT uptake from the sediment by sediment-dwelling organisms, known as oligochaetes. The second test measures the PBT concentration in fish exposed to the chemical via contaminated prey. This is known as the Biomagnification Factor (BMF). These additional tests are currently accepted in the REACH assessment only as supporting evidence for the official BCF test, but are not considered independently.

Chemicals that do not bind to fat are more likely to accumulate in blood plasma, liver and kidneys. This means they can accumulate in toxic proportions in an organism but can avoid detection with the current REACH test. For this type of chemical, the scientists suggest an additional test based on their ability to bind to proteins instead of fats. Measuring the uptake of chemicals using radioactive tracers is also a possibility for assessing bioaccumulation potential, since radioactivity can be measured without focussing on a particular substance or organ. However, the most appropriate technique to use is still under discussion in the scientific community.

Alongside the recommended additions to the REACH criteria, the researchers highlighted the importance of consistency in the existing BCF test. For example, fish in early developmental stages (embryos and larvae) have a high surface to volume ratio, leading to an enhanced BCF compared to juvenile or adult fish. This must be taken into account when evaluating different data sources.

1. See: REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) http://ec.europa.eu/enterprise/sectors/chemicals/reach/index_en.htm

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