Code Number and Title:

LRI-ECO29: Improving assessment of persistency through including adaptation; standardize methodology and assess ecological significance

Background

Persistent (P) environmental chemical substances are an issue of global concern especially when coupled with bioaccumulative (B) and toxicological (T) properties. Substances identified as vPvB have the potential to persist in the environment and to accumulate in living organisms. PBT substances also show adverse effects following long-term exposure (ECETOC 2005). Persistence is either assessed with half-lives determined in simulation tests (e.g. OECD 307, and 308) or through default values assigned from screening tests results (e.g. the OECD 301 ready biodegradability tests). The degradation rates derived from these studies are compared to national and international half-life criteria for environmental persistence.

OECD ready biodegradability tests were designed to identify chemical substances that will undergo rapid and complete degradation in the environment. The microbiological stringency of the OECD ready biodegradability tests makes them unsuitable for prioritizing chemicals based on their environmental persistence or half-life. To address these technical weaknesses, the technical guidance documents for degradation assessments within REACH, identified a number of enhancements to the ready biodegradability tests. These enhancements were specifically aimed to improve the environmental relevance of the tests and increase the reliability of the degradation predictions resulting from the tests (ECHA, 2012). One of these enhancements is to allow the low-level adaptation of microorganisms as it is known to occur in the natural environment. The most promising set-up is probably to expose microorganisms continuously in various test systems at environmentally realistic substrate concentrations. Standardized OECD screening tests can subsequently be carried out with an inocula derived from these test systems. Previous industry initiatives in the development of biodegradation test methods have been the assessment of the influence of microbial diversity on the biodegradability of organic substances (Goodhead *et al*, 2013), and improvements of the experimental set-up to assess half-lives in water/sediments systems (Fenner *et al*, 2014). This work has provided valuable information demonstrating that more relevant and reliable predictions of environmental half-lives can be obtained for regulatory purposes.

Validated methods to expose microorganisms present in various natural ecosystems (sea, rivers, etc.) and biological treatment systems are not currently recognized or standardized. The relevance of adaptation is not obvious for regulatory purposes contrary to the common opinion in environmental microbiology (Alexander, 1994). Evidence of the relevance of results obtained with exposed microorganisms using the standardized methods to assess persistency is, therefore, key. Changes in catabolic capabilities and microbial communities upon exposure show that biodegradation and persistence half-lives change with time. For example microbial communities in the environment have been found to adapt to and degrade xenobiotics that were not degraded in laboratory tests. The evolution and spread of antibiotic resistance should be considered as a model to demonstrate the ecological importance and significance of adaptation research.

Objectives

- Review examples where microbial adaptation and evolution of catabolic and functional changes in microbial communities have occurred in response to chemical exposure.
- Assess the importance of adaptation (growth-linked biodegradation) with respect to environmental persistence.
- Develop methodologies to expose microorganisms to appropriate concentrations of test substance under environmentally relevant test conditions.

Scope

- Evaluate methods to expose microorganisms to non-readily biodegradable substances using the appropriate exposure scenario and environmentally relevant test conditions. Important variables to explore will change based on the exposure scenario and receiving environment but may include test substance exposure concentrations, dose frequency, and duration of exposure. Consider use of screening tests (OECD 301) with exposed inocula to determine biodegradability.
- Investigate adaptation using exposure systems and other biodegradation test methods (i.e. OECD 301, 307, 308, 303, 314) as appropriate.
- Prepare guidance on how adaptation should be used within regulatory persistence assessments.
- Write a paper on adaptation (growth-linked biodegradation) of chemical substances entering the environment and explain its importance for identifying persistency for regulatory purposes.
- Assess the feasibility and relevance of deriving default half lives from the results obtained in OECD screening tests with adapted and non adapted microorganisms. Propose what such relative half lives might be.

Deliverables

The final report shall contain an executive summary (2 pages max), a main part (max. 50 pages) and a detailed bibliography. It is expected that the findings will be developed into at least one peer reviewed publication, following postering(s) and presentation(s) at suitable scientific conference(s).

Cost and Timing

Start in early 2015, duration 3-4 years
Budget in the order of €600.000

Partnering/Co-funding

Applicants should provide an indication of additional partners and funding opportunities that can be appropriately leveraged as part of their proposal. Partners can include, but are not limited to industry, government/regulatory organizations, research institutes, etc. Statements from potential partners should be included in the proposal package.

Fit with LRI objectives/Possible regulatory and policy impact involvements/ Dissemination

Applicants should provide information on the fit of their proposal with LRI objectives and an indication on how and where they could play a role in the regulatory and policy areas. Dissemination plans should also be laid down.

References

M Alexander (1994) Biodegradation and bioremediation Academic press Inc San Diego US

ECETOC (2005) Risk Assessment of PBT Chemicals Technical report no 98 ISSN 0773-8072.

ECHA (2012) Guidance on information requirements and chemical safety assessment Chapter R.7B End-point specific Guidance p 183

K Fenner, Th Junker, D Hennecke, S Hahn (2014) Improved test system to determine chemical degradation in laboratory water/sediment systems. Experimental results SETAC Europe, Basel

A Goodhead, I Head, J Snape, R Davenport (2013) Standard inocula preparations reduce the bacterial diversity and reliability of regulatory biodegradation tests. Env Sci Pol Res published online

DEADLINE FOR SUBMISSIONS: August 31, 2014

Please visit www.cefic-lri.org for general information about the LRI funding programme, guidelines for grant applications and links to application documents.

For further assistance do not hesitate to contact the LRI Secretariat by e-mail at lri@cefic.be or by phone on 0032 (0)2 676 7368.