LRI-ECO63: MECHANISTIC UNDERSTANDING OF SORPTION/DESORPTION OF POLYMER IN ENVIRONMENTAL MEDIA

Background

The European Commission Chemicals Strategy for Sustainability includes the objective of extending registration requirements for certain polymers of concern (1). Polymers are exemplified as a group of substances where there is "much knowledge to be acquired". In this context, ECETOC has actively engaged in developing a conceptual framework for risk assessment, reviewing assessment methodology, and identifying gaps. The characterization of sorption/desorption was identified as an area for additional research for an improved assessment of the environmental distribution and informing exposure models (2).

Sorption/desorption of polymers in various environmental media is a key process in determining the distribution and bioavailability of polymers in various environmental compartments. Although the sorption/desorption process of discrete organics (i.e., nonpolymeric substances) is well understood, mechanisms governing the sorption/desorption of polymers in different environmental media have rarely been studied.

Sorption encompasses the processes of absorption, adsorption, ion exchange, and chemisorption (3). The distribution coefficient (K_d) is the ratio between the content of the substance in the solid phase and the mass concentration of the substance in the aqueous solution when sorption equilibrium is reached. The organic carbon-normalised distribution coefficient (K_{oc}) relates the K_d to the content of organic carbon of the soil, sediment, or sewage sludge sample.

This research aims to gain a mechanistic understanding of the sorption/desorption of polymers in environmental media, with the intent to improve the characterization of distribution in and movement between environmental matrices, as well as establish a fundamental understanding of structure-activity relationships for polymer sorption/desorption.

Objectives

The project's objectives are to:

1. Evaluate experimentally and identify polymer characteristics that would inform the sorption/distribution of a range of polymers in soil, sediment, or activated sludge. The polymer characteristics under consideration could include but are not limited to polymer type/chemistry, average molecular weight, and dispersity, surface activity, and charge density.2.
2. Identify appropriate parameters to evaluate the sorption/desorption of different types of polymers based on consideration of their governing sorption mechanisms. This project shall elucidate if the organic carbon-normalized partition coefficient K_{oc} (commonly used for assessing the sorption of neutral discrete organic chemicals onto the soil at the screening level) is the appropriate parameter.
3. Establish structure-activity relationship for sorption/desorption of polymers in soil, sediment, or activated sludge.4.
4. Publish research findings and recommendations on how to best conduct sorption/desorption studies for soluble and dispersible polymers.

Scope

Polymers vary widely by polymer type/chemistry, average molecular weight and dispersity, surface activity, and charge density. Thus, polymers from a variety of classes need to be investigated experimentally. However, this research will focus on soluble and dispersible polymer classes and not on solid polymeric materials.

Out of scope (optional)

Solid polymeric materials such as microplastics and articles as test chemicals (as stated above).

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 poster(s) and presentation(s) at a suitable scientific conference(s).

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.

DEADLINE FOR SUBMISSIONS: September 1st, 2023 at 11:59 PM

Related links

References

1. Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions, Chemicals Strategy for Sustainability Towards a Toxic-Free Environment, 2020, Brussels. https://ec.europa.eu/environment/pdf/chemicals/2020/10/Strategy.pdf
2. ECETOC. 2020. European Centre for Ecotoxicology and Toxicology of Chemicals. Technical Report No. 133-2; Version 1. Applicability of analytical tools, test methods and models for polymer risk assessment. Brussels, Belgium, March 2020. https://www.ecetoc.org/wp-content/uploads/2020/03/ECETOC-TR133-2.Polymers-Risk-Asessment.pdf
3. US EPA. 1997. Expedited site assessment tools for underground storage tank sites: A guide for regulators. EPA 510-B97-001; March 1997; https://www.epa.gov/ust/expedited-site-assessment-tools-underground-storage-tank-sites-guide-regulators.

Timing: Start in Q4 2023, 2 years

LRI funding: €150,000 - 200,000

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