LRI ECO67: UNDERSTANDING THE RELATIONSHIP BETWEEN PLASTIC-BASED FABRICATED ARTICLE COMPOSITION, ARTICLE DEGRADATION PROCESSES, AND THE GENERATION OF MICROPLASTICS UNDER RELEVANT ENVIRONMENTAL CONDITIONS

Background

There is an increasing concern related to potential environmental and human risks associated with microplastics. The environmental risk of microplastics is dictated both by bioavailability and toxicity (i.e., hazard), as well as the likelihood of exposure to microplastics in the environment. Thus, the processes through which end-use articles manufactured from plastics degrade into microplastics under environmentally relevant

conditions are important for determining microplastic exposure and risk in the environment. Gaining a robust understanding of these degradation processes is critical to improve the understanding of the lifetime/timescale of plastics in the environment and their consequent interactions with biota.

Plastic-based fabricated articles such as packaging (e.g., films, pouches, bags, bottles, plastic-ware), agricultural film (e.g., silage, mulch, greenhouse), and durable goods (fishing nets, ropes, boating equipment, etc.), are found in the terrestrial and aquatic environment either as part of their in-service function, or as waste. These articles slowly degrade as a function of time and environmental factors (light, heat, pressure, abrasion, biological activity, etc.). These degradation processes can result in the formation of microparticles in the environment. Plastic characteristics, including but not limited to chemical composition and structure (e.g., crystallinity, molecular weight), impact degradation processes. Moreover, plastic-based products (i.e., fabricated articles) are seldom made from a single plastic but rather are often engineered from several materials including more than one plastic type, different polymers and/or non-polymeric materials (e.g. additive, fillers). The formulation and design of the final plastic product is based on the specific end-use application(s) to deliver the required performance and function. These diverse materials, used to generate the final plastic product, can all influence degradation and introduce significant variability into degradation processes across different end-use plastic products. In addition, the fabrication conditions used to produce the finished plastic article and any transition the fabricated article might have undergone during its use could potentially influencing the degradation processes, thus must be taken into consideration to both accurately assess environmental and human health risk and find solutions to address that risk. Many of these factors were not considered in prior microplastic studies. Especially, the impact of product formulation on the degradation of plastics in the environment is under studied.

Environmental conditions also play an important role in the degradation of plastic-based fabricated articles. Natural environments are complex systems consisting of multiple potential degradation processes, including but not limited to photodegradation by UV radiation, chemical degradation by oxygen, mechanical degradation by natural forces, and

microbial degradation by microorganisms. There is currently a knowledge gap regarding the cumulative impacts of multiple environmentally relevant stressors on the degradation of fabricated plastic articles to macro-fragments, microparticles, and nanoparticles.

To address the gaps of our understanding on degradation of plastics in the environment, Cefic LRI is currently sponsoring a project to develop a mechanistic model of micro and nanoplastic fragmentation in the environment (Cefic LRI ECO59). The 2nd ICCA MARII Workshop, held in June 2023, had a dedicated session on degradation processes of microplastics. One of the research priorities identified from this session is the need for quality data linking fabricated article product formulation to plastics degradation processes and the generation of micro- and naoplastics, under relevant environmental conditions, which can then be used to build robust predictive models.

Therefore, proposals are requested to build an understanding of how plastic-based fabricated article formulation impacts plastics degradation and micro- and nanoplastics generation, under environmentally relevant conditions.

Objectives

This project is looking to build an understanding of how plastic-based fabricated article formulation impact plastic degradation and micro- and nanoplastic generation, under environmentally relevant conditions. To make the scope of the research project manageable within the desired timeline, 1) please consider proposing one or two representative but specific environmental relevant conditions; and 2) please consider proposing one or two representative fabricated article types.

The project's objectives are to:

- Identify key formulation factors per selected plastic-based fabricated article, e.g., packaging, consumer, agricultural, industrial, durable goods, etc., that impact the degradation of plastics and generation of microplastics in the environment.
- Build a quality dataset on the influence of product formulation on the degradation and generation of micro- and nanoplastics.

- Develop a formulation-degradation-micro/nano plastics-environment model, based on the quality dataset built
- In developing the model, the adoption of the recommended six principles of "Good Modelling Practice" (GMP) should be followed (Buser et al, 2012). Notably, specify the input and output data entirely, conduct a sensitivity analysis to identify the input parameters that have the greatest influence on the key results, and specify the limitations and limits of applicability of the model results.

Scope

Micro- and nanoplastic generation from degradation processes, including mass, particle number and size distribution, and rate of microplastic generation.

Deliverables

- Publication(s) in top-tier peer-reviewed journal(s).
- Presentations at scientific meetings to summarize results and obtain feedback on research directions.

The final report shall contain an executive summary (2 pages max), a report (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) presented at 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: July 30th, 2024

Please see www.cefic-lri.org/funding-opportunities/apply-for-a-grant/ for general LRI objectives information, project proposal form and further guidance for grant applications

Related links

- 2nd ICCA MARII Workshop - ECETOC
- ECO59 : FRAGMENT-MNP: Developing a mechanistic model of Micro and NanoPlastic FRAGMentation in the ENvironmenT – Cefic-Lri
- Good modeling practice guidelines for applying multimedia models in chemical assessments - PubMed (nih.gov)

Timing: Q4 2024, duration 2 years

LRI funding: €400,000

LRI research programme overview

LRI Projects advancing chemical safety

Funding Opportunities

LRI Toolbox for your needs

for your
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Events**
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Cefic-LRI Programme
European Chemical Industry Council - Cefic aisbl

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