CEFIC Long-range Research Initiative
Request for Proposals (RfP)

Title and Code Number:
Emission factors for microplastics to support environmental exposure modeling – **LRI ECO60**

Background
Characterizing potential risks of microplastics (MP) in the environment requires an understanding of their fate & transport properties, which are partly a function of their use, release and distribution in the environment. General purpose risk assessment tools are being developed to calculate predicted environmental concentrations (PECs) of MP, which will require that the User provide emissions data. This is a similar strategy that is used within REACH for chemical risk assessment, which often rely on emission factors (EF) derived from Specific Environmental Release Categories (SpERC; https://www.esig.org/reach-ges/environment/). SpERCs are an extension of general purpose environmental release categories (ERC, REACH Guidance Chapter R.12) where the use scenario, tonnage, and defined operational control conditions are related to emissions into air, water, and soil compartments. This approach is convenient because use tonnages are often required for chemical registrations. This then results in fractions of total production, or use volumes (kg/d) that are emitted to local, or regional environments (kg/d).

Objectives
Develop fit for purpose EF for MP that span a range of likely professional, consumer, and industrial use scenarios which cover manufacturing, value chain, service life (e.g., washing), and/or end of life stages. Relevant data types could include monitoring data from water, soil, sediment, product loss data, emissions from WWTPs, Municipal solid waste (MSW) leakage rates, as well as mechanistic fragmentation data that are scaled to typical use conditions.

These EF can be used in combination with use tonnage information as the input to fate models to estimate PECs to support risk assessments. Therefore, the use categories of EF and tonnage inputs need to be aligned. If use-based tonnage data are not available, then direct emission rates can be derived.

This project will establish the framework and will rely on available data to derive MP EF and relevant use categories.

Scope

All types of synthetic solid polymeric materials are in scope. The RfP is not restricted to certain type of microplastics e.g. polyolefin origin. For the sake of prioritisation, efforts may be focused initially on high production volume or high exposure solid polymer types including but not limiting e.g. polyethylene, polypropylene, polystyrene, Butyl Rubber, Polyurethane, PET, PVC, Polyester, Polyacrylates, and Polyamides.

The present RFP is requesting development of SpERC-like EFs for MP. A key step will be resolving the combined emission and fragmentation of larger "marco" and "meso" plastics (including large articles from service and waste life stages) and the conversion and integration of these values with direct emissions of primary and secondary MP. The approach could combine top-down, and bottom-up strategies. For example, combining ambient monitoring data with article fragmentation data. It is also likely, that not all data exist for all combinations of uses and polymer types. Therefore, it is important to establish the general framework, and provide practical recommendations, which could be refined in the future as additional data become available. Indeed the framework could provide the direction to identify key future data needs.

SpERCs are used to estimate emissions based on use type and tonnage, and can be derived considering all relevant physicochemical properties of the substances. The SpERC concept is useful since it organizes emissions data around the life cycle inventory of a substance (e.g., manufacture and finally waste stages, and Uses in professional, industrial, or consumer applications). It is likely that these level of information will not be available for all polymers, and for all use types.

Table of candidate MP emission categories:

Life Cycle Stage	**Category**	**Processes**
Service Life	Discharge from Municipal WWTPs	Textile washing, wash-off cosmetics / PCPs, dishwashing/laundry materials
Service Life	Direct Discharge to Marine Systems	Fishing equipment abrasion / loss, marine coatings and paints, shipping losses (pellets / other)
Service Life / Waste	Direct Discharge to Ag & Non-Ag Soil Systems	Deposition (air), land application of sewage sludge, AgChem applications (fertilizer, pesticides, geotextiles)
Service Life / Waste	Widespread Dispersive Discharge to Air (urban, non-urban)	Re-suspension of fragments, main focus on outdoor air consistent with focus environment risk assessment
Service Life	Tire & Road wear Emissions	Tyre wear, road particles / paints, brake dust/particles, automotive paint/debris, etc…

Manufacture	Manufacturing	Pellet production (including mixing and formulation) and land-based transport, fugitive emissions of direct MP from manufacturing facilities (air, water, soil)
Manufacture	Polymer Processing / Production	Fugitive emissions of MPs from the processing, calendaring, extrusion, forming of pellets/fibers into articles (air, water, soil?)
Service Life	Article Service Life	Degradation/wear of plastic articles in industrial (food packaging, hygiene, processing aids), professional, and consumer applications. Indoor & outdoor, durable (1+ year) and single-use or non-durable goods (plastic bags, straws, non-food packaging, etc…)
Waste	End of Life / Waste	Mis-management of waste, runoff from sanitary sewers / river systems, leakage from MSW / waste transport (shipping of waste/recycle material)

It is likely that there will be regional variations in emissions data but all available data should be considered. For data limited applications, consensus EF based on available data can be derived. For data-rich applications, regionally specific EF can be derived. For example, in 2018 the United Nations Environmental program developed emission tables (Section 6) [1] relying on available data. Further, several studies have derived various forms of EF for different use patterns and could be used as a source of data, or reference for development of the SpERC-like EF framework [2-10].

The project discussed in the present RFP covers several different sector groups such as paints, construction materials, chemical manufacturers, tyres, etc. Careful coordination among the relevant trade groups to identify sources of data and frameworks is needed. The CEFIC LRI monitoring team can assist in making these connections in addition to the connections that the research team has already.

A key outcome of this work will be tables of EF by use category for various polymer types. Ideally EF would be available per size class of MP (e.g., 0.1 – 5000 µm), though the size class bins will vary with available data. It is anticipated that the size fraction determinations may be based on a combination of empirical measurements, as well as mechanistic fragmentation modelling, which could be extrapolated across relevant use scenarios. Also, recommendations on key data types can be provided to guide implementation and refinement of the EF framework.

Out of scope

Data gathering on indoor air exposure is being addressed through separate research programs at the state, country levels and by industry. Coordination with other projects in this area is encouraged to leverage the data already generated.

Deliverables

Tables of EF per use category, per MP type where possible, suggested guidance / next steps where quantitative values cannot be reliably established.
Background / justification documents (similar to SpERC documentation) to support use in regulatory risk assessment
At least one open-access peer-reviewed publication documenting the methods, data, and results.
Presentation at one or more scientific conferences (i.e., SETAC)
Participation in MARII R&D workshop(s)

Cost and Timing

300.000 Euro
Duration: 2 years
Start of project in Q1 2023

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 11, 2022

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.

References

1. Ryberg MW, Laurent A, Hauschild M. 2018. Mapping of global plastics value chain and plastics losses to the environment: with a particular focus on marine environment.
2. Wang T, Li B, Zou X, Wang Y, Li Y, Xu Y, Mao L, Zhang C, Yu W. 2019. Emission of primary microplastics in mainland China: Invisible but not negligible. *Water Research* 162:214-224.
3. Kole PJ, Löhr AJ, Van Belleghem FGAJ, Ragas AMJ. 2017. Wear and Tear of Tyres: A Stealthy Source of Microplastics in the Environment. *International Journal of Environmental Research and Public Health* 14:1265.
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5. van Wezel A, Caris I, Kools SAE. 2016. Release of primary microplastics from consumer products to wastewater in the Netherlands. *Environmental Toxicology and Chemistry* 35:1627-1631.
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7. Koutnik VS, Alkidim S, Leonard J, DePrima F, Cao S, Hoek EMV, Mohanty SK. 2021. Unaccounted Microplastics in Wastewater Sludge: Where Do They Go? *ACS ES&T Water* 1:1086-1097.
8. Uzun P, Farazande S, Guven B. 2022. Mathematical modeling of microplastic abundance, distribution, and transport in water environments: A review. *Chemosphere* 288:132517.
9. Tang N, Liu X, Xing W. 2020. Microplastics in wastewater treatment plants of Wuhan, Central China: Abundance, removal, and potential source in household wastewater. *Science of The Total Environment* 745:141026.
10. Koutnik VS, Leonard J, Alkidim S, DePrima FJ, Ravi S, Hoek EMV, Mohanty SK. 2021. Distribution of microplastics in soil and freshwater environments: Global analysis and framework for transport modeling. *Environmental Pollution* 274:116552.