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

***Title and Code Number:***
Evaluate factors that determine the environmental hazards of microplastics **– LRI ECO49**

***Background***

- Research on solid polymer particulates is becoming more prevalent, especially with regard for the public's concern regarding the fate and effects of microplastics in the environment. Microplastics are generally characterised as water-insoluble, solid polymer particles that are ≤ 5 mm in size.
- Microplastics are often detected in the environment but the risks they pose are debated and largely unknown.
- Regulatory efforts to examine microplastic safety have been raised as future areas of concern and focus.
    - For example, EU COM has given ECHA a mandate to prepare an Annex XV restriction dossier on microplastics. The mandate contains a broad definition that will likely include the following elements: synthetic, water-insoluble and non-biodegradable polymers used in plastic microbeads of 5mm or less, and at least 14 polymers. ECHA has 12-months to prepare a restriction dossier and an additional 18-24 months to review and approve.
- Assessing the applicability and adaptability of the existing hazard assessment framework to solid polymer particles can provide insight into the relative hazard of these particles and will help to identify future targeted testing efforts to support read-across and categorical assessment of solid polymer particles.
- The assessment of the hazard of microplastics brings several challenges which include:
    1. Assessing the applicability and adaptability of existing toxicity testing methods and framework to solid polymer materials (i.e., microplastics).
        - Recently, Connors et al. (2017)[1] conducted a review of the quality and focus of environmental research in the microplastics area. In this paper, nine areas requiring improvement in microplastic research are delineated (*e.g.,* a need for a thorough characterization of the test particles, analytical verification of test concentrations, environmental relevance of tested materials, inclusion of appropriate controls, and endpoint applicability for environmental risk assessment, etc.).
    2. Selecting and designing appropriate hazard studies with environmentally relevant exposure levels and pathways.

[1] Connors KA, Dyer SD, Belanger SE. 2017. Advancing the quality of environmental microplastic research. *Environmental Toxicology and Chemistry* 36:1697 – 1703.

3. Determining the physical, chemical, and environmental factors responsible for any observed adverse effects in test organisms.
4. Determining the potential relevance and sensitivities of traditional test species and dosing methods.

***Scope and Objectives***

- **Phase 1**: It is proposed that a comprehensive literature review be conducted in order to identify both key ecological hazard research gaps and the appropriate methodologies for conducting hazard tests with microplastic materials to fill these research gaps.
    - This literature review should focus on the applicability, adaptability, and usage of existing toxicity testing methods for evaluating the hazards of solid polymer materials for representative test organisms (i.e., fish, invertebrates, algae) and organisms which have been identified as potentially sensitive to solid polymer particles.
    - It is expected that published literature, expert input from stakeholder workshops, and relevant summary reports and guidance from regulatory groups and various task forces are consulted during the comprehensive literature search.
        - Some key review papers, reports, and presentations on microplastics are recommended in the annex to this RfP.

- **Phase 2**: Based on this comprehensive literature review, targeted ecological hazard research should be proposed and, **if approved by the Cefic LRI/ECETOC Monitoring Team**, conducted to evaluate how both intrinsic and extrinsic factors influence the effects of microplastics on sensitive environmental species.
    - **Key research areas:** The following key areas are proposed to further guide the scope of the desired ecotoxicity research:
    1. Identifying key factors that determine the toxicity of microplastics.
        - Considerations for the physical and chemical composition of microplastics include (but are not limited to): size, shape, charge, and type of microplastic.
        - Considerations for the surrounding medium include (but are not limited to): ionic strength, pH, temperature, and presence of other molecules (like natural organic matter)
        - Consideration of specific species traits (*e.g*. feeding behaviour, gut morphology, egestion capacity, sensitive surface areas) that are potentially linked to sensitivity in hazard responses from exposures to microplastics

2. Potential derivation of threshold values (e.g. based on particle number or total plastic concentration [mg/L]) which characterise hazard of certain classes of microplastics.
3. Determining which exposure scenarios and receptor species are most relevant and important to consider in environmental hazard and risk assessment of microplastics.

**Additional Guidance:**

- The selection of targeted hazard testing should be based on current state of the science as accomplished in Phase 1.
- Species selection in environmental test proposals should also be relevant to the expected environmental fate and exposure route of the tested microplastic material.
    - Aquatic species (i.e. marine and/or freshwater species as well as sediment-dwelling species) are of primary interest at this time due to the focus of microplastic occurrence/effects in aquatic systems. Terrestrial species may also be of interest, but are generally not understood to be particularly sensitive to microplastic particles.
    - Targeted research may be necessary to determine relatively sensitive species to water-insoluble, solid polymers in the size range of ≤ 5 mm.
- Adoption of recommended practices of conducting hazard testing with particles should be followed (e.g. Connors et al., 20172; Hüffer et al., 20173). Notably, the test material should be characterised such that effects can be understood, and preferably attributed to the microplastic particle and not driven by co-formulated materials.
- The endpoints evaluated in the proposed research should have relevance to determining adverse outcomes, which are translatable to population and community responses for application in ecological risk assessments.
- In this case, examining the potential effects of microplastics as vectors for other contaminants is out of scope.
- In this case, examining environmental fate including bioaccumulation and trophic transfer of microplastics is also out of scope.

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[2] Connors KA, Dyer SD, Belanger SE. 2017. Advancing the quality of environmental microplastic research. *Environmental Toxicology and Chemistry* 36:1697 – 1703.

[3] Hüffer T, Praetorius A, Wagner S, vonder Kammer F, Hofmann T. 2017. Microplastic exposure assessment in aquatic environments: learning from similarities and differences to engineered nonparticles. *Environmental Science & Technology* 51:2499-2507.

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***Deliverables***

- The expected deliverables of the project are several publications that would summarise the results of the literature review and the targeted hazard testing in relation to the larger picture of microplastic toxicity trends. The information gathered should inform the development of hazard trends for microplastics in order to strengthen chemical and/or biological read across approaches.
- Additionally, presentations at scientific meetings to summarise preliminary results and obtain feedback on research directions and future testing strategies are required deliverables.

The final report shall contain an executive summary (2 pages max), a main part (max. 50 pages) and a detailed bibliography At least one article related to the research project shall be published in the open access literature.

***Cost and Timing***

Start in Q1 2019
Total duration for Phase 1 and 2: 3 years
Phase 1: Budget in the order of €75.000; timeline 9 months
Phase 2: Budget in the order of €325.000 (pending review and approval of Cefic LRI/ECETOC Monitoring Team): timeline 2 years 3 months

***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.
It is recognised that the scope of this RfP spans a range of expertise (literature review and ecological hazard testing) and thus proposals are anticipated from teams comprising a collaboration from diverse disciplines.

***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: Review Papers on Microplastics**


1. Connors KA, Dyer SD, Belanger SE. 2017. Advancing the quality of environmental microplastic research. *Environmental Toxicology and Chemistry* 36:1697 – 1703.
2. Hüffer T, Praetorius A, Wagner S, vonder Kammer F, Hofmann T. 2017. Microplastic exposure assessment in aquatic environments: learning from

similarities and differences to engineered nonparticles. *Environmental Science & Technology* 51:2499-2507.
3. Koelmans, A. A.; Bakir, A.; Burton, G. A.; Janssen, C. R., Microplastic as a Vector for Chemicals in the Aquatic Environment: Critical Review and Model-Supported Reinterpretation of Empirical Studies. Environmental Science & Technology 2016, 50, 3315.
4. Ivleva, N. P.; Wiesheu, A. C.; Niessner, R., Microplastic in Aquatic Ecosystems. Angewandte Chemie 2016, n/a-n/a.
5. Van Cauwenberghe, L.; Devriese, L.; Galgani, F.; Robbens, J.; Janssen, C. R., Microplastics in sediments: A review of techniques, occurrence and effects. Marine Environmental Research 2015, 111, 5-17.
6. Eerkes-Medrano, D.; Thompson, R. C.; Aldridge, D. C., Microplastics in freshwater systems: a review of the emerging threats, identification of knowledge gaps and prioritisation of research needs. Water Res 2015, 75.
7. Shim, W. J.; Hong, S. H.; Eo, S. E., Identification methods in microplastic analysis: a review. Analytical Methods 2017, 9 (9), 1384-1391.
8. Salvador Cesa, F.; Turra, A.; Baruque-Ramos, J., Synthetic fibers as microplastics in the marine environment: A review from textile perspective with a focus on domestic washings. Science of The Total Environment 2017, 598, 1116-1129.
9. Sharma, S.; Chatterjee, S., Microplastic pollution, a threat to marine ecosystem and human health: a short review. Environmental science and pollution research international 2017, 24 (27), 21530-21547.
10. Li, J.; Liu, H.; Paul Chen, J., Microplastics in freshwater systems: A review on occurrence, environmental effects, and methods for microplastics detection. Water Research 2018, 137, 362-374.
11. Yu, Y.; Zhou, D.; Li, Z.; Zhu, C., Advancement and Challenges of Microplastic Pollution in the Aquatic Environment: a Review. 2018; Vol. 229.

## Reports

Microplastics in Aquatic Systems: An Assessment of Risk SUMMARY OF CRITICAL ISSUES AND RECOMMENDED PATH FORWARD Prepared by: G. Allen Burton, Jr., Ph.D. University of Michigan Water Environment & Reuse Foundation (WE&RF) 2017

ECETOC Technical Report. An evaluation of the challenges and limitations associated with aquatic toxicity and bioaccumulation studies for sparingly soluble and manufactured particulate substances. (Currently being drafted).

## Presentations

Microplastics in the Environment: Evaluating the risks and identifying major knowledge gaps. Emil Bruns and Alistair Boxall (Environment Department, University of York, Heslington, YO 10 5NG, UK. Poster presentation at SETAC Rome 2018

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http://cefic-lri.org/wp-content/uploads/2018/06/Burns_SETACposter_Microplastics-in-the-environment_Evaluating-the-risks.pdf

**DEADLINE FOR SUBMISSIONS: 2 September 2018**

**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.**