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

Title and Code Number:
Develop Fate and Transport Model for Microplastics in the Aquatic Environment -**ECO48**

Background

- Research on solid polymer particulates is becoming more prevalent, especially with increasing public and regulatory 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. These materials are often detected in the environment, however the risks they pose are debated and are 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. ECHA has 12-months to prepare a restriction dossier and an additional 18-24 months to review and approve.
- Currently, there is limited knowledge of the fate and transport of microplastics in the environment, which limits the ability to perform environmental risk assessments for these substances. In particular, it is difficult to predict the distribution of these particles between various environmental compartments (e.g., sediment, water column, water surface). This greatly complicates the ability to accurately determine environmental concentrations, and consequently environmental risk quotients for ecotoxicity evaluation. Furthermore, a limited understanding of the physical/chemical characteristics of microplastics that impact their environmental fate and transport hinders the ability to make distinctions between, or categorical assessments of, various polymer types and/or particle sizes.
- Understanding the characteristics, processes, and environmental conditions associated with fate and transport of microplastics may help determine appropriate environmental concentrations and put into context the relevance of hazards from these contaminants. Additionally, development of a microplastic environmental fate and transport model can facilitate risk assessment for different microplastic categories and can inform safer chemical development and future sustainability efforts.

Scope and Objectives

- It is proposed that a regional and global scale environmental fate and transport model for microplastics be developed which:
    - ✓ Takes into account and leverages existing fate and transport modelling frameworks for similar particulate matter (i.e., nano-particles, sediment transport models);

- ✓ Identifies physical/chemical properties of microplastics that are useful for informing environmental fate and transport of microplastics (e.g., size, density, mechanical durability, aging);
- ✓ Determines environmental characteristics that are useful for informing environmental fate and transport of microplastics (i.e., effects of water chemistry on agglomeration / dispersion of microplastic particles);
- ✓ Informs the expected environmental concentrations of microplastics in different compartments to help define realistic exposure scenarios for future ecotoxicity studies, thereby better informing risk assessments of microplastics.

- In developing the model, the adoption of the recommended six principles of 'Good Modelling Practice' (GMP) should be followed (Matthew et al., 20121). 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.
- It is also proposed that follow-up studies be conducted to further investigate the most important factors affecting fate and transport of microplastics, based on the preliminary sensitivity analysis from the modelling exercise.
  - ✓ Model results should be validated with existing data, with one or more regions selected for which detailed fate and transport data has been previously collected for microplastics.
  - ✓ Output from these studies should be used to further refine the fate and transport model, and to build the foundation for categorisation and read-across strategy development for future microplastic risk assessment.

Deliverables

- An integrated regional and global scale environmental fate and transport model which has undergone validation.
- Publications in top tier peer-reviewed journals including full publication of the model.
- Presentations at scientific meetings to summarise results and obtain feedback on research directions.

[1] M, B. A.; Matthew, M.; Martin, S.; Don, M.; Mark, B.; H, R. M.; V, D. J.; Konrad, H., Good modeling practice guidelines for applying multimedia models in chemical assessments. *Integrated Environmental Assessment and Management* **2012,** *8* (4), 703-708.

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
Duration: 2 years
Budget in the order of 200.000€
Optional: additional 50.000€ available if open source code developed for the model

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: Review Papers on Microplastics

1. 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.
2. Ivleva, N. P.; Wiesheu, A. C.; Niessner, R., Microplastic in Aquatic Ecosystems. Angewandte Chemie 2016, n/a-n/a.
3. 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.
4. 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.
5. Shim, W. J.; Hong, S. H.; Eo, S. E., Identification methods in microplastic analysis: a review. Analytical Methods 2017, 9 (9), 1384-1391.
6. 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.
7. 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.

8. 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.
9. 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

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.
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.