

Master's Internship Proposal

Starting from January 2025 for 5 to 6 months

Ecotoxicity of tire particles on aquatic organisms from coastal mudflats

1. Context and objectives of the study

In 2019, global rubber production, whether natural or synthetic, reached 28 million tons (Mattonai et al., 2022). Furthermore, automotive tires accounted for 57% of synthetic rubber use in 2010, with an estimated consumption of 6.4 million tons per year (Boucher & Friot, 2017). During their use, the tread material of the tire is abraded and produces particles known as Tire Wear Particles (TWP). These particles, despite having distinct physico-chemical characteristics from microplastics, contribute to plastic pollution on both local and global scales (Wagner et al., 2018) and can form heteroaggregates with road materials. They are then referred to as Tire and Road Wear Particles (TRWP) (Klößner et al., 2019). Generally, pollutants emitted by road traffic tend to disperse into different environmental compartments, potentially reaching distant receiving environments such as rivers. Similar to microplastics, for which the risks of ingestion and the resulting impacts have been demonstrated, TRWP can pose an ecotoxicological risk to certain organisms living in compartments impregnated with these particles.

This internship proposal is part of the Plasti-nium project (2021-2025) – Plastic debris in the land-sea continuum, funded by the Région Pays de la Loire and Nantes Métropole. The objective of this internship is to evaluate the ecotoxicological effects of TRWP on two endobenthic and sentinel aquatic organisms: the worm *Hediste diversicolor* and the bivalve *Scrobicularia plana*.

2. Methodology

During this internship, different conditions of organism exposure to TRWP will be investigated (control, new particles, aged particles, leachates of aged particles and aged and leached particles). Organisms will be exposed to the different conditions through experimental design involving realistic exposure scenario during 21 days. At the end of the exposure, the TRWP will be analysed in the whole tissues by Py-GC-MS, as well as in the sediments. The effects on organisms will be investigated through biochemical (oxidative stress, neurotoxicity; by UV-Vis spectrophotometry) and lipidomic marker analyses (by High resolution mass spectrometry; HRMS). Behavioral studies (burrowing and clearance rates) will complement the analyses. The results will be correlated to determine the factors influencing ecotoxicity.

3. Missions and responsibility

The intern will participate in the sampling of study organisms. He/She will be responsible for setting up exposure tests and monitoring the progress of the experiments. The intern will assist in preparing samples for analyses and will be involved in analyses (biochemical markers, lipidomics, TRWP bioaccumulation) and in the interpretation of the obtained results (statistical tests, bibliographical research, results synthesis)

4. Candidate profile

Applicants must have a background in aquatic biology, toxicology and ecotoxicology. The candidate must have knowledge of biochemical and chemical analyses. Experience of the analytical techniques mentioned above would be an advantage. Good statistical and writing skills.

5. Management and contacts to apply

Project primary location : Isomer UR 2160, Nantes University, 2 rue de la Houssinière, 44322 Nantes

Primary supervisor : laurence.poirier@univ-nantes.fr

Secondary supervisor : louisa.landebrit@univ-eiffel.fr

6. References

- Boucher, J., & Friot, D. (2017). *Primary microplastics in the oceans : A global evaluation of sources*. IUCN International Union for Conservation of Nature. <https://doi.org/10.2305/IUCN.CH.2017.01.en>
- Klößner, P., Reemtsma, T., Eisentraut, P., Braun, U., Ruhl, A. S., & Wagner, S. (2019). Tire and road wear particles in road environment – Quantification and assessment of particle dynamics by Zn determination after density separation. *Chemosphere*, 222, 714-721. <https://doi.org/10.1016/j.chemosphere.2019.01.176>
- Mattonai, M., Nacci, T., & Modugno, F. (2022). Analytical strategies for the quali-quantitation of tire and road wear particles – A critical review. *TrAC Trends in Analytical Chemistry*, 154, 116650. <https://doi.org/10.1016/j.trac.2022.116650>
- Wagner, S., Hüffer, T., Klößner, P., Wehrhahn, M., Hofmann, T., & Reemtsma, T. (2018). Tire wear particles in the aquatic environment—A review on generation, analysis, occurrence, fate and effects. *Water Research*, 139, 83-100. <https://doi.org/10.1016/j.watres.2018.03.051>