

## Sujet de thèse 2022 – ED chimie de Lyon

### Identification des activités et des voies de transfert de microplastiques dans les hydrosystèmes

### Identification of activities and transfer pathways of microplastics in hydrosystems

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#### Background, hypotheses and scientific questions.

In a report proposed by the "Office parlementaire d'évaluation des choix scientifiques et technologiques", entitled "Plastic pollution: a time bomb?" (Préville et al., 2020; in French), parliamentarians focused on microplastics (MPs) as a source of massive pollution. A study mentioned in this report estimates the amount of MP discharged by the Rhône into the Mediterranean Sea at 22 tons per year (Constant et al., 2020). Meijer et al (2021) estimate that the Rhône transports almost 10 tons per month of macro-plastics. According to the parliamentary report, "the Mediterranean Sea is the most polluted in the world, representing only 1% of the oceans but concentrating more than 7% of microplastics". These sources mention the urgent need to study MP on a national level and in the Rhône basin.

Research on MP pollution (small particles of <5 mm in size) has long focused on their largest sink: the ocean. More recently, researchers have expanded their focus to include freshwater and terrestrial environments. This is an important development, given that an estimated 80% of MP in the ocean comes from land and that rivers are one of the dominant pathways for MP to reach the oceans (Rochman, 2018). Several hypotheses have been formulated concerning MP emitting activities - domestic, industrial, agricultural, urban. This plastic pollution accumulates or is transferred to natural environments via urban water management systems (e.g. transfer via wastewater treatment plants, or storm water overflows; accumulation in retention/settlement or infiltration basins) or via storm water runoff.

The studies carried out so far are interested in characterizing the MP in water or sediment matrices in order to establish links between hydroclimatic and hydrological conditions and MP fluxes. In this context, it seems necessary to identify which are the main anthropogenic activities that produce MP and which are the transfer pathways towards the Rhône basin.

#### Objectives

This thesis proposal aims to identify the main MP emitting and diffusing activities and their predominant transfer pathways in the Rhone basin. To this end, sediment samples will be collected at different scales to identify the heterogeneity of emitting and diffusing sources. This approach, based on sediments and

sediment cores, makes it possible to date different MP concentrations, which can be compared with local economic activities at different times by means of statistical techniques. Two forms of variability would thus be integrated, one spatial and the other temporal.

The doctoral student will be able to analyze MP using an innovative method and to understand the links between sources, transfers and natures of MP, in particular by means of statistical methods used in economics. This project will take place in a favorable scientific context since several projects (ANR SEDI-PLAST, IDEX Aquaplast, ZABR MicroPlastic Rivers Development) within the LEHNA laboratory and research support mechanisms (ZABR, OTHU research federation - field observatory in urban hydrology) will support and backup the thesis, notably on the characterization of MP concentrations and fluxes.

## Methodology

Initially, sediments will be sampled in the Rhône River, its tributaries and within the city of Lyon. The urban samples will be taken from retention and decantation basins. These structures are considered in the framework of this thesis as receptacles of MP produced in the urban environment. The extraction of MP present in the sedimentary matrices will be carried out by densimetric separation and removal of organic matter. The identification of MP will be carried out by filter mapping using a Fourier Transform Infrared spectrophotometer (FTIR, Spotlight 400, Perkin Elmer). Important metrics work will be necessary to exploit the data collected and create a standardized database consistent with the various SEDI-PLAST and IDEX Aquaplast projects.

In a second step, causal and/or correlative links will be established between the emitting and diffusing activities and the measured MP fluxes. This will be carried out using econometric tools well known in economics (regression on panel data, hierarchical model), but applied in a different context, which will require methodological adaptations and socio-economic data to represent anthropic activities. There is therefore multidisciplinary in terms of content (impact of the economic sphere on sediments) but also in terms of method.

In addition, a comparative analysis will be carried out to relate the data collected in a constrained environment (retention/settlement and infiltration basins considered as receptacles for MP generated in the urban environment) with the data from the sedimentary matrices collected in the river. The comparison results will serve as a basis for the evaluation of public policies for MP management in urban environments. Strategies and techniques to reduce MP at source will also be proposed.

This project is part of a systemic and multidisciplinary approach that will require the PhD student to produce a transversal conclusion on the issue of PM emitting and diffusing activities as well as on the public policies to be implemented to reduce the presence of PM in urban hydrosystems.

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