Micro(plastics) in the Environment of Some French rivers

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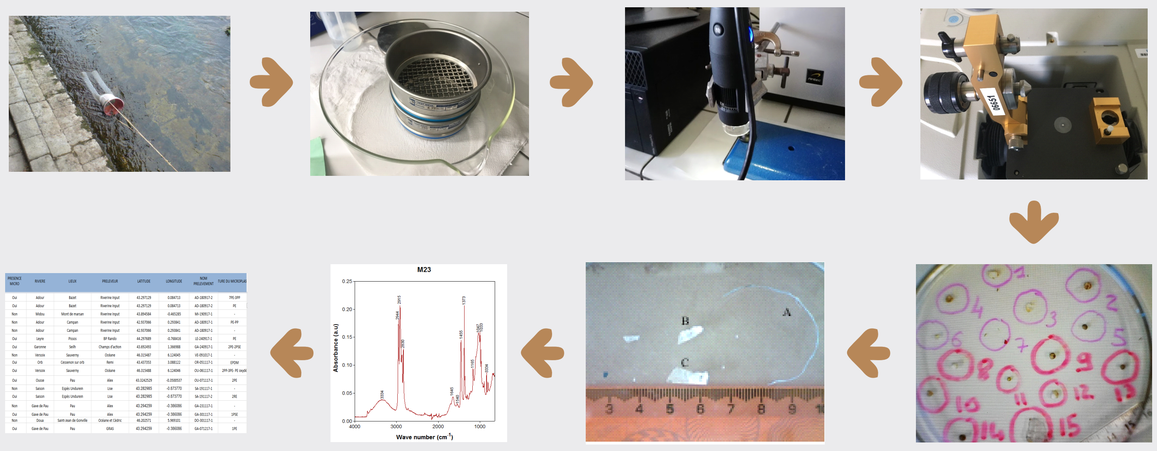
It is now well known that the vast majority of microplastics (MPs) found in the seas and oceans come from lands and as such freshwater environments (rivers and riverbanks) play a major role in this process. We must therefore imagine the scenario that a used plastic, become a waste after use, is found in the environment if it left, for one reason or another from a collection and recycling stream. Its stay in the environment can last a wild and this waste will then be exposed to a set of environmental constraints (UV, rain, wind, mechanical erosion, ..) which will continue and amplify its degradation, leading to its fragmentation since the macroplastics into MPs, even into nanoplastics (NPs). Riverpast Project consists in collecting and analyzing the composition of MPs at the surface waters of different French rivers. To this, we rely on citizen science operations, in particular thanks to the contribution of the BabyLegs sampling net [1], which makes it possible to multiply samples and analyzes [2]. A specific focus has been done on the Garonne River during spring 2018 with a sampling campaign of more than 120 samples analyzed. Collected data and results are reported on open web access map [3].

Experimental

Once received, the contents of the babyleg sampling are sieved in different steps using decreasing mesh sizes. First, it is sieved at 4,57 mm to separate the bigger particles (not considered as MPs). The content is rinsed with distilled water and used water is kept apart. A first manual separation is done to eliminate the vegetal big particles (pieces of branches, leaves, lichens,...). Afterwhat, the rest is sieved again at 1mm and 250 µm mesh sizes. The filtered content of 1 mm and 250 µm is dispersed in water. An optical observation is done under a binocular light device. Suspected plastic particles are taken away from the liquid medium using tweezer and disposed in a Petri dish. After half day in an oven regulated at 60°C, the samples are observed and captured with a photo using a 5 Megapixel resolution PCE-MM200 digital microscope along with a measuring tape. Finally, the particles are observed with a FTIR spectrometer (Thermo-Nicolet 380 FTIR) in ATR (Attenuated Total Reflection, 4000 - 643 cm^{-1}, 4 cm^{-1} resolution, 32 scans accumulated) mode using a diamond crystal. Spectra are recorded and analyze using OMNIC software. The chemical identification is ensured by using a polymer database spectra.



Results

Since the beginning of our analysis (**September 2017**), a total number of **196 sampling** has been carried out. Over these samplings, **123** have been analyzed giving rise to the identification of **246 MP** particles (5 mm < size < 250 µm) c.a. an average of **2 particles/sampling.**

Results are saved on a datadrive and an updated map is accessible online [5]

- 120 particles have been identified as Polyethylene c.a. 49%
- 45 particles have been identified as Polystyene c.a. 18 %
- 30 particles have been identified as Polypropylene c.a. 12%
- 13 as EPDM (Etylene-Propylene Diene monomer), 9 as cellophane (4%), 4 as PET (Polyethylene Terephtalate), 2 as PVC (Polyvinyl Chloride) and 23 as Others (Polyamide, Ethylene Vinyl acetate, Polymethyle methacrylate, Polydimethyl Siloxane)

Focus on Garonne River

A specific focus has been done onto the Garonne river during **spring 2018** (3 weeks in may 2018) in the field of the **NERRI** campaign [5]. During this sampling period **116 samplings** have been carried out. Over these 116 sampling **46** have been analyzed and **137 MPs** have been identified representing thus an average of **3 MPs/sampling** (about 50% more then the overall ratio see upper)

For a better reliability, some samplings have been performed in duplicate or triplicate

Polymer	Total number	< 1 mm	Between 1 and 5 mm	> 5 mm
Polyethylene	66	7	48	11
Cellophane	19	-	16	3
Polypropylene	18	3	12	3
Polystyrene	13	-	9	4
EPDM	10	1	8	1
EVA	6	-	5	1
Alkyd Resin	3	2	1	-
PVC	2	-	1	1

137 MPs have been identified and the average size of most of them is comprised between 1 and 5 mm.

Conclusions and Perspectives

During the first year of analysis (2017-2018) we built up:
- **a methodology based upon citizen scientists participation**
- **a physico chemical methodology called the WYSIWYG methodology** (What You See Is What You Get) allowing us to separate, to count and to identify MP with sizes greater than 250 mm (both mesh size of Manta nets and babylegs is around 300 mm + the minimum size for ATR-FTIR is around 100 mm)

The future development of this research is in the improvements of the WYSIWYG protocol sensitivity. As MP characterization implies three inseparable analytical steps : Collecting/Separating/Analysis, efforts must been done one each of them to increase the WYSIWYG resolution. we shall develop new:
- **methodology for collection** (hydrocyclonic)
- **method of density separation** by using specific chemical liquids such as Ionic liquids
- **FTIR analysis by using a Focus Plane Array detector** (FPA-FTIR) allowing us to go down to 10 mm resolution.
- **microscopic-thermal coupled methods** for the quantification of the MPs fraction

References

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