Determination of microplastics in River sediments on the example of Vistula tributaries near Krakow (Poland)

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Introduction: Lands are an important and at the same time insufficiently researched source of microplastics in the aquatic environment. Various plastic particles are deposited in the river catchment area, where they erode. Then, along with atmospheric precipitation, surface water and probably also groundwater they are transported downstream [1, 2]. Particles made of lighter materials (polyethylene, polypropylene, polystyrene) are easier to float on the surface of the water. If they are not deposited on floodplains or river banks, they will remain in the watercourse until they reach the sea or ocean. The remaining, heavier particles either remain in the water column or fall to the bottom "enriching" the aquatic sediment.

Methods: Three samples of bottom sediment from the Vistula tributaries near Krakow were collected in April 2018. The volume of each sample was 100 mL. The sediments were pre-sifted with distilled water through a 5 mm sieve to separate non-microplastic particles. The samples were dried under the clean fume hood, covered with aluminum foil, to avoid contact with air and possible contamination of airborne fibers. In order to separate microplastics from the sediment, density separation was implemented [1-8]. The 1.2 g/cm^3 NaCl solution was added to dried sediments and left for 24 hours under the fume hood and aluminium foil cover. After this time, lighter plastic particles began to float on the surface of solution. The upper layer of the solution containing floating microplastics is subjected to further macroscopic analysis.

Results: During the pre-sieving, a piece of macroplastic film with the diameter exceeding 5 mm was isolated in the sample MP-1. The use of NaCl solution with a density of 1.2 g/cm^3 allowed the lighter microplastics to float on the surface of the solution. The top layer was collected with a glass dropper and placed on a glass slide, and then covered with aluminum foil and allowed to dry under the fume hood.

Plastic particle in the form of a film of 4 mm length were found during the macroscopic analysis.

Discussion: In the case of density separation, the big limitation is the decision what kind of solution should be used. A solution with appropriately selected density enables microplastics isolation that are lighter than the prepared solution. Light microplastics as polyethylene, polypropylene or polystyrene are isolated using a NaCl solution with a density of 1.2 g/cm^3 [2, 4, 5, 7, 8]. While, solutions with higher densities, e.g. NaBr (1.37-1.4 g/cm^3), $ZnBr_2$ (1.71 g/cm^3), $ZnCl_2$ (1.6-1.8 g/cm^3) sodium tungstate dihydrate (1.4 g/cm^3) or sodium polytungstate (1.4 g/cm^3) for the separation of heavier microplastics as polyvinyl chloride, polyethylene terephthalate, polycarbonate, ore polyurethane, are used [1–3, 5–8]. The NaCl solution is the most commonly used because of its price and low toxicity for the environment. It is also chosen due to the fact that it is a sufficient solution for separating light microplastics, which are more frequently deposited in the environment than heavier ones. The research is still conducted and experiments are carried out to select the appropriate methodology and apparatus.

The problem of microplastics determination in aquatic sediments consists mainly in the lack of the uniform sampling, preparation and analysis methodology, as well as unified interpretation of results, which are usually given in different units. All these make it difficult to compare results from different regions of the world.

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