

Description for the general public

In most cases, the quality of river water is assessed on the basis of biological and chemical tests. The purpose of this research is to estimate the level of pollution of Vistula river water by solid anthropogenic particles which the source is connected with human activity in city agglomerations. The city of Warsaw is one of the largest single emitters of the Vistula's pollution in the central part of Poland, which supplies municipal waste, rain water containing urban and industrial dusts, waste from ash storage sites, etc. The Vistula's River and its basin in southern and central parts of Poland are heavily exposed to pollution coming from industry, agriculture and municipal waste. Municipal and industrial waste entering the river contains among others solid particles with heavy metals. Rain waters provide to the Vistula pollution of atmospheric air which is eluted during the rainfall and transported to the river.

The aim of this project is to estimate the level of heavy metal pollution of the river water and the origin of heavy metals based on magnetic methods (magnetometry). The study material will be the river sediments, which accumulate pollution particles and reflect the level of pollution. I plan to identify the sources of river pollution within the Warsaw agglomeration. In this aim it will be studied pollution of surface sediment along the Vistula in the area where the river flows into and out of the Warsaw city limits and within the Warsaw city center. In this way, it is possible to assess the contribution of heavy metals pollution generated by the city in the river sediments. Knowledge of pollution of river waters flowing through urban agglomerations may be important for the identification and prevention of various diseases associated with the type and concentration of pollutants. Fine anthropogenic particles can be easily transported with water over long distances and accumulate in different areas along the river. Therefore, the research of sediments collected outside of Warsaw allows to analyze the transport of the magnetic particles, assess the level of its accumulation and indicate the places with the highest concentrations of these particles.

In the project, to estimate the level of river sediment pollution by heavy metals the magnetic method will be applied. It is known that urban and industrial pollution contains anthropogenic magnetic particles (AMP) which contains various iron components. These particles comes from urban and industrial sources. AMPs of ashes mostly originate from the high temperature processes and they are released during combustion of natural raw materials, additives, fuels, etc. Other AMPs are generated by moving vehicles in processes of abrasion and corrosion of different parts of vehicles and road surface. AMPs very often are carriers of heavy metals and toxic trace elements; therefore, the magnetic parameters proportional to the concentration of magnetic minerals (i.e. magnetic susceptibility) correlate with the content of these elements. I propose to use the magnetic parameters as an indicator of presence of AMP and toxic heavy metals in the Vistula's River sediments.

The study material will be the new collection of sediments samples, taken from several locations along the Vistula: in the area where the river flows into and out of the Warsaw city limits, within the center of Warsaw in 2015 and 2016. For the collection of samples taken within this project the magnetic measurements will be conducted. The results of the investigation will allow to assess the concentration of magnetic particles, its mineralogy and domain structure (the size of magnetic particles). In particular, such parameters as magnetic susceptibility (χ), hysteresis loops and thermomagnetic curves of $\kappa(T)$ and $M(T)$ will be measured. For about 10-15% of samples the magnetic studies will be supplemented by scanning electron microscopy observations and the analysis of chemical composition. The magnetic properties, the morphology and the chemical analysis of surface of magnetic particles will allow to indicate the sources of pollution.

In second step of the study, I plan the research of individual AMPs with different shape and surface morphology. AMPs will be selected from magnetic extract using optical microscope. On the basis of the magnetic properties, the morphology and the chemical analysis of surface of individual magnetic particles it will be identified the sources of pollution. My previous study showed that particles with strong magnetic properties are presented mainly in the fine granulometric fractions i.e. in size of $71\mu\text{m}$ and smaller than $71\mu\text{m}$. Therefore for this study I will prepare fractions smaller than $71\mu\text{m}$ i.e. from $63\mu\text{m}$ to $20\mu\text{m}$. For those granulometric fractions the contribution of AMPs and its chemical composition will be determined.

The map of distribution of magnetic susceptibility and the concentration of heavy metals along the studied part of Vistula River will be created as the result of the project. It will be shown the places with high and low level of pollution within studied areas. As the result, there will be also worked out detailed procedure for the study of river sediment pollution by measurements of AMP particles properties. The method will be useful for the study of other rivers flowing through different urbanized areas.