

Recently in the world, a great demand for new technologies has been observed. The development of electrical and electronic industry, rapid consumption and "aging" of the equipment entail the necessity of regular replacement, which increases the amount of electrical and electronic waste (called just e-waste or WEEE). E-waste is a specific type of waste, that is a source of potentially toxic elements (Potentially Toxic Elements - PTE), including TCE (Technology Critical Elements). TCE are used in many industries, electronics, electricity and many others. Spent e-waste after getting into the environment become a potential source of TCE. Therefore, the European Union (European COST Action TD1407: Network on Technology-Critical Elements) draw the attention of the scientific community to investigate the content of these elements in various elements of the environment and the impact of environmental processes on the forms of their occurrence, as well as threats to human health caused by them. For example, germanium in the human body accumulates in organs and can cause inflammation and cancer. Thallium toxicity is high and depends on its form. Due to the easy assimilation of tellurium by living organisms, local contamination of the environment with this element can be an environmental threat.

This project assumes the realization of two major research objectives. The first one includes an indication of the transformations and mobility of TCE and their forms in the soils of selected industrial areas, especially around the e-waste processing plants. The project will also result in optimizing methodologies for determining the total and speciation forms of germanium, tellurium and thallium content in soils. The research will answer the question, whether the concentration of the least-known studied critical elements (Ge, Tl, Te) increases in nature with the increase of their use in new technologies? Is e-waste recovery/recycling the source of TCE? Whereas, the second aim concerns an assessment of the effectiveness of soil magnetometry as a tool for the precise spatial and vertical delineation of selected TCE in soils impacted by e-waste. Obviously, the processes applied in chosen e-waste plants as well as the composition of wastes will be recognized as the possible source of dust emission. The study will complement the gap in knowledge on the total content of selected TCE and their forms in soil, and the relationships between TCE and other metals co-occurring in soils and soil magnetic susceptibility values as well.

The proposed scope of this submission and the usefulness of the obtained results will help in creation of the comprehensive and analytically advanced project of qualitative and quantitative analysis of speciation forms of selected TCE connected with storage and e-waste processing, their mobility and impact on the environment. The implementation of the project's objectives will require an interdisciplinary collaboration of specialists from different disciplines: geochemistry, soil science, environmental and metallurgical engineering, instrumental chemistry and statistics. New analytical and computing procedures, which can become standards will be developed. The proposed project will use a modern scientific workshop including an integration of set of methods like i.e. field monitoring by means of highly specialized equipment for *in situ* and *ex situ* magnetic susceptibility measurements, analytical techniques such as ICP-MS, ICP-OES (total elements determination) and the combined technique HPLC-ICP-MS (speciation forms determination), SEM-EDX and X-ray diffraction analyses as well as mathematical methods for chemometric calculations using the Matlab program. The implementation of a wide variety of chemical analyzes will also allow to improve and optimize a method of chemical fractionation of TCE. The type of e-waste processing collected by the plants together with the quantitative and qualitative recognition of their components will be analyzed in the project, and the tests will be carried out using metallurgical methods.

The project concerns original, experimental research work, undertaken primarily in order to gain new knowledge about the basics of phenomena and observable facts without focusing on direct practical application. Due to the low level of knowledge about TCE, their forms and changes in the environment, as well as the systematic and uncontrolled inflow into the environment of electro-waste, rich in TCE, the research planned in the project is very important. The research will make an important contribution to evaluate the mobility of selected elements (Ge, Tl, Te) belonging to the TCE. It will provide new information and supplement the current state of knowledge about the speciation of the above elements in the environment. Methodology for the determination of total PTE/TCE content and speciation forms of germanium, tellurium and thallium in soils will be prepared and tested. The results of this study could make a significant contribution to environmental engineering, instrumental chemistry, soil science and a new branch of geophysics - Environmental Geophysics.