

The mobility of toxic metals caused by the presence of microorganisms is essential for environmental protection. Currently, many researchers focus on modern industrial areas, while historical sites of mining activity are much less studied and controlled. As a result of the natural oxidation of sulphide minerals (bioweathering), acidic leachates are produced, threatening the environment due to toxic elements such as arsenic and cadmium or lead presence. The mechanism of the transformation of toxic elements resulting from the activity of acidophilic bacteria in mining waste has not been fully understood. The adhesion of bacteria is a crucial element conditioning these processes. The presence of microorganisms and surfactants together with pH, ionic strength, chemical and mineralogical composition causes modification of the mineral surface, affecting their hydrophobicity and electrical properties. These changes can lead to increased solubility of potentially toxic elements and their release into the environment.

Many current environmental and technological issues demand a better understanding of the factors controlling microorganisms' immobilisation at solid/liquid interfaces. At present, there is only an incipient understanding of the bacteria-mineral interactions at an ionic and molecular level and the importance of the dissolved-metal concentration gradient resulting from bioleaching. A complex dynamics can only be explained by considering the intrinsic characteristics of the microorganisms, such as hydrophobicity, motility, and mineral properties (hydrophobicity, dissolution behaviour, and ionic contribution).

The effect of the presence of surfactants on the mobility of bacteria and the dissolution of potentially toxic elements from arsenic-containing waste is planned. The research will verify the following hypothesis: The mechanism of arsenic-bearing waste dissolution is affected by surface-active compounds, which also inhibit arsenic release by preventing bacterial adhesion to the solid surface. The first part includes studies on the mobility of bacteria in the porous bed in the presence of surfactants. In the next stage, bioleaching experiments in the presence of surfactants will help identify conditions under which the release of arsenic into the environment is inhibited. Experiments will be conducted in columns to reflect the natural conditions of the waste heap. The last part involves the study of the mechanism of waste dissolution and a theoretical description of mineral-bacterial interactions.

The project will result in answers to the following i) how surface-active compounds affect bacterial adhesion to waste particles, ii) is it possible to inhibit arsenic dissolution by the use of surfactants, iii) what is the mechanism of arsenic-bearing waste dissolution, and iv) if it is possible to predict interfacial behaviour of the mineral-bacteria system. The research will extend the knowledge on the physicochemical aspects of potentially toxic elements dissolution in post-mining areas in the presence of surface-active compounds. The results may also form the basis for developing innovative solutions in, for example, the use of waste as a secondary source of metals, bio-beneficiation or bioremediation.