Microbial Valorisation of acid mine drainage sludge (ValorAMD)

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Sweden is among the most active mining countries in Europe and consists one of the leading countries of EU in the mining sector. On the other hand, mining activities create wastewater that contain a variety of metals such as manganese, zinc, cadmium, lead, copper and nickel and need to be treated before disposed in the environment. For the removal of these metals from contaminated effluents, industry currently relies mostly on hydroxide precipitation using neutralizing agents such as lime, calcium carbonate and magnesium oxide. Several factors, however, affect the effectiveness of the process. Among the different options, lime neutralization/precipitation is commonly used. The drawback of these treatments are their high cost, inefficient sulfate removal and the generation of high volumes of soluble sludge which requires further treatment. Biological methods have also been proposed as they are environmentally sustainable which can reduce the toxicity of wastewater and at the same time recover the metals.

The ValorAMD project is a collaborative work between the Biochemical Process Engineering and Mineral Processing groups at LTU and aspires to develop environmental-friendly process that will enable the recovery of valuable metals for mining wastewaters in the form of metal nanoparticles. These metal nanoparticles can be used in wide range of advanced applications, such as medical imaging, magnetic data storage, semiconductors, optoelectronics and cancer therapy among others. To achieve this, we will study the use of fungal whole cells or cell-free extracts in water containing metals (such as Cu, Ni, Co and Cd) and with the help of specific enzymes (called reductases) these will react with SO_4 and create metal sulfides particles. Strategies to improve the secretion of proteins (and specifically reductase enzymes) such as application of electric current (electrofermentation) and ultrasounds (sonofermentation) will be also examined during the growth of the fungus.