Sustainable use of industrial acid by-product and environmental microbial consortia to recycle important metals from municipal incineration slag

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There is no doubt that the development of the world and our society is in an increasing demand of metals. While intensive mineral prospecting, exploration and mining activities are being carried out, million tons of municipal waste are generated every day leaving huge amount of metals unrecycled in disposed waste and the resulting incineration slag. Metal extraction and recovery from incineration slag could be one solution to metal resource depletion and the existing mismatch between metal supply and demand. Conventional biohydrometallurgy is mainly used to recover certain metals from sulfide ores which are physico-chemically different from incineration slag. The goal of this study therefore is to investigate the feasibility of biotic leaching of metals from municipal waste incineration slag by using microorganisms and to evaluate combined abiotic and biotic extraction procedures to increase metal extraction efficiency.

In collaboration with a waste incineration plant and governmental authorities, we investigate the extraction of basic metals, strategically important precious metals, Rare Earth Elements and heavy metals from household waste incineration slag. A two-step extraction procedure was applied: i) the alkaline incineration slag was firstly treated abioticlly with industrial hydrochloric acid that is provided as a cost-free waste product by the incineration plant; ii) different bacteria that are well-known for biometallurgical applications as well as microbial consortia enriched from sediments of the highly acidic and metal-contaminated river Rio Tinto in Spain were added to increase and maximize the leaching efficiency. We found that in particular the addition of the Rio Tinto microbial consortia improved the metal leaching efficiency significantly compared to abiotic leaching or leaching with single bacterial strains. This study suggests that we can benefit from incineration slag as profitable source of metals economically by applying bioleaching technique using microbial gifts from nature.