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Resource innovation Network for European Waste

Investing in Opportunities
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INTERREG IVB

BIOLEACHING – Recovery of valuable metals from anthropogenic deposits

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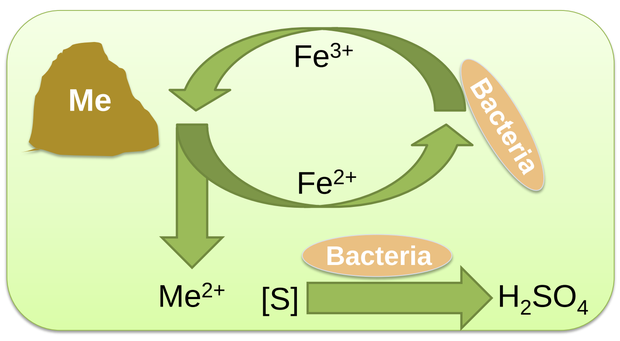
New stocks for valuable metals

Due to the intense use of valuable metals for the production of electronic products, they have become an ever growing limitation for the modern economy. Their natural stocks are unevenly distributed around the world and Europe especially depends on foreign supplies. After electronic products exceed their use they are recycled to regain valuable metals. The recycling rate, however, is limited by economic aspects and a significant amount of metals is lodged without further use. The challenge is to develop methods, which allow an economical use of these sources.



Continuous leaching process

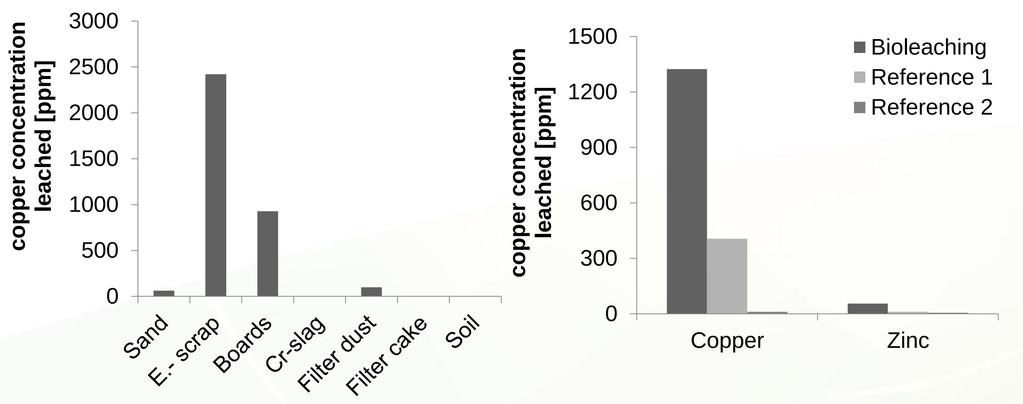
While deposits can contain high concentrations of metals, their recycling is a challenging task. Mechanical separation works to a certain extent on a macroscopic level, but microscopic mixtures can only be separated with high efforts. Based on the experience of lean ore leaching, microorganisms can be utilized to transfer metals into an aqueous solution. Bacterial cells therefore oxidize Fe^{2+} Ions to Fe^{3+} Ions for their energy production. These ions can be used to subsequently oxidize valuable metals and increase their water solubility. Other bacterial cells can be used to produce sulphuric acid, to preserve the necessary acidic environment.

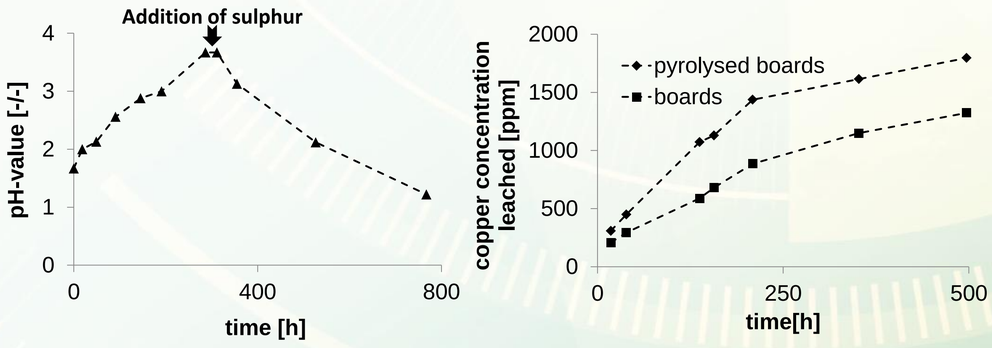
In contrast to established heap and dump technologies for lean ore leaching, urban mining demands a more compact solution. Therefore, a continuous leaching process was designed and implemented in a pilot leaching plant on laboratory scale. The flows of leached material and bacterial cells are contrary.

During the investigations samples were shared with three partners to combine technologies and compare results of different technologies. CTP grinded electronic waste as a pre-treatment and the University of Limerick performed a pyrolysis with this material. VITO did chemical leaching tests with these samples and compared the results with the biological leaching results.

Results and conclusions

Within the project a series of experimental trials were conducted with bacterial cell suspensions to identify the impact of different boundary parameters and to estimate the leaching potential in an industrial application. Using XRFA, several potential substrates were identified. Through batch tests they were tested for their leaching potential. Experiments were carried out in cooperation with VITO to directly compare chemical and biological leaching potential. The results clearly indicated a success of biological leaching with some of the chosen substrates. In contrast to this other substrates showed high metal contents which proved to be unavailable for biological leaching.





- Biological leaching was successfully applied to recover valuable metals from waste, with comparatively low demand for energy and chemicals
- Sulphur oxidizing bacteria can be used to preserve an acidic environment
- The three steps chemical leaching approach by VITO showed higher leaching results. However in comparison to the chemical leaching the biological leaching can be performed in a relatively simple setup. Also cost and demand for chemicals (acids) and energy are less. So the biological leaching could be used as a pre-treatment, to obtain preliminary a solution of biological leachable metals with a smaller amount of contaminants. This might reduce the costs of chemical leaching.
- Pyrolysis supported the leaching results of certain metals (copper)
- While the metal content alone was no reliable indicator for biological leachability, each waste stream has to be investigated separately.

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