INNOMET

Energy-efficient Zinc Recovery from (Bio)leachates with Electricity Producing Microorganisms

Innovative treatment of metallurgical dusts and slags using leaching and separation to recover metallic secondary raw materials

The INNOMET project aims to optimize the recovery of valuable metals from steelmaking dusts and slags by combining biological leaching and metal recovery via bioelectrochemistry. Biohydrometallurgical techniques using microorganisms to extract metals from secondary resources, such as steelmaking dusts and slags, are receiving increasing attention, due to their economic and environmental benefits. The solubilization of metals, such as iron (Fe) or zinc (Zn), by microbial activity is known as bioleaching. However, a crucial step after bioleaching is the recovery of these metals from the obtained leachate.

Bioelectrochemical systems are environmentally friendly and energy-efficient technologies for removing and recovering metals from metal-containing wastewaters, acid mine drainage, or (bio)leachates. As depicted in Figure 1, microorganisms are implemented in the anode chamber of an electrochemical system. These microbes are electroactive and have the ability to interact with the electrode by delivering electrons to the electrode via direct and indirect electron transfer mechanisms, while oxidizing organic substances such as wastewater. The generated current can be used to drive the entire or a part (depending on the redox potential) of a metal reduction reaction at the cathode, attaining a separation of the target metal.

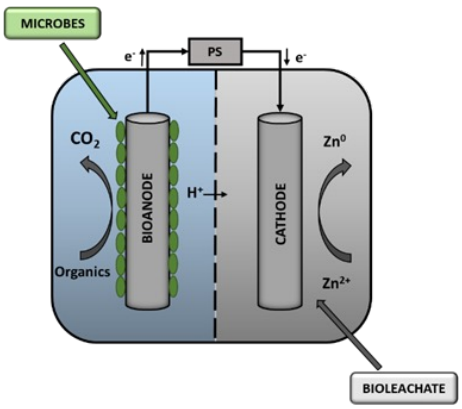

Figure 1: Microbial electrolysis cell for the recovery of zinc from bioleachate.

For instance, to recover Zn in its elemental form, a low potential has to be applied at a microbial electrolysis cell (MEC), while solid Zn is deposited on the cathode surface. MECs offer several advantages compared to electrowinning, such as low energy consumption, cheap anode materials, and simultaneous wastewater treatment.

In INNOMET, a MEC in form of a H-cell was setup in a first step. The anode was inoculated with a mixed microbial culture, maintained under anaerobic conditions, and frequently fed with synthetic wastewater. Furthermore, synthetic leachates, containing the metals Fe and Zn at concentrations corresponding to steelmaking dust, were prepared, and used as the MEC catholyte to investigate Zn recovery. MEC performance parameters such as chemical oxygen demand removal efficiency, current consumption, and Zn recovery efficiency were monitored regularly. To improve the purity and recovery selectivity, leachate pre-precipitation, to remove metal impurities such as Fe, is currently investigated. Hereafter, the use of metal-rich bio-leachate as MEC catholyte is planned and the selective recovery of Zn will be further investigated and optimized.

Update on dissemination activities

Some of the project results have been recently presented in a presentation entitled “Coupling bioleaching and bioelectrochemistry for innovative recovery of zinc from metallurgical dusts and slags” held at the 6th European Meeting of the International Society for Microbial Electrochemistry and Technology (EU-ISMET) in Wageningen (NL).

The first paper, "Zinc recovery from bioleachate using a microbial electrolysis cell and comparison with selective precipitation", has been published in Frontiers in Microbiology.

Involved Partners

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