ENVIRONMENTAL TECHNOLOGIES

BioElectroMET

At a Glance

Title: Bioelectrochemical systems for metal recovery

Instrument: Collaborative project FP7

Total Cost: € 4 205 507,-

EC Contribution: € 3 301 743,-

Duration: 48 months

Start Date: 01-04-2012

Consortium: 7 partners from 6 countries

Project Coordinator: Stichting Wetsus centre of excellence for sustainable water technology (Netherlands)

Project Web Site: www.bioelectromet.eu

Key Words: Bio-electrochemical systems, Electrodeposition of metals, Metal recovery, Metallurgical wastewater treatment

The Challenge

BioelectroMET is a collaborative research project between Magneto special anodes (NL), MAST Carbon International ltd (UK), Centre de Recherche Public Henri Tudor (Lux), Universitat Jaume I (ES), Linnaeus University (SE), Tampere University of Technology (FI) and Wetsus, centre of excellence for sustainable water technology (NL). The project is funded by Europe's 7th Framework Programme and is coordinated by Wetsus.

BioelectroMET will investigate, develop and demonstrate a bioelectrochemical system capable of recovering metals from metallurgical waste and process streams with no or limited energy input. The bioelectrochemical system will combine electrowinning at the cathode with the oxidation of biodegradable substrates at a bioanode.

Project Objectives

This project aims to achieve sustainable production, recovery and removal of metals in the mining and metallurgical industry by means of bioelectrochemical systems. The main objective of BioelectroMET is to develop and test a bioelectrochemical device that can efficiently recover copper and other metals from metallurgical process and waste streams.

Scope

Electrowinning is a metallurgical process during which solubilised metals are electrodeposited on a cathode. At the anode oxygen evolution takes place, which makes the process highly energy intensive. BioelectroMET investigates more energy efficient anode reactions (Fig. 2).

Most methods for metallurgical wastewater treatment are based on the immobilising the residual metals, this results in the accumulation of solid wastes. BioelectroMET offers a solution that recovers valuable metals, which are currently being lost.

Possible Anodic Oxidation Reactions		E^0 (V vs NHE)
Acetate	$C_2H_3O_2^- + 4\,H_2O \rightarrow 2\,HCO_3^- + 9\,H^+ + 8\,e^-$	0.19
Sulphide	$HS^- \rightarrow S^0 + H^+ + 2\,e^-$	-0.06
Thio-sulphate	$S_2O_3^{2-} + 5\,H_2O \rightarrow 2\,SO_4^{2-} + 10\,H^+ + 8\,e^-$	0.28
Oxygen	$2\,H_2O \rightarrow O_2 + 4\,H^+ + 4\,e^-$	1.23

Methodology

In BioelectroMET the competences and capacities of the individual participants are combined to successfully develop and launch the BioelectroMET technology.

Fig. 1 presents the simplified work plan. During the initial phase, the metallurgical streams are characterised and promising microorganisms and substrates for the bioanode are identified. This information will be used to separately develop the anode and cathode. Subsequently, the optimised anode and cathode will be integrated and scaled-up. The up-scaled bioelectrochemical cell will be piloted at a metallurgical site.

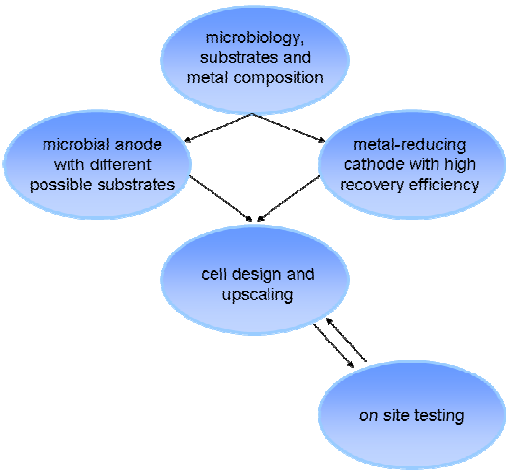

Fig. 1 Simplified BioelectroMET PERT chart

Technology

In BioelectroMET, the oxidation of a biodegradable electron donor at the bioanode is coupled to the electrowinning of dissolved metals at a cathode. The difference between oxidation and reduction potentials indicates if the overall energy efficiency. In that respect organic wastes and metallurgical streams with reduced sulphur compounds form promising feeding for the bioanode.

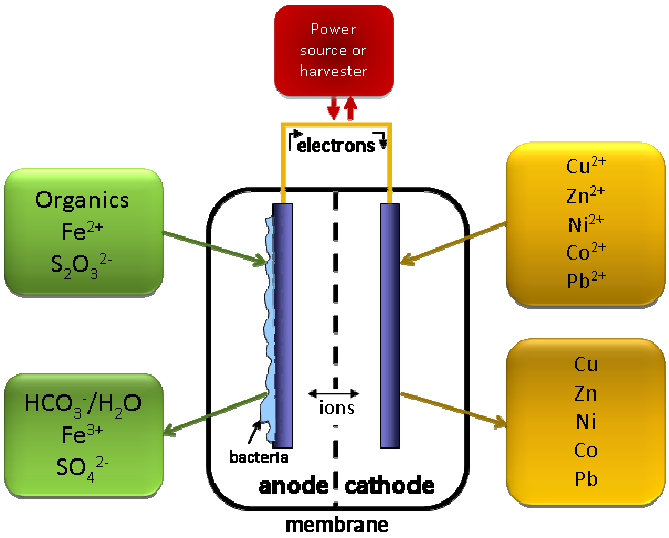

Fig. 2 Overview possible anode and cathode reactions

Expected results

The expected results of the BioelectroMET project are:

- Electro deposition of copper at positive cell potential
- Bioanode capable of utilising substrates available at metallurgical sites (e.g. reduced sulphur compounds)
- Metal recovery from metallurgical waste streams (e.g. acid mine drainage, tailings and waste water from smelters)

Project Partners	
STICHTING WETSUS CENTRE OF EXCELLENCE FOR SUSTAINABLE WATER TECHNOLOGY	NL
MAST CARBON INTERNATIONAL LTD	UK
LINNÉUNIVERSITETET	SE
TTY-SAATIO	FI
MAGNETO SPECIAL ANODES BV	NL
UNIVERSITAT JAUME I DE CASTELLÓN	ES
CENTRE DE RECHERCHE PUBLIC HENRI TUDOR	LUX