References & Services

Process Development in Laboratory and Pilot Scale

- intensification of Cu-heap leaching by addition of surfactants
- kinetics of high pressure nickel and molybdenum leaching
- recovery of cobalt and tungsten carbide from hard metal scrap
- water modelling of metal refining with semi-continuous filter centrifuges
- impact of anode impurities on metal distribution and electrolysis cell characteristics
- effect of organic additives in copper and tin electrolysis
- use of packed bed anodes made from heavy contaminated metals
- electroplating of metastable alloys like Zn-Sn-Co using ionic liquids
- cleaning of industrial waste waters by continuous chemical neutralization, rotating disc electrolysis and electro-coagulation
- synthesis of nanoscaled spherical powders from Au, Ag, Cu, Co, Ni, Fe and their alloys

Small Scale Production & Customer Oriented Research

The IME know-how and equipment allows the validation of production processes for metal winning and recovery. New recycling and environmental optimized routes as well as the inhouse production of chemicals and powders in lab- and pilot-scale can be tested e.g. by following process combinations:

- leaching - extraction - electrolysis
- leaching - filtration - spray pyrolysis

IME Process Metallurgy and Metal Recycling
RWTH Aachen, 52056 Aachen
Postal Address: Intzestraße 3, 52072 Aachen, Germany

Infoline
Phone : +49 (0) 241 80 95851
E-Mail : hydro@ime-aachen.de
Homepage : www.ime-aachen.de

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Hydrometallurgy Equipment

- **Heap Leaching:**
  - 8 columns (H = 2 m, Ø = 0.3 m)
  - 8 magnetic pumps (0.8 up to 36 l/h)
  - dosing via magnetic valves and distribution systems
- **Agitation Leaching:**
  - continuous solution flow (max. 10 l/h)
  - continuous feed of neutralization agent (max. 4.5 l/h)
  - online pH measurements and control
  - three double wall glass reactor, each 10 l (temp. ± 1°C)
- **Pressure Leaching:**
  - vessel volumes: 2 l and 50 l
  - temperature control: ± 1°C, quick cooling device
  - max. pressure: (100 bar / 2 l) and (10 bar / 50 l)
  - max. temperature: T = 300 °C / 2 l / 150 °C / 50 l
  - stirring speed: ≤ 3000 rpm
  - online sampling and dosing of reactants under high pressure
- **Filtration:**
  - operating pressure: 6 bar
  - plate dimension: 300 x 300 mm
  - chambers: 4
- **Solvent Extraction:**
  - 6 mixer-settler: Ø 100 x 775; volumes: 2.6 l (mixer) / 3,4 l (settler)
  - agitator: Ø 80 x 525; 71-355 rpm; infinitely variable
  - teflon membrane pump: 0-12 / 0-120 l/h; infinitely variable
- **Electrolysis:**
  - sets of 6 electrolyte pvc cells
  - cell volume: 6 l, 470 mm x 105 mm x 140 mm
  - electrode size: approx. 100 x 400 mm
  - heating via circulating water: (± 1 °C), max. 70 °C
  - electrolyte circulation via airlift system
- **Electroplating:**
  - lab scale: plate and drum cathodes
  - 14 cells in line (bath dimension: 300 x 300 x 350 mm)
  - potentiostat: ± 10 V/± 10 nA to ± 10 A
  - 5 rectifiers: 15 V/10 A
  - Taber abraser for wear resistance measurements
  - X-ray fluorescent thickness tester
- **Waste Water Purification:**
  - flow rates: up to 1000 l/h
  - selectable reactor geometries: bed, agitation, pipe reactors
  - customisable electrode materials: aluminium and/or iron
- **Ultrasonic Spray Pyrolysis:**
  - ultrasonic generators: 0.8-2.5 MHz
  - furnace (three zones); height: 2.10 m, max. 1100 °C
  - multistage ESP 30-60 kV; 150 °C
  - SMPS online size control (7-1.000 nm)

Hydrometallurgy

IME Metallurgie Prozesstechnik Recycling

DIE METALLURGEN

- **Leaching**
- **Filtration**
- **Solvent-Extraction**
- **Electrolysis**
- **Electroplating**
- **Waste Water Purification**
- **Nano-Powder-Synthesis**

Department and Chair of

RWTH Rheinisch-Westfälische Technische Hochschule Aachen

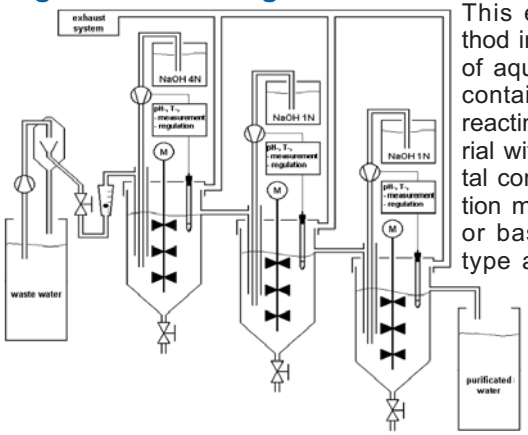
IME Opportunities in Hydrometallurgy

Metal winning from primary or recycling ressources requires always an individually optimized process based on acceptable productivity as well as on high selective process steps. The right selection will determine the economic success of the rate. Hydrometallurgy offers a wide range of extraction (leaching) alternatives allowing high production rates or low cost operations. Many refining possibilities for the resulting suspension can be chosen starting from physical solid-liquid separation over ion-exchange/solvent extraction up to the final reduction steps of crystallisation/precipitation and electrolysis. Compared to pyrometallurgy offgas volumes are significantly reduced, but waste water treatment becomes essential. The know-how and the available equipment at the IME offers the opportunity for experiments to cover the full intended process line. Spin offs from these activities are the nano-powder synthesis via aerosol decomposition and our electroplating laboratory.

Heap Leaching

Heap leaching is a cost effective process for the extraction of metals (e.g. Cu) from ores. By addition of adequate additives the metal extraction from the ore can be enhanced which leads to an improved yield and kinetics of the process. The IME column leaching equipment can be used for experimental process modelling and testing of innovative additives. Furthermore the elution behaviour of slags can be easily simulated before their application in road construction or landfilling.

Agitation Leaching



This extraction method involves the use of aqueous solutions containing a lixiviant reacting with a material with valuable metal content. The solution may be of acidic or basic nature. It's type and concentration is controlled to allow the metals to be recovered selectively. The kinetic and extraction efficiency improves with increased agitation as the diffusion layer becomes thinner.

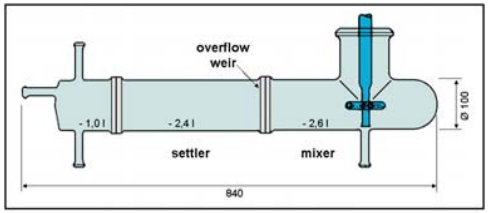
Pressure Leaching

The application of high-temperature leaching in an autoclave is definitely the best way of overcoming slow kinetics. Pressure hydrometallurgy has been applied for the leaching of copper and nickel oxide, sulphide and arsenide in autoclaves. Its main characteristics are: reduced effects to the environment, short reaction times and high extraction ratios due to high pressure. Different reactors allow experiments in acidic as well as in alkaline ambients.

Filtration

Solid-liquid separation is a necessary step for separating a precipitate from solution and is a necessary pre-treatment of e.g. leachates and waste waters. To accomplish this process step the IME has suction filter in different sizes allowing optimal filtration of low volumes and in addition for continuous filtration of bigger volumes a filter press is installed.

Solvent Extraction



Solvent Extraction is a common process step for removal of impurities from a leachate and to concentrate the metal content which is settled between leaching and electrowinning. The IME solvent extraction equipment allows trials with all kinds of leachates up to pilot plant scales. The influence of impurities on the formation of crud and carry-over of solvent can be tested in various concentrations in the leachate.

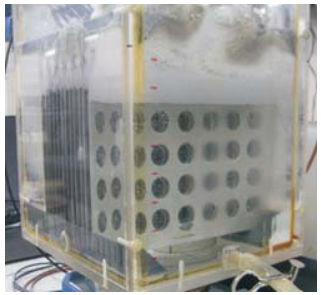
Electrolysis

The removal of impurities from crude alloys (refining electrolysis) and the recovery of metals from dissolved compounds (winning electrolysis) are proven technologies. For example Ag, Cu, Ni, Zn are regulary investigated at the IME electrolysis laboratory. Electrolysis processes are also possible for Al, Ti and Mg, if water free electrolytes are used.

Electroplating

The electroplating unit is applied for the metal deposition of the multilayer system copper-nickel-chromium in order to obtain decorative gloss chromium surfaces on different substrates like steel, plastic, brass or aluminium. The development of new corrosion protective coatings from aqueous and also ionic liquid electrolytes is also investigated in this lab. A Taber Abraser can be used to test the wear resistance of the deposit. With the Fischer X-ray fluorescent thickness tester the coating thickness and the alloy composition can be determined.

Waste Water Treatment



Purification of metal containing effluents can be based on chemical, physical or electrochemical methods. The IME runs a full continuous chemical precipitation line as well as innovative technologies in lab scale. Electrochemistry offers an eco-friendly operation while reducing the use for fresh water resources.

Synthesis of Nanopowder by Ultrasonic Spray Pyrolysis

Aerosol generation is maintained by a powerful source of ultrasound on a corresponding solution. It forms droplets with constant droplet size, which depends on the solution characteristics and the frequency of ultrasound. By controlling the process parameters (e.g. concentration of the solution, residence time of the aerosol, presence of additives, flow rate, decomposition temperature atmosphere) it is possible to obtain customized nano-powder morphologies. An online measurement of the nano-particle size distribution via SMPS allows for immediate reactions in order to control the product quality.