

# INTMET PROJECT

## INNOVATIVE PROCESSES TO RECOVER BASE METALS AND CRM FROM LOW-GRADE AND COMPLEX ORES

[www.intmet.eu](http://www.intmet.eu)

The EU funded project “*Integrated innovative metallurgical system to benefit efficiently polymetallic, complex and low-grade ores and concentrate* – INTMET” concentrated on the difficult task to recover valuable metals – base metals as well as CRM – from low-grade and complex ores. INTMET tested three innovative hydrometallurgical processes – atmospheric, pressure and bioleaching – and novel more effective metals extraction techniques (e.g. Cu/Zn-

SX-EW, chloride media, MSA, etc.) in relevant environments aiming to maximise metal recovery yield and minimising energy consumption and the environmental footprint.

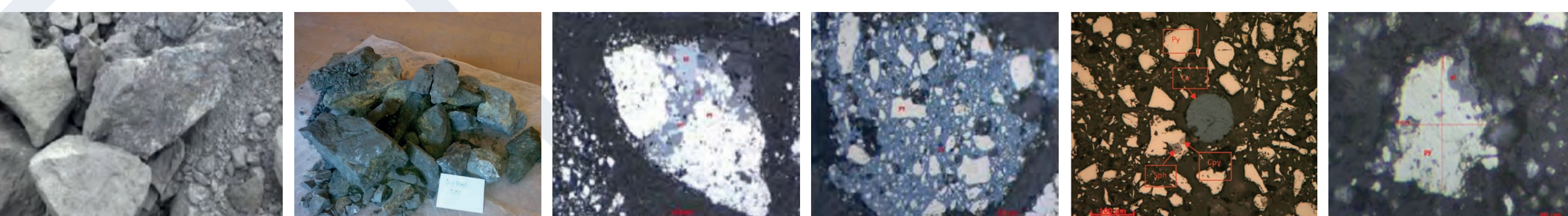
Towards the end of the project, after 33 months of experimental work, preliminary results shall be shared with the public, even as the final goal of the project to offer a real business solution seems to be achievable.

For more details please visit the project website: [www.intmet.eu](http://www.intmet.eu)

### WP 1: RAW MATERIALS SAMPLING AND CHARACTERIZATION

Four materials obtained from mineral deposits from CLC, KGHM, BOR and Somincor were sampled and characterized. These included polymetallic ores and concentrates, complex or low grade copper ores and concentrates and pyrite concentrates. In this work package the delivery of samples for experimental testing was also coordinated.

Regarding flotation tailings and metallurgical wastes as secondary raw materials, limitations related to polymetallic low-grade and complex ores to achieve high efficiency recovery of valuable metals (Cu, Zn, Pb, Ag) and critical raw materials (Co, In, Sb) have been overcome.



Pictures of samples to be characterized and metallographic image analysis

### WP 2: ENHANCED PERFORMANCE FLOTATION PROCESS

WP2 develops the necessary technology for bulk concentrate production and provides samples for lab-scale and pilot testing. Main areas of activity are comminution and flotation improvements and production of samples from the developed processes.

Newly developed flotation reagents and microwave techniques have been applied. Additionally, pilot plants have been established to confirm results and produce samples for further testing activities.

Electrical pulse fragmentation has been tested as a pre-concentration technique. The potential energy saving is going to be evaluated.



Sulphide Flotation

Microwave deflection to mineral

Ore feed system

Grinding mill

FLOTATION PILOT PLANT ARRANGEMENT AND TESTING

### WP 3: DEVELOPMENT OF INTEGRATIVE ATMOSPHERIC LEACHING PROCESS

Atmospheric leaching applied on bulk concentrates or middlings is one promising key technology for efficient metals recovery from low-grade, complex and polymetallic ores proposed by INTMET.

Obtained results at lab and pilot scale have shown the high recoveries as expected (e.g. 94% Cu and 95% Zn recovery). Continuous operation has proved that it is possible to recover lead and silver in high yield from the atmospheric leaching residue. It can be stated that a new technological approach has been developed to treat efficiently reserves of polymetallic primary sulphides by means of hydroprocessing.



CLC: Atmospheric leaching test at lab

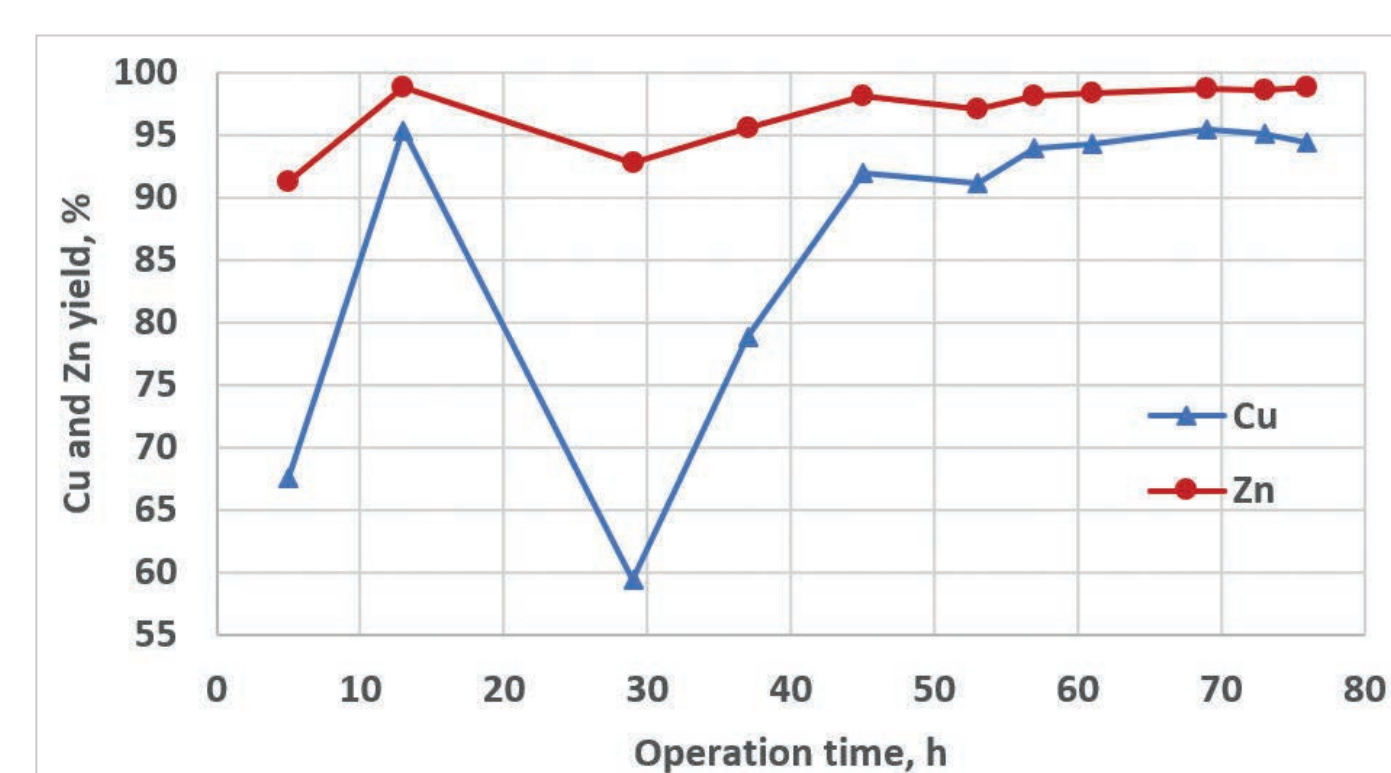
CLC: Atmospheric leaching pilot plant design, commissioning, start up, running & fine tuning. PLS & leaching residue samples produced

TR: continuous recovery of lead and silver

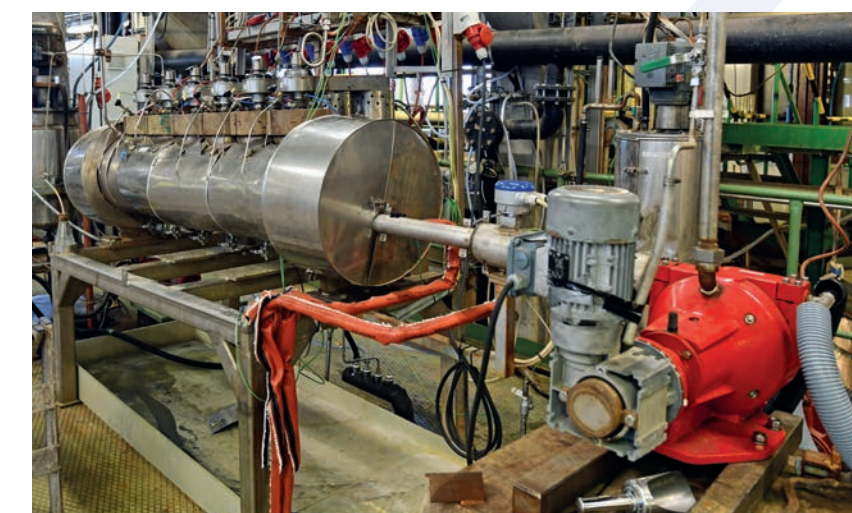
### WP 4: DEVELOPMENT OF INTEGRATIVE PRESSURE LEACHING PROCESS

High temperature pressure oxidation is a well proven process for Ni, Au and Zn production. A process for leaching of both Cu and Zn is developed – pressure oxidation in an autoclave at temperatures from 135°C to 210°C destroying sulphides rapidly at leach times lower than 60 minutes - releasing base metals into solution for further recovery.

INTMET proposes this technology as an efficient way to recover base metals from bulk concentrates and middlings. Lab as well as pilot results obtained showed high Cu and Zn yields (Cu 95%, Zn 99%).



Copper and zinc leaching yields during the pressure leaching pilot run



Pressure leaching continuous pilot run at Outotec Autoclave with auxiliary equipment

### WP 5: DEVELOPMENT OF INTEGRATIVE BIOLEACHING PROCESS

Bioleaching is a process described as being “the dissolution of metals from their mineral source by certain naturally occurring microorganisms”. This technology is considered very promising to INTMET. The bioleaching performance on four polymetallic samples was assessed by means of testing and detailed steady-state mass balances.

The results indicated that thermophilic bioleaching conditions (both in lab and pilot-scale) would be required to achieve acceptable Cu and Zn recoveries on three of the samples, whereas high Cu extractions could be achieved on the fourth sample at moderate temperatures. The process flow consists of bioleaching, iron precipitation, resin-in-pulp (RIP) and brine-leaching of the residue. The maximum extractions achieved were 85% Cu, 75% Zn, 90% Pb, 90% Au and 80% Ag. A recent study indicated favourable economics for the process up to the Cu production stage, with studies of the further downstream processes to follow.



Continuous bioleaching at Mintek of the IRM-Bor, Somincor, KGHM (Lubin) and CLC feed materials



Cultivation of local bacterial cultures at BOR



Bioleaching infrastructure at Bor Institute.

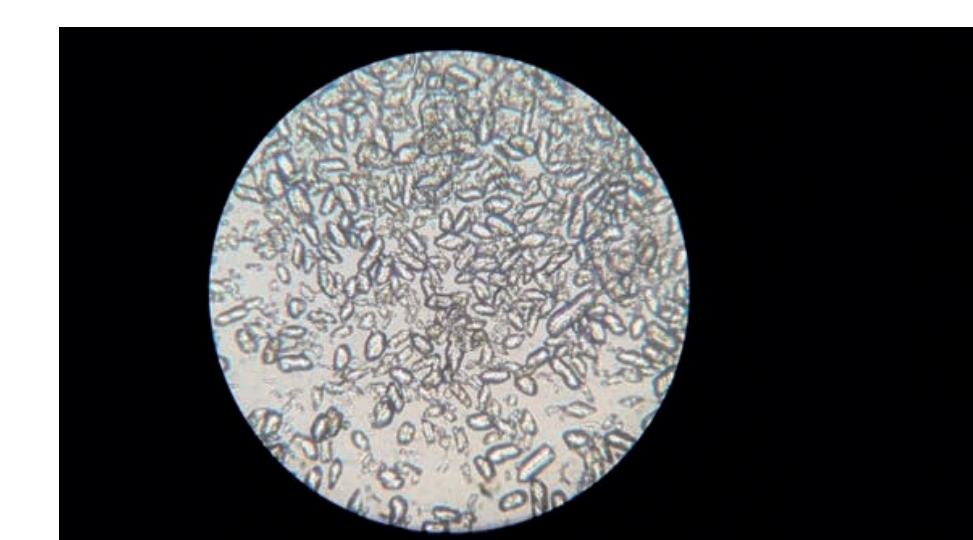
### WP 6: VALORISATION OF TAILINGS, WASTES AND EFFLUENTS

The project intends to limit the amount of wastes and effluents by valorizing these streams using best tailored technologies. Flotation tailings are processed to produce a new collective concentrate that can be used in hydrometallurgical industry. Pyrite is oxidized to valorize sulphur in form of potassium sulphate and produce iron that meets requirements of ferrous metallurgy. High quality coarse-grain gypsum with a limited heavy metals

content for commercial applications is produced from sulfuric acid effluents. Post-treatments to recover and separate Co, Mn, Zn and other elements from High quality coarse-grain gypsum with a limited heavy metals content for commercial applications is produced from sulfuric acid effluents.



AGG: Samples before and after treatment



Well-developed gypsum crystals of favourable length/width proportions close to 1:2 – 1:4. Scale-up of the process had no influence on the product quality



IMNR: Potassium sulphate obtained from mining wastes