INTMET

INTEGRATED METALLURGY FOR POLYMETALLIC, COMPLEX AND LOW GRADE ORES AND CONCENTRATES

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WORK PACKAGE 4: DEVELOPMENT OF INTEGRATIVE PRESSURE LEACHING PROCESS

OBJECTIVES

Main objective is to develop a pressure leaching process, capable of efficiently dealing with low grade copper concentrates (<10-15% Cu), polymetallic concentrates (<10-15% Cu+Zn+Pb), and flotation middlings, to yield high quality metal products.

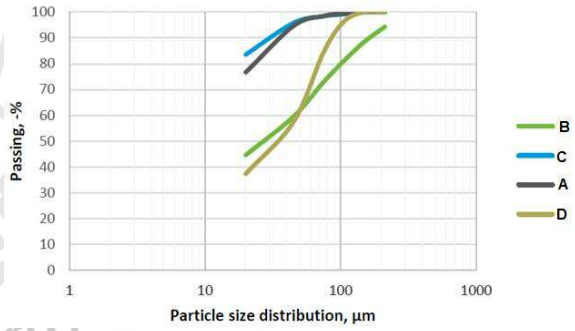
Specific objectives:

- To perform lab-scale tests with four different concentrates to select suitable pressure leaching conditions and determine metal recoveries.
- To select the most effective process conditions to be tested in continuous pilot plant.
- To perform continuous testing of developed pressure leaching process to recover the valuable metals, mainly Cu, Zn and Pb.

MAIN RESULTS

Pressure leaching test work was carried out with polymetallic concentrate samples provided by Intmet partners.

Concentrate	Cu %	Zn %	Pb %	Fe %	S %	As %
A	1.8	5.8	3.9	37	45	0.5
B	1.5	3.9	4.6	23	35	0.3
C	4.9	8.9	13	29	38	0.4
D	13	1.1	4.9	8.4	14	0.5



PRESSURE LEACHING AT HIGH TEMPERATURE

Outotec carried out pressure leaching tests in sulphate system using temperatures from 180 °C to 210 °C and oxygen partial pressures between 3 and 7 bar of O2. Batch tests resulted in leaching recoveries of 92-99% for copper and 95-99% for zinc. The required leaching time was typically 60 min for Cu and 30 min for Zn when operating at 200 °C. High leaching temperatures (≥ 200 °C) are favourable for Fe because those promote Fe in-situ precipitation. Arsenic co-precipitated as well at higher leaching temperatures. All concentrates included sulphide minerals such as pyrite and chalcopyrite, therefore significant acid generation occurred during leaching. A continuous pressure leaching pilot run with a 65 litre autoclave was executed in March 2018 with good results.

Sampling from pilot autoclave

IntMet has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689515

PRESSURE LEACHING AT MODERATE TEMPERATURE

IMNR carried out pressure leaching bath tests at temperatures below 150°C and using air as oxidation agent. Mechanical activation (grinding) was carried out prior to leaching to enhance the results. For the concentrates with relatively high copper, the recommendation is pressure leaching in aqueous sulphate system. Tests with this system yielded Cu leaching recoveries of 91-96% and Zn recoveries of 97-98% after 4h. For concentrates with low copper content, chloride leaching was used, giving leaching recoveries of 92-95 % for Cu and 95-99% for Zn. In addition, Pb was also efficiently leached in chloride medium.

COPPER AND ZINC RECOVERY

Depending on the leaching route and medium, various downstream processing options were proposed and tested. Outotec executed a continuous lab/bench scale pilot campaign of copper and zinc SX and Zn electrowinning. SHG Zinc was produced and the SX circuits performed as an efficient barrier to avoid impurities to EW. High efficiency of Cu SX was also achieved.

CTA with Mn resistant coating

Coated Titanium Anodes (CTAs) induce the reduction in the overpotential of oxygen evolution in EW, thereby the cell voltage is drastically reduced, and more than 15 % of energy saving will be possible. The novel Mn resistant coating developed for Outotec CTAs can completely inhibit Mn oxide deposition.

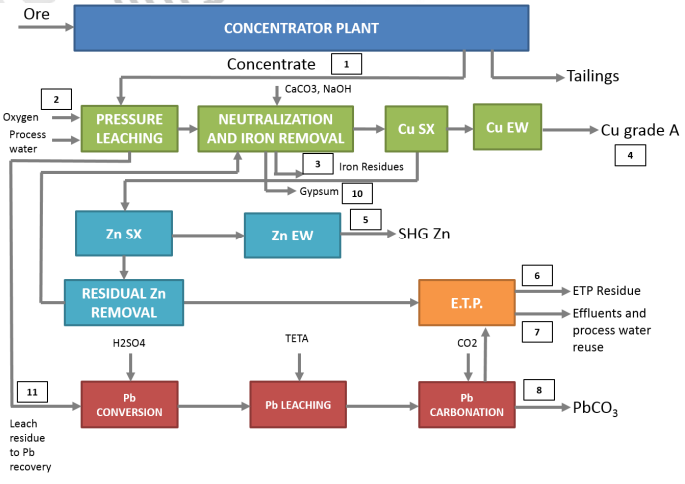
LEAD AND SILVER RECOVERY

In tests at IMN, TETA (triethylenetetramine) solution was successively used for lead recovery from pressure leaching residues. Depending on the starting materials the recovery of lead leaching varied from about 30% to about 70%. Conversion of lead jarosite to lead sulfate prior to TETA treatment resulted in more than 80% of Pb recovery. Subsequently, solution carbonation was used to produce lead carbonate product.

BOR INST is executing tests with pressure leach residue from Outotec pilot run utilising hot brine loop process and EW for lead recovery as well as organic reagents for silver recovery.

FLOWSHEETS FOR CONCEPTUAL TECHNO-ECONOMIC EVALUATION

Preliminary flowsheets as well as mass and energy balance calculations for the processing from concentrate up to end products were developed for the techno-economic evaluation of pressure leaching processes.



The economic feasibility varies much between the tested feed materials. A low iron content favours the economics of processing while concentrates with high amounts of pyrite are more challenging both in terms of CAPEX and OPEX.