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

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WORK PACKAGE 3: DEVELOPMENT OF INTEGRATIVE ATMOSPHERIC LEACHING PROCESS

OBJECTIVES

The main objective is to develop an innovative hydrometalurgical process at atmospheric pressure able to efficiently leaching complex-low grade copper concentrates and polymetalic concentrates. The specific objectives are.

- Evaluate the lab scale results to select the most effective process conditions.
- Install pilot plant facilities to tes teh novel hydrometallurgical processes

1: MAIN RESULTS

3.1 Lab scale metals recovery and refining

<u>Atmospheric leaching</u> lab scale tests have been performed on samples provided by SOMINCOR, CLC, KGHM and BOR INST.

SAMPLE	Cu (%)	Zn (%)	Pb (%)	Fe (%)			
CLC	1,44	5,35	3,83	35,30			
BOR	1,77	4,92	4,62	23,80			
SOMINCOR	4,97	9,34	13,70	28,80			
KGHM	12,80	1,13	4,67	8,20			
TABLE 1 CONCENTRATE CHARACTERIZATION							

Catalyst effect on Cu and Zn recovery from concentrates was the main goal in these tests. It was demonstrated that recoveries were improved by a catalysed process. Results are showed in next table:

	No ca	talyst	With catalyst			
SAMPLE	Cu Ext. (%)	Zn Ext. (%)	Cu Ext. (%)	Zn Ext. (%)		
CLC	65,7	72,1	97,5	94,5		
BOR	69,2	19,6	88,9	73,2		
SOMINCOR	63,4	75,2	88,8	95,5		
KGHM	98,1	97,2	ofo.	-		

TABLE 2 – ATMOSPHERIC LEACHING RECOVERIES.

3.1.1 Cu AND Zn WINNING

Cu and Zn extracction has been elvaluated though three stages:

- Solvent Extraction of Cu. PLS from leaching is treated with a base in order to reduce acidity downt to 20 g/L. Solvent extraction has proved to be very selective and producing a loaded electrolyte suitable for conventional electrowinning.

Loaded electrolyte contains: 20ppm of Fe, 80 ppm Zn, 32 ppm of Ca, 4ppm of Mg, <5ppm of Mn and <10ppm of As

Iron Removal. CuSX raffinate is treated with limestone under controled conditions to produce a
precipitate of paragoethite and gypsum of good filterability. Filtrate has a concentration fo iron bellow
5ppm and therefore is suitable for Zn recovery using Zincex[™] technology.

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	Zn	Cu	Fe
CuSX raffinate (g/L)	51.2	1.2	57.3
ZnSX PLS (g/L)	51.6	0.84	0.003
Precipitation eff.	1.2%	24%	100%

 Solvent Extraction of Zn. Filtrate from iron removal can be feed to zinc solvent extraction and electrowining (Zincex[™] process) to produce metalic zinc and a raffinte that is returned to atmospheric leaching.

3.1.2 Ag & Pb RECOVERY

Ag and Pb recovery has been elvaluated though four stages:

- Lead Leaching. Atmospheric leaching residue has been treated in brine solution to leach lead (81%) and silver (94%) togeher with other impurities.

	Pb	Ag	Zn	Cu	Fe	Hg	Bi
Loaded brine composition (g/L)	13.3	0.200	0.130	0.160	0.590	0.045	0.035

- Iron Removal. Iron is remover from solution in order to produce a purer lead carbonate.
- Silver is cemented using Pb dust. Silver recovery is high, above 98%. Leached Cu, Bi and Hg report in the cement.

	Pb	Ag	Zn	Cu	Fe	Hg	Bi
Lead Loaded brine (g/L)	13.7	0.002	0.110	0.060	0.002	<0.001	0.001

- Finally, lead is recovered as PbCO3 by precipitation form led loaded brine using Na₂CO₃.

3.2- Pilot Plant arrangement and testing

In accordance with WP3 objectives, pilot plant facilities were designed and installed at CLC to test in continuous the novel hydrometallurgical process to recover the valuable metals from bulk concentrates.

During the beginning of 2016, the engineering was performed by CLC. Then, the construction period started. Once the equipment was installed, the pilot plant was ready for commissioning and rump-up. After that, nominal conditions leaching campaign started mid-year. Pilot plant has been operated at nominal conditions and variable setting up was based on results obtained in prior laboratory tests.

After covering successfully atmospheric leaching pilot test works, yielding copper and zinc extraction (94% Cu and 95% Zn recovery), it can be stated that it has been developed a new technological approach to treat efficiently reserves of polymetallic primary sulphides by means of Hydroprocessing.

Pilot plant for Pb and Ag recover has been recently operated in TR. We are currently analysing the results.