WORK PACKAGE 6: VALORISATION OF TAILINGS, WASTES AND EFFLUENTS (IMN, IMNR, AGQ)

OBJECTIVES

Main objective is to benefit old tailings and metallurgical wastes with enough metals content, critical elements or value raw materials; maximizing reuse of water to minimize water consumption and enhance purification of effluents.

Specific objectives:

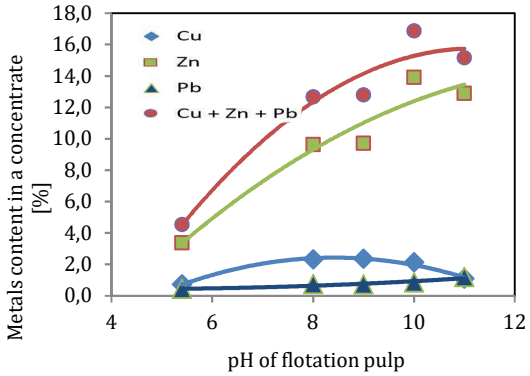
- To select the best pre-concentration treatments and conditioning processes for tailing and wastes.
- To optimize valuable metals recovery from industrial residues & valorize pyrite to produce pure iron oxides.
- To obtain gypsum of a commercial grade.
- Water and effluents purification, recycling, and reuse.

MAIN RESULTS

TAILINGS AND WASTES PRE-CONCENTRATION

The optimal conditions were developed to produce polymetallic concentrate that can be used as a feed in hydrometallurgy from the flotation tailings. The scope of work covered physic-chemical analysis of delivered material, flotation and gravitational tests to beneficiate materials.

It was showed that flotation of such a material produced poly-metallic concentrate with Cu, Zn and Pb content as high as 16%. It was also possible to produce rich pyrite concentrate (>90%).



PYRITE OXIDATION, SULFUR VALORIZATION AND RECOVERY OF IRON

The technology consists in the alkaline oxidation (potassium carbonate) of metal sulphides from pyrite concentrates at moderate temperatures and pressures (autoclave leaching), using air as oxidizing agent.

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The sulphur valorisation/recovery was performed by evaporation – crystallization (rotary evaporator, spray-dryer). Recovery was accomplished by obtaining by-products such as K_2SO_4, containing 42-44% K and 17-18% S.

To achieve a commercial iron by-product it was necessary to separate, purify and concentrate the iron oxide. The removal of impurities (Cu, Pb, Zn, As) from oxidized pyrite in order to obtain a by-product to be used in steel industry or in construction materials was carried out in two stages:

a) removal of arsenic from pyrite or oxidized pyrite concentrates by solubilization in alkaline medium. In this case, for the intensification of chemical processes, various techniques were used such as: microwave, ultrasonic and/or combined treatment;

b) removal of Cu, Pb, Zn from oxidized pyrites by solubilization in chlorine media including chloridizing volatilization.

GYPSUM PURIFICATION AND MAKING BY-PRODUCTS

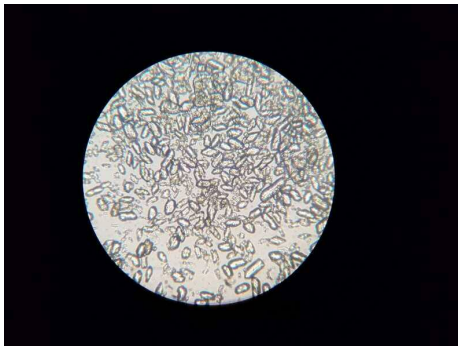

Figure 1: Well-developed gypsum crystals

Research was focused on the gypsum production from weak spent acid, which included in its composition sulphuric acid, iron and metals such as copper, nickel, cobalt, arsenic, and zinc.

As a result of the technology 40-60% of the sulphuric acid contained can be recovered in the form of grain coarse gypsum with properties enabling its utilization in the construction materials industry, in particular in cement production.

WATER AND EFFLUENTS PURIFICATION, RECYCLING AND REUSE

Based on the circular economy strategy, new technologies which are able to convert residues to new raw materials with economical value were proposed. In addition, these methodologies promote the purification of these mining wastewaters and effluents.
For that purpose, several techniques are studied and tested during the development of the project: absorption, flocculation, chelating, ion exchange, neutralization or fractional/selective precipitation.
Two technologies, namely ion exchange and fractional/selective precipitation, are the ones which present better results in terms of efficiency and high recoveries.