ABSTRACT OF DOCTORAL DISSERTATION

Leaching of copper sulphide concentrate in oxygenated sulphuric(VI) acid solutions

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Hydrometallurgical treatment of copper sulphide concentrate from Lubin-Glogow Copper Basin (LGOM) ore have been presented. Usefulness and efficiency of atmospheric leaching process was the aim of the dissertation and leaching was investigated as a method of recovery of copper and accompanying metals from commercial copper oncentrate produced at Lubin Concentrator KGHM "Polska Miedź".

The following research was performed: chemical and mineralogical characterization of the flotation concentrate from Lubin Concentrator (ZWR), modification of leaching feed (controlled decomposition of carbonates with sulphuric acid, grinding, separation of precipitated gypsum by flotation), determination of atmospheric leaching parameters (temperature, concentration of Fe(III), solid to liquid ratio, oxygen flow rate, concentration of chloride ions), complementary research to determine mechanism of sulphide minerals leaching (electrochemical measurements using the sulfide electrodes prepared from natural sulphide minerals from Lubin deposit). Moreover, examined was the possibility of application of atmospheric leaching as a treatment method for "high recovery concentrate" (2^{nd} cleaning flotation 1^{st} circuit concentrate from Lubin Concentrator).

Chemical and mineralogical analysis shown that the concentrates from LGOM deposits indicate unique and exceptionally beneficial features for their application as a leaching feed in hydrometallurgical treatment. Non-oxidative leaching (controlled decomposition of carbonates) was always performed before each atmospheric leaching experiment. Non-oxidative leaching conditions guarantee a selective decomposition of carbonate gangue minerals, consequently increasing the liberation of metal-bearing sulfide grains. Simultaneously, such a leaching process assures high chemical stability of metal sulfide minerals.

The experiments of atmospheric leaching of copper and base metals were performed in oxygenated sulphuric acid solution and in oxygenated sulphuric acid solution in the presence of iron(III) ions. The temperature of leaching was increased from 50 °C to 90 °C, improving leaching conditions and increasing the process rate. The most effective leaching of sulphide minerals from concentrates produced in Lubin Concentrator was possible only in the presence of iron(III) ions in oxygenated sulphuric acid solution even at the lowest iron(III) concentration (10 g/dm^3). The leaching results showed that the optimum solid to liquid ratio for copper and zinc is 1:6 and for nickel and cobalt is 1:8. The increase of solid phase in leaching suspension significantly declined leaching conditions and decreased the process rate. It was found that for leaching process of final flotation concentrate the oxygen flow rate should be 60 dm^3/hour. The experiments exhibited that the presence of chloride ions was increasing the rate of sulphide minerals digestion process.

The additional grinding of the concentrate prior to leaching appeared to be an undesirable operation because it reduced the beneficial effect of galvanic interactions. The electrochemical measurements of redox potential during leaching process was a very effective method of leaching process control. It could quickly indicate the leaching stage and suggest necessary changes of process parameters. The atmospheric leaching process of sulphide minerals from concentrate produced in Lubin Concentrator with oxygenated sulphuric acid solution in the presence of iron(III) ions could be represented by shrinking-core model with a constant particle size.