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SILVER RECOVERY FROM THE WASTE MATERIALS BY THE METHOD OF FLOTATION PROCESS

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During the leaching process of zinc concentrates, the waste materials rich in various metals such as eg. silver are produced. So far no attempts of silver recovery from the mentioned waste materials have been made due to the lack of any method which would be both effective and beneficial. The paper presents some possibilities of application of flotation process in silver recovery form waste materials generated during zinc production.

Key words: zinc concentrate, leaching, waste products, flotation process, silver

INTRODUCTION

In an era of shrinking natural resources the need of metals recovery is focused on recyclable materials or the materials with quite limited participation of metals. Recycling has become a necessity both from an environmental and economic point of view. Since there is a wide variety of the materials which contain metals, and both the content and their physical nature are varied, the need for the methods of metal recovery which suit each individual recyclable material appeared. The methods should guarantee high degree of recovery efficiency and meet the environmental requirements.

The paper presented suggests the use of flotation process for the separation of metals from the nonmetallic components of waste materials being the by-products of the leaching process of zinc concentrates. The leaching process is one of the main technological stages of zinc production [1]. Flotation is the method of separation most frequently used for the processes of enrichment of metal ores and carbon. Flotation occurs as the result of interfacial phenomena in the solid/liquid/gas system. If a grain exhibits hydrophilic properties under certain defined conditions, then in the flotation process it can be separated from the grains which do not demonstrate such properties. The intensity of flotation process depends on a number of factors the most essential being properties of flotation foam (type of frothing agent) and grain size The flotation method can be used for separation of metal from grain fraction of some oxides and carbides [2, 3]. This was confirmed by test results obtained during recovery of native gold from polymetallic copper ores performed by CSIRO Minerals in Australia [4]. The studies on silver recovery form jewellery wastes carried out with the flotation method have also been conducted at the Silesian University of Technology in Poland [5].

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DESCRIPTION OF TECHNOLOGICAL PROCESS AND ITS FINAL PRODUCT USED FOR FURTHER STUDIES

The material used for tests in the form of slime is the effect of leaching process of zinc concentrates which have been developed as the result of flotation of ores containing zinc.

Zinc concentrates go to a Roasting Department where sulfide zinc concentrates are subjected to roasting. Roasting process is conducted in a fluidized bed furnace at a temperature 960^{O}C. The product is zinc oxide and roast gases. Zinc oxide goes to Zinc Electrolysis Department and gases which contain SO_2 after cleaning go to Sulphuric Acid Plant.

Oxide concentrate supplied by the Roasting Department is subjected to leaching process at the Leaching Department. There, it is dissolved in sulphuric acid with the participation of reverse acid electrolyte bath originating from the Department of Electrolysis . The resulting acidic zinc sulfate solution is then subjected to sedimentation. After clarification it is cleaned with zinc fluid and filtered. The electrolyte solution is cooled in cooling towers and subjected to the process of electrolysis. Additionally to the generated electrolyte, waste slime of 20-25 % of its initial mass is produced. And it is this slime which is the subject of the described investigations.

CHEMICAL COMPOSITION OF THE STUDIED WASTES

In order to determine the chemical composition of wastes, 2 samples were taken and subjected to qualitative analysis with the application of Joel JDX-7S X-ray. The it was followed by quantitative analysis with

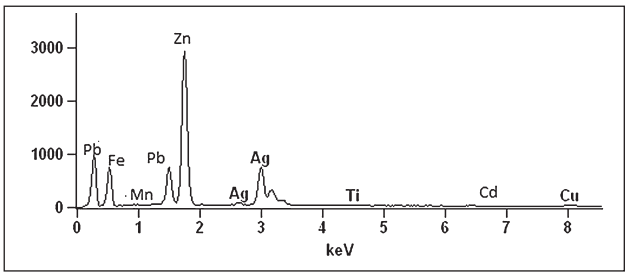

Figure 1 Sample X-ray/radiograph of waste generated in the leaching process (sample 1)

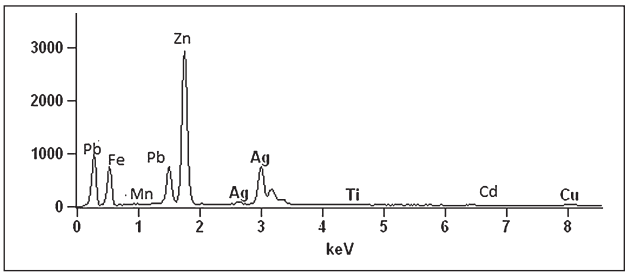

Figure 2 Sample X-ray/radiograph of waste generated in the leaching process (sample 2)

Unicam atomic absorption spectometer Solaar M6. X-rays of wastes for the analyzed samples are presented in Figures 1-2, whereas Table 1 contains their chemical compositions.

Table 1 **Chemical composition of wastes under studies**

Zn / %	Pb / %	Mg / %	Fe /%	Cd / %	Ag / %
18,6	5,85	0,68	19,8	0,23	0,023

MATERIALS AND TEST APARATUS

In the course of the conducted research on the flotation process, various types of frothing agents, collectors and pH regulators have been used. They are listed in Table 2

Table 2 **Agents used in the studies of flotation process**

Agent type	
frothing agents	pine oil, Dawtrot
collectors	oleic acid, sodium amyl xanthate, sodium ethyl xanthate
pH regulators	CaO

TEST RESULTS

The conducted studies aimed at determining the conditions of the flotation process of materials contained in wastes. The analysis of the following factors affecting the course of floating process has been performed:

- rotor speed,
- gas flow rate,
- type and amount of flotation agents,
- process length.

The studies with the use of wastes generated at the leaching process have been conducted at the rotor speed of 300 and 500 rpm.

Figure 3 Laboratory flotation device used in the studies of flotation process

Silver content in the flotation concentrate reaches the concentration close to its final content in the product of flotation already after ca. 15 min. It proves that running the process for a long time is not necessary. Longer

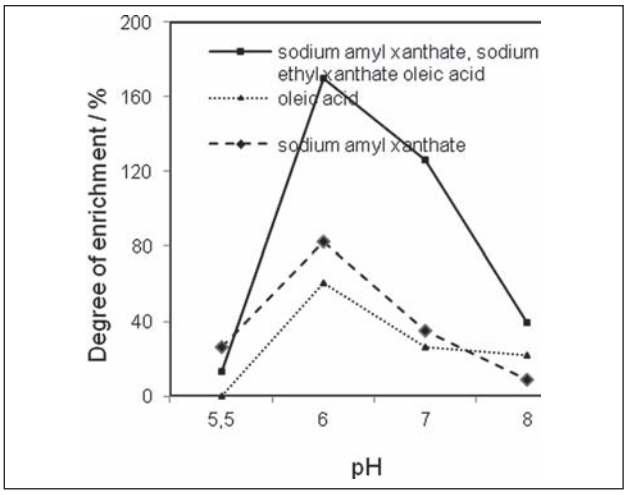

Figure 4 The dependence of the degree in silver enrichment on pH at the rotor speed of 500 rpm (gas flow rate 4 cm^3/min)

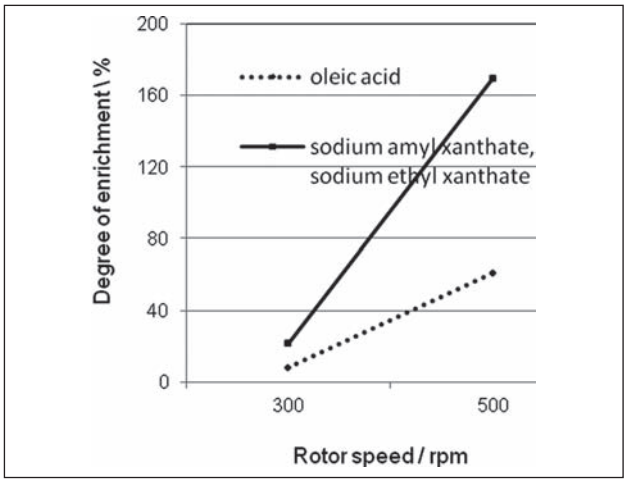

Figure 5 The dependence of the degree in silver enrichment on the rotor speed (pH = 6, Dawtrot as frothing agent, gas flow rate 4 cm^3/min)

time of the process reduces the concentration in the product of flotation

Figures 4 - 7 depict sample results of the studies on flotation process which have been conducted on wastes form leaching process of the roasted blend.

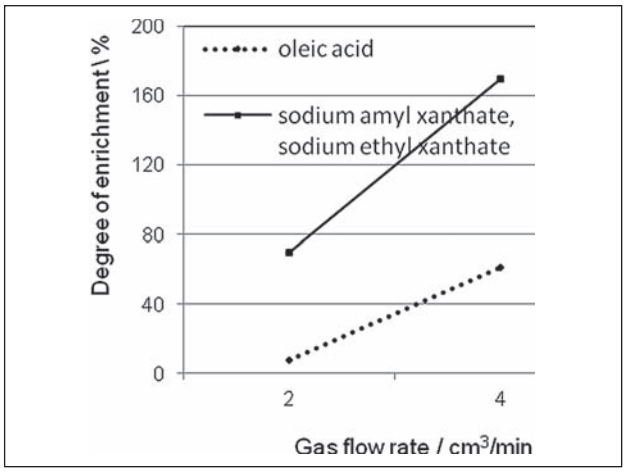

Figure 6 The dependence of the degree in silver enrichment on gas flow rate (Dawtrot as frothing agent, rotor speed of 500 rpm, pH = 6)

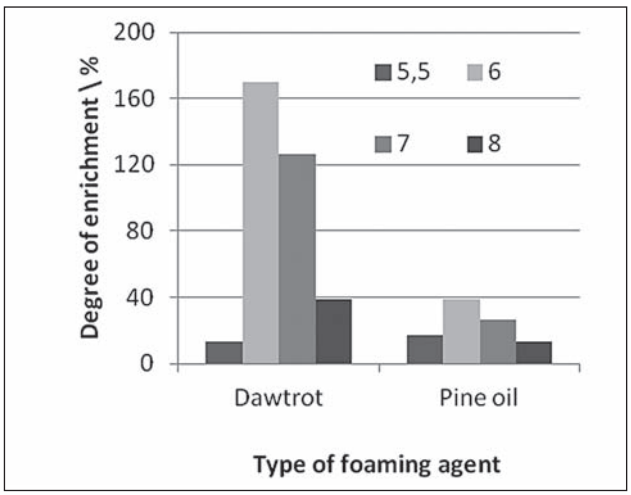

Figure 7 The dependence of the degree in silver enrichment on the type of frothing agent with the use of amyl xanthate as collector, air flow rate cm^3/min, rotor speed of 500 rpm

SUMMARY

On the basis of the carried out investigations the following conclusions can be formulated:

- Flotation process can be applied successfully for enrichment of silverbearing fractions of wastes generated in the leaching process of roasted blend.
- The best results have been obtained for the following frothing agents: Dawtrot collectors: methyl xanthate, sodium ethyl xanthate.
- The high rest degree in silver enrichment of the concentrate has been achieved for the following parameters of the flotation process:
- rotor speed - 500 rpm,
- flow rate - 4 cm^3/min,
- pH=6.
- At best, the degree of concentrate enrichment in silver was 169% which has been achieved through the studies of flotation process of silverbearing wastes generated in the leaching process.

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Note: Krajewska T. is responsible for English language, Katowice, Poland