SUMMARY

Viscosity of metallurgical slags obtained in various pyrometallurgy processes is a key physicochemical value. Controlling this parameter in industrial conditions enables efficient recovery of metals from slag and has an efficient influence on the work of metallurgical furnaces. It is commonly regarded that this parameter is closely related with the structure of slag and phenomena occurring at formation of liquid phases. A significant number of articles in the literature concern the issue of viscosity of pure alloys of metals, fused salts, and synthetic slags. A great number of arrangements remains not studied, or information about them are scant. These arrangements include multi-component oxide systems, like metallurgical slags. One of aims of this work is to supplement data concerning viscosity of two types of slag. One of them is flash slag obtained from "Głogów II" Copper Mill. On the other hand, the second slag is flash slag subject to the process of decopperising in laboratory conditions.

Flash slag obtained from "Głogów II" steelworks includes a significant amount of copper in its composition (about 14% of the mass), thus, it undergoes the process of decopperisation in an electric furnace in order to recover the largest possible amount of it. The process of recovering copper from slag has a cyclical character and occurs in the course of two phenomena. In the first one, copper is obtained in the course of reaction of reduction, while in the second one, as a result of conditions favouring coalescence and deposition of copper particles on the bottom of an electric furnace. A share of copper oxides in liquid slag has a direct influence on the value of its viscosity. In processes of recovering metals from metallurgical slags, an increase of viscosity takes place in the course of the phenomenon of polymerisation. In case of the process of decopperisation of flash slag, mainly oxide and aluminosilicate anions undergo polymerisation. The more polymerised slag, the higher viscosity of it. Too viscous slags cause inhibition of the processes of coalescence and sedimentation of reduced metal to alloy, what leads to a lesser yield of this metal in alloy. A solution of this problem in the flash technology realised at "Głogów II" steelworks is an addition to slag about 10% of calcium carbonate, which undergoes thermal decomposition into calcium oxide and carbon dioxide. On the one hand, calcium oxide efficiently decreases viscosity of flash slag, having an influence on an increase of yield of copper in alloy, on the other, increases the mass of slag, artificially underrating concentration of this metal. What is more, the process of decopperisation of flash slag is regarded as a highly energy-consuming process. In this process, about 1/3 of energy from the whole process is used for decomposition of calcium carbonate.

The issue of the technology for decopperisation of flash slag was discussed in many references from the perspective of yield of decopperised metal, but they did not consider the possible influence of calcium oxide or other oxides of basic character on ionic structure of slag. There are not many concepts of mechanisms occurring inside the structure of slag, which would unequivocally explain the behaviour of oxide ions. Discussing the issue of viscosity of slags, the author tries to answer the question whether basic oxides are oxides modifying the structure of slag by breaking oxide-aluminosilicate anions, at the same time decreasing viscosity of analysed slag. Do there exist other technological additives, which, added to an electric furnace in small amounts (below 10%) could significantly improve the process of

recovery of copper from slag, at the same time replacing currently added calcium carbonate? This work focuses also on the issue how possible change of added calcium carbonate can influence an improvement of the production process at KGHM Polska Miedź S.A.

Experimental studies on viscosity of slags were divided into two parts. The fist part presents results of studies on viscosity of flash slag, as well as flash slag during its decopperisation, and completely decopperised slag (in laboratory conditions). Charts of viscosity are presented as a function of temperature at controlled oxygen potential. For determined partial pressures of oxygen, viscosity of slag changes along with temperature in accordance to the Arrhenius equation. The second part focuses on the influence of added basic oxides, i.e. CaO, FeO, CaF_2 and Na_2O on viscosity of decopperised slag in laboratory conditions at controlled oxygen potential. On the basis of obtained data, conclusions are presented.