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ALTERNATIVE BINDER FOR COPPER CONCENTRATE BRIQUETTING

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In the paper, results of investigations on the use of new, alternative binder, based on technical grade glycerine and higher alcohols, for copper matte briquetting are presented. The use of alternative binder yields briquettes that show better drop and compressive strength properties compared with briquettes produced using traditional, sulphite lye binding material.

Key words: copper concentrate, briquetting, binder, briquette strength

INTRODUCTION

Shaft furnaces are metallurgical systems where charge materials require adequate preliminary preparation. This mainly refers to their necessary, appropriate lumped form which ensures that the charge column is draughty and the charge itself is not lifted by flue gases. Materials that can be fed into shaft furnaces in the form of briquettes are copper concentrates as well as fine-grained metal-bearing wastes or fuel [1 - 6]. During copper matte smelting in a shaft furnace, the system is charged with ore concentrate briquettes which are obtained through press moulding by various devices. A very important issue in the briquetting technology is selection of binder that ensures proper strength of final briquettes. In the present paper, results of investigations on copper concentrate briquetting with the use of alternative binding material, i.e. liquid mixture of technical grade glycerine and multicomponent, balanced combination of higher alcohols, are discussed. Similar binders are successfully applied for production of alternative energy fuels based on fine-grained, carbon-bearing waste materials [7, 8].

RESEARCH METHODOLOGY

For the investigations, sulphide copper concentrate from KGHM "Polska Miedź", containing 27,81 % mass Cu, was used. The binding material was sulphite lye or new binder: a mixture of technical grade glycerine ($C_2H_8O_3$), obtained as a co-product during biofuel and lignosulphonate powder production, as well as a multicomponent, balanced combination of higher alcohols.

The alternative binder is non-Newtonian fluid, used at higher temperatures, that forms a homogenous mixture with copper concentrate. The mixture is supplemented with e.g. lignocellulose (a cross-linking component). The obtained binding properties result from the mechanical power that is reinforced by the binder reactive polymerisation capabilities, induced by the effects of briquetting temperature of approx. 70 to 75 °C. The yielded briquettes are subjected to autogenous hardening with removal of excessive, chemically unbound moisture.

The briquetting process was conducted using a hydraulic press (max load of 10 Mg). As the binding material, sulphite lye or the alternative binder was used. The resulting briquettes were cylinders of 30 mm in diameter and 25 – 30 mm in height. During the investigations, both the binder type and the compression load were modified. Basic parameters of the experiments are presented in Table 1. The briquettes were subjected to compressive and drop strength testing. These are essential tests to be performed in order to determine mechanical properties of agglomerates that are formed using ore concentrates [9, 10].

The compressive strength tests were performed using an INSTRON 4 469 test machine, at the compression speed of 2 mm/min. During the drop test, 3 briquettes were dropped six times onto a steel plate from a height of 2 metres. After each drop, the amount of remaining briquette fraction of over 10 mm in diameter was determined. Both immediate and seasoned briquettes were tested for their mechanical properties.

Table 1 **Basic experimental parameters**

Concentrate fraction / %mass	Lye fraction / %mass	Alternative binder fraction /%mass	Compression load / Mg
94,7	5,3	-	1 - 5
94,7	-	5.3	1 - 5

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STUDY RESULTS AND DISCUSSION

In Table 2 and Figure 1, examples of the drop test results with regard to the briquettes produced using, as the binder, sulphite lye or the alternative, glycerine-based binding material, are presented. As a measure of this strength type, the amount of fraction of briquettes over 10 mm in diameter, yielded following the consecutive drops, was assumed. The results clearly show that for both binder types and for various seasoning periods, amounts of the analysed briquette fraction exceed 98,5 %. This confirms their very high drop strength.

In Figures 2 and 3, results of compressive strength tests for the obtained briquettes as well as representative stress-strain curves for the briquette samples, containing two various binders, are illustrated. The results show that the use of alternative binder yields about 35 % higher briquette strength compared with sulphite lye.

Table 2 **Examples of the drop strength test results for copper concentrate briquettes (following one drop)**

Type of binder	Compression load / Mg	Seasoning period / h	Fraction >10 mm / %
Sulphite lye	4	0	99,2
		24	98,9
		48	99,3
	5	0	97,4
		24	99,2
		48	98,9
Alternative binder	4	0	99,4
		24	99,4
		48	99,8
	5	0	99,9
		24	99,9
		48	99,9

Moreover, a distinctly higher deformation capability of the sample with alternative binder, during the compressive strength test, is observed. The deformation, corresponding to the maximum stress, is greater by approx. 50 % than that for the sample with sulphite lye. Results of the static compression tests clearly show that the outcomes of sulphite lye replacement with the new

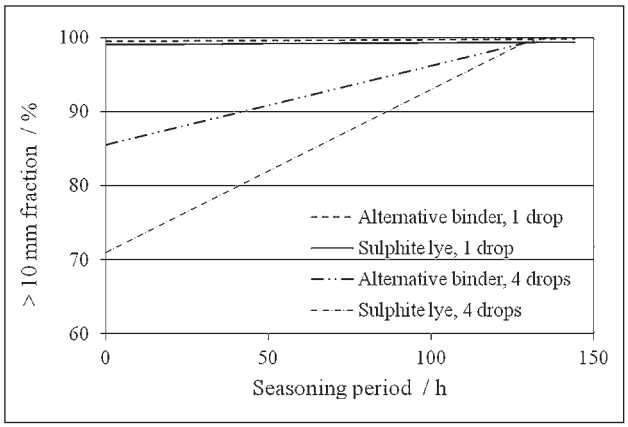

Figure 1 Effects of the briquette seasoning period on their drop strength (1 drop, 4 drops)

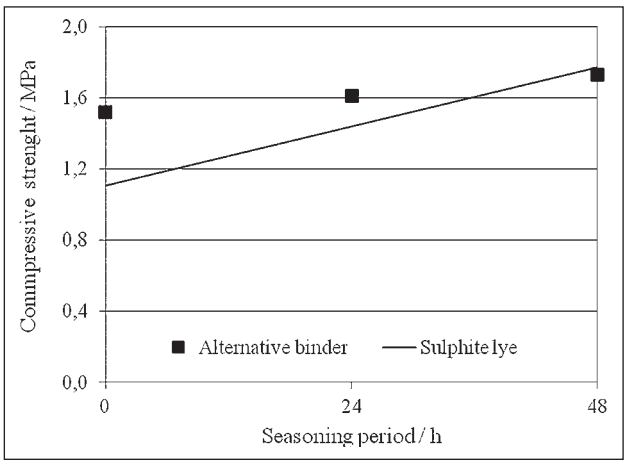

Figure 2 Effects of the briquette seasoning period on their compressive strength

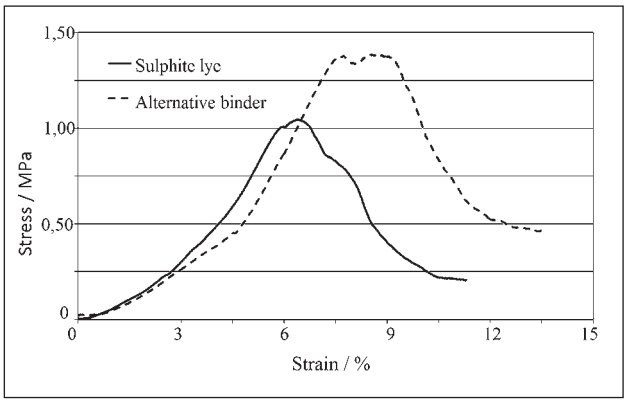

Figure 3 Examples of the stress-strain curves for the investigated binders (immediate briquettes)

binding material are: a higher compressive strength and higher deformation capability of the briquettes.

SUMMARY

Based on the results of investigations on copper concentrate briquette properties, the following can be concluded:

- The use of alternative binder, based on a mixture of technical grade glycerine and higher alcohols, for the briquetting process conducted on a stamping press, results in briquettes of a higher drop strength compared with briquettes produced using sulphite lye.
- The results of the static compression tests clearly show that the outcomes of sulphite lye replacement with the new binding material are: a higher compressive strength and higher deformation capability of the briquettes.
- The seasoning period does not affect mechanical properties of the briquettes.
- Potential applications of the new binder, under industrial conditions, for the technological process of copper concentrate preparation for smelting in a shaft furnace requires confirmation of the obtained results by briquetting investigations with the use of roll presses.

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Note: O. Rochowska - Siwiec is responsible for English language, Katowice, Poland