FLOTATION OPTIMIZATION OF COAL SLURRIES

Fecko Peter[1] and Drobik Martin[2]

[1]VŠB-Technical University Ostrava, Ostrava, Czech republic, e-amil: peter.fecko@vsb.cz
[2]OKD, a.s. Důl Lazy, o.z., Orlová Lazy, Czech republic

ABSTRACT

The work deal with research of flotation optimization of coal slurries, by application of statistically planned experiments 2 to 3 under laboratory and industrial conditions. In these experiments were studied the following parameters: influence of collectors dosage, ratio of collector/frother, and air amount for ash content in flotation concentrate as well as for concentrate yield. From the results followed that statistically significant are all three factors were statistically significant in laboratory condition while collector dosage and ratio collector/frother were statistically significant in the coal plant František.

INTRODUCTION

There is necessity of the most perfect coal processing as also maximum utilisation of its combustible compounds at present because there is trend of total decrease of coal mining. The development of mineral processing goes to the most effective processing of separate treatment phases as well as decrease of energetic rights and costs in the input processing.

This work shows possibilities of flotation optimalization in the black coal samples treated by flotation in the Mine František, OKD a.s. Flotation optimalization process was undertaken in the laboratory condition in the coal plant of Mine František OKD, a.s. For this purpose the statistically planned experiments 2 to 3 were applied. The influence of these parameters (collector dosage, ratio collector/frother, air amount) were followed on the results of flotation (namely to ash content in flotation concentrate, to concentrate yield).

MINERALOGICAL-PETROGRAPHICAL CHARACTERISTICS OF TESTED COAL

The petrographical results show that coal contain 77,6 % of vitrinite, 4,4 % of liptinite and 18 % of inertinite. From the view of microlitotype black coal classification there is dominant vitrinite in the sample as well as clarite is often represented and passes to duroclarite in some grains. Iron sulphide was found in well-known forms, the isolated grains with fragment shape and massive character can be determined most often. Euhedrite sulphide was found in small amount at the form of diminutive grains. The occurence of framboids are unique in coal grains. From mineralogical view, the clay minerals are represented in carbargilite grains as well as silver colour grains exhibiting red-orange reflexes.

Mineralogical-petrographical composition of coal shows following figures:

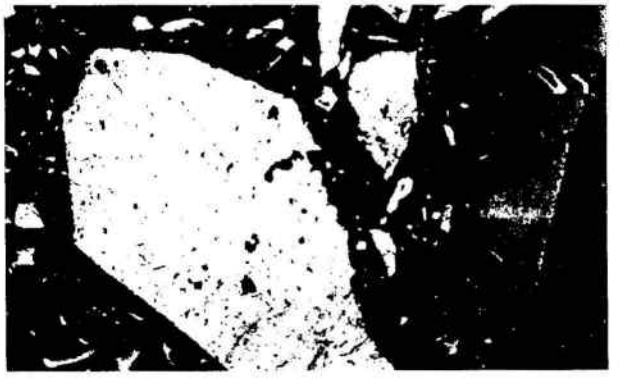

Fig.1: Grain of duroklarite

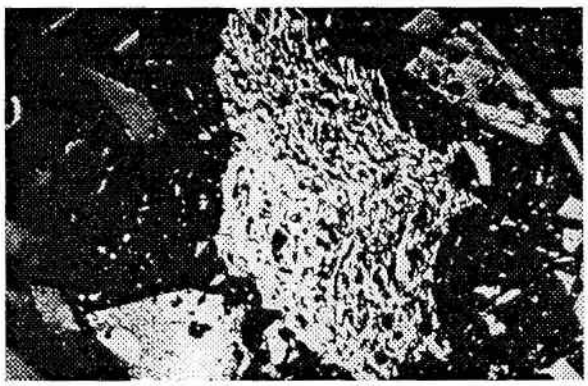

Fig.2: Fuzite

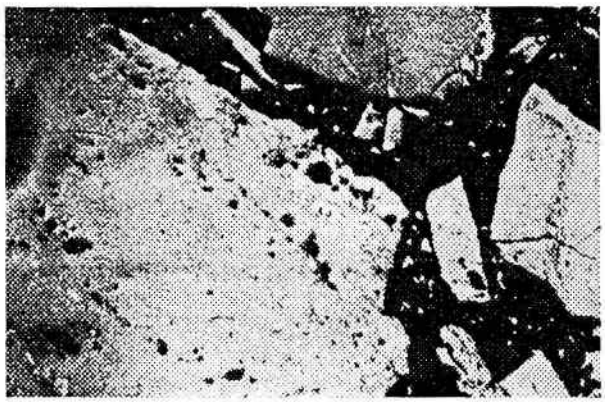

Fig.3: Grain with sulphidic euhedrals and framboids

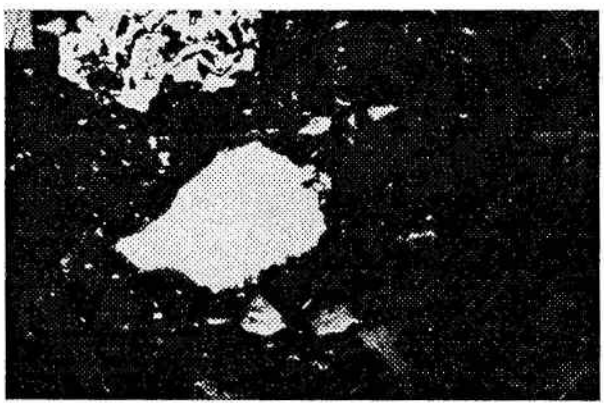

Fig.4: Grain of massive Fe sulphide

METHODOLOGY OF FLOTATION EXPERIMENTS

Statistically planned experiments 2 to3 were undertaken according planning matrix, where factor x_1 is collector dosage, x_2 is ratio between collector and frother and x_3 is air amount. The correlation between parameters was not tested.

First set of experiments was undertaken in laboratory of Department of Mineral Processing, Mining University of Ostrava under following condition:

Pulp: 150 g/l

Agitation with collector and frother: 1 minute

Flotation time: 5 minutes

As flotation collector was used FLOTAKOL NX and as frother OXOHEXANOL. Both chemicals are products of Czech republic.

Factor experiments were performed under these conditions:

Factor	x_1	x_2	X_3
Basic level **z =0**	650	1:4	400
Interval of variation **z**	50	1:1	100
Upper level **z = +1**	700	1:5	500
Lower level **z = -1**	600	1:3	300

The results of flotation experiments conducted according planning matrix are presented in the Table 1

The regression equation that describedthe process results from the results evaluation of statistically planned experiments 2 to 3 for ash content in flotation concentrate was:

$$y = 903 + 1{,}11\ x_1 + 037\ x_2 + 0{,}46\ x_3$$

From the results follows that the ash content in the concentrate was significantly statistically influenced by all 3 factors.

The regression equation that described the process results from the results evaluation of statistically planned experiments 2 to 3 for concentrate yield as follows was:

$$y = 84{,}51 - 0{,}46\ x_1 + 0{,}86\ x_2 - 1{,}87\ x_3 - 0{,}7\ x_2x_3$$

The results shown that the concentrate yield was statistically influenced by all 3 factors as well as interation of second and third factor.

It can be said that from the results of flotation experiments conducted in laboratory conditions follows that all three factors are statistically significant for both tested quantities, so for ash content and mass yield concentrate.

Table 1 : Table 2 : Results of flotation tests conducted according to factor´ planning

Test no.	Condition	Condition		Yield (%)	Ash content (%)
1	Dosage (g/t)	600	K	86,97	9,86
	Ratio collect./frother	1:3	O	13,03	80,28
	Air amount (l/m^2/min)	300	P	100	19,03
2	Dosage (g/t)	700	K	85,47	7,36
	Ratio collect./frother	1:3	O	14,53	76,35
	Air amount (l/m^2/min)	300	P	100	17,38
3	Dosage (g/t)	600	K	87,11	10,24
	Ratio collect./frother	1:5	O	12,89	85,03
	Air amount (l/m^2/min)	300	P	100	19,88
4	Dosage (g/t)	700	K	85,99	7,91
	Ratio collect./frother	1:5	O	14,01	81,72
	Air amount (l/m^2/min)	300	P	100	18,25
5	Dosage (g/t)	600	K	81,28	10,28
	Ratio collect./frother	1:3	O	18,72	67,31
	Air amount (l/m^2/min)	500	P	100	20,96
6	Dosage (g/t)	700	K	80,89	8,24
	Ratio collect./frother	1:3	O	19,11	77,04
	Air amount (l/m^2/min)	500	P	100	21,39
7	Dosage (g/t)	600	K	84,52	11,26
	Ratio collect./frother	1:5	O	15,48	86,04
	Air amount (l/m^2/min)	500	P	100	22,84
8	Dosage (g/t)	700	K	83,88	9,26
	Ratio collect./frother	1:5	O	16,12	80,66
	Air amount (l/m^2/min)	500	P	100	20,77

RESULTS OF FLOTATION EXPERIMENTS PERFORMED AT COAL PLANT OF THE MINE FRANTIŠEK, OKD a.s.

A set of planned experiments in the coal plant of Mine František OKD, a.s. was performed under the same condition that the first set of experiments, for the comparison.

The results of flotation experiments conducted according planned matrix are given in the table 2.

Table 2: Results of flotation tests

Test no.	Condition	Condition		Yield (%)	Ash content (%)
1	Dosage (g/t)	600	K	75,97	7,83
	Ratio collect./frother	1:3	O	24,03	71,34
	Air amount (l/m^2/min)	300	P	100	23,09
2	Dosage (g/t)	700	K	71,96	6,41
	Ratio collect./frother	1:3	O	28,04	42,32
	Air amount (l/m^2/min)	300	P	100	16,48
3	Dosage (g/t)	600	K	77,22	9,23
	Ratio collect./frother	1:5	O	22,78	63,22
	Air amount (l/m^2/min)	300	P	100	21,53
4	Dosage (g/t)	700	K	61,55	6,98
	Ratio collect./frother	1:5	O	38,45	46,49
	Air amount (l/m^2/min)	300	P	100	20,78
5	Dosage (g/t)	600	K	77,5	8,21
	Ratio collect./frother	1:3	O	22,5	64,08
	Air amount (l/m^2/min)	500	P	100	22,17
6	Dosage (g/t)	700	K	72,61	6,64
	Ratio collect./frother	1:3	O	27,39	62,49
	Air amount (l/m^2/min)	500	P	100	21,94
7	Dosage (g/t)	600	K	79,7	10,85
	Ratio collect./frother	1:5	O	20,3	68,35
	Air amount (l/m^2/min)	500	P	100	22,55
8	Dosage (g/t)	700	K	61,36	7,11
	Ratio collect./frother	1:5	O	38,64	42,96
	Air amount (l/m^2/min)	500	P	100	20,96

The regression equation described the process results from the results evaluation of statistically planned experiments 2 to 3 for ash content in flotation concentrate was:

$$y = 7,91 - 1,12\ x_1 + 0,64\ x_2$$

From the results followed that ash content in flotation concentrate was significantly influenced by both collector dosage and ratio collector/frother.

The regression equation that adequate describe the process results from the results evaluation of statistically planned experiments 2 to 3 for yield of flotation concentrate as follows:

$$y = 72{,}23 - 5{,}36\ x_1 - 2{,}28\ x_2 - 3{,}14\ x_1x_2$$

Also in this case can be seen that from the view point of yield of flotation concentrate were significant factors x_1 and x_2 as well as their interaction.

The real flotation process is significantly influenced by both collector dosage and ratio collector/frother what can be elicited from comparing both equations.

CONCLUSION

The goal of this work was optimization of black coal flotation conducted on the coal samples from Mine Frantisek, OKD, a.s. at laboratory condition as well as in the coal plant.

The research was solved within the grant task GACR/105/98/0836 and brought new knowledge in the black coal slurries flotation in OKD a.s. district.

A statistical analyse of results shown that all three factors (collector dosage, ratio collector/frother and air amount) did influence significantly the process in the laboratory condition. To experiments conducted in the flotation plant, under real conditions, was observed that only collector dosage and ratio collector/frother were statistically significant.

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