FLOTOFLOCCULATION OF COAL BY SACCHAROMYCES CARLSBERGENSIS HANSEN

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ABSTRACT

This paper deals with the application of flotoflocculation by yeast Saccharomyces carlsbergensis Hansen on the samples of hard coal sludges from the Frantisek colliery in OKD. It was found, from the mineralogical analysis, that these sludges, deposited at the mud pit, have a high content of quality coal mass and therefore it is necessary to devote attention to their treatment. In this paper two technologies are compared: the classical flotation and flotoflocculation by yeast Saccharomyces carlsbergensis Hansen. From the results follows that flotoflocculation gives concentrates of better quality and the combined technology consisting of one basic and one cleaning – out flotation gives saleable concentrates with ash content under 10%.

INTRODUCTION

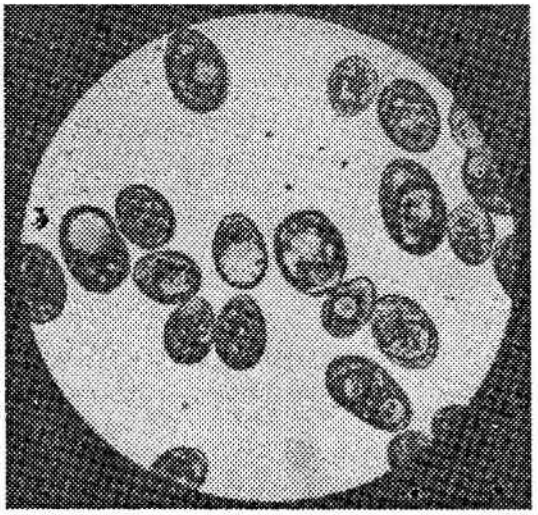
The nowadays trend of general decreasing and suppressing of coal exploitation evokes the necessity of maximal utilization of coal combustible constituents and coal processing as perfect as possible. These facts led the to development of coal treatment processes towards intensifying of the efficiency of particular processing steps as well as at the same time towards energy consumption and charge reducing. Therefore the aim of the following work was to estimate the possibility of the application of flotoflocculation for utilization of black coal slurries from slurry ponds at Mine Frantisek, OKD, a.s. by the means of yeast Saccharomyces carlsbergensis Hansen. The results were compared with classical flotation output.

CHARACTERISTIC OF THE YEAST SACCHAROMYCES CARLSBERGENSIS HANSEN

The yeast Saccharomyces carlsbergensis Hansen (picture no. 1) were cultivated from Saccharomyces cerevisiae. We can work in them systematically to kind pocked sponge – Ascomycetes, tribes Saccharomycetaceae, genus Saccharomyces. All yeast genus Saccharomyces are substituted by two types:

1. Saccharomyces carlsbergensis Hansen
2. Saccharomyces uvarum

The all yeasts have rounded or oblong oval form. The size of the cell varies from 5 to 15 μm. In the investigation, yeast was applied – the clean organic culture from Brew-house Ostravar,a.s.



Picture no. 1 : Saccharomyces carlsbergensis Hansen

COAL SAMPLES CHARACTERISTIC

Samples of black coal slurries were used for the tests of flotation and flotoflocculation. The samples were taken from five different slurry ponds of Mine Frantisek OKD,a.s. The samples were expressed by letters A, B, C, D, E. All samples show the highest mass yield under

0.020mm that varies from 36 –46%. The average ash content of all samples is around 30%.

Mixed samples were used for mineralogical petrographical analysis. The results of the analyses show that investigated coal contains 77,6 % vitrinite, 4,4 % liptinite and 18,0 % inertinite.

Considering the microlitotype of the black coal, vitrinite is dominant element. Clarite, which is converting into duroclarite in some grains, is quite abundant as well. The clarodurite grains are rare. Fuzite was found only on the minor number, combined together with the others microlitotypes or in the forms of small grains inside the cementing matter. Iron sulphide was detected in the well - known forms. It mostly occurs in isolated grains of the fragmental shape of solid character. Euhedral sulphide also occurred in the form of small grains inside the coal grains, but only in insignificant amount.

The framboides were also found only scarcely. From the group of mineral elements clay minerals inside the grains of carbargilite were presented also silver colour grains with red-orange reflections. The results chemical analyses shows following composition of the coal samples: 71,0 %C, 1,22 %N, 4,2% H and 20,65 % A.

FLOTATION AND FLOTOFLOCCULATION TESTS

During the research, the influence of collector dosage on the test results was investigated. As the collector, Flotakol NX produced in Czech republic, was used. The main goal of flotation was to achieve the appropriate flotation concentrate quality with ash content below 10%. Basic experiments were performed with the sample A (with collector dosage from 200 – 700 g/t). The flotation tests were performed in the laboratory at Department of Mineral Processing, VŠB TU Ostrava under the following conditions:

- Pulp: 150 g/l
- Agitation time with collector: 1 minute
- Flotation time: 5 minutes

Flotoflocculation tests were performed like the flotation tests except that bioflocculant was dosed and agitated for 1 minute prior collector addition. The yeast was added in different doses to flotation media (1, 5, 10 and 20 ml) in order to find the optimum dosage of bioflocculant.

The test was performed on sample D with hoppy yeast Saccharomyces carlsbergensis Hansen from brew-house Ostravar,a.s. The flotoflocculation tests with optimal dosage of yeast were done on samples A, B, C, E.

RESULTS FLOTATION AND FLOTOFLOCCULATION EXPERIMENTS

Results of flotation experiments are given in Table 1.

From the presented results can be seen that the best results were obtained with the collector dosage of 600 g/t, mass yield 56,6 % and ash content 12,71 %. Considering that required concentrate quality with ash content below 10 %, was not achieved by main flotation at all, other experiments followed. Flotation tests with one basic and one cleaner flotation were undertaken, where the collector was added to cleaner flotation.

These experiments were undertaken with all samples (A, B, C, D, E).

From the results given in Table 2 follows that with one basic and one cleaner flotation required quality flotation concentrate was reached in all samples. The best flotation tests were attained with samples D, E were the highest mass yields were obtained.

Table 1: Results of flotation tests (sample A)

Dose collector (g/t)		Mass yield (%)	Ash content (%)
200	K	12,75	16,65
	O	87,25	30,73
	P	100	28,93
300	K	21,39	17,77
	O	78,61	33,74
	P	100	30,32
400	K	27,29	15,41
	O	72,71	35,27
	P	100	29,85
500	K	40,13	12,63
	O	59,87	40,01
	P	100	29,02
600	K	56,6	12,71
	O	43,4	52,75
	P	100	30,08
700	K	62,67	14,47
	O	37,33	57,66
	P	100	30,59

Table 2: Results of flotation tests with one basic and one cleaner flotation

Sample		Mass yield (%)	Ash content (%)
A	K	21,94	9,95
	O1	47,17	41,04
	O2	30,89	29,57
	P	100	30,90
B	K	34,62	6,33
	O1	48,04	41,73
	O2	17,34	31,35
	P	100	27,88
C	K	32,72	8,34
	O1	45,91	48,54
	O2	21,37	27,84
	P	100	30,99
D	K	38,81	8,99
	O1	35,73	46,40
	O2	25,46	38,11
	P	100	29,77
E	K	46,27	8,23
	O1	37,56	55,13
	O2	16,17	37,92
	P	100	30,80

Table 3: Results of bioflotoflocculations tests (sample D)

Dosage of yeast (ml/l)		Mass yield (%)	Ash content (%)
1	K	45,12	12,96
	O	54,80	42,71
	P	100	29,25
5	K	59,53	12,79
	O	40,47	54,61
	P	100	29,71
10	K	64,47	12,52
	O	35,53	59,39
	P	100	29,17
20	K	61,07	14,86
	O	38,93	51,85
	P	100	29,26

Legend for all tables:

P … input K … concentrate

O … waste O1 … waste after basic flotation

O2 … waste after cleaner flotation

Table 4: Results of bioflotoflocculations tests (sample A)

		Mass yield (%)	Ash content (%)
Without yeast	K	56,6	12,71
	O	43,4	52,75
	P	100	30,08
With yeast	K	69,42	15,44
	O	30,58	64,61
	P	100	30,47

Table 5: Results of bioflotoflocculations tests (sample B)

		Mass yield (%)	Ash content (%)
Without yeast	K	34,59	14,20
	O	65,44	35,99
	P	100	28,45
With yeast	K	73,74	13,70
	O	26,26	63,31
	P	100	26,72

Table 6: Results of bioflotoflocculations tests (sample C)

		Mass yield (%)	Ash content (%)
Without yeast	K	34,21	16,56
	O	65,79	40,35
	P	100	32,21
With yeast	K	69,23	15,92
	O	30,77	69,09
	P	100	32,28

Table 7: Results of bioflotoflocculations tests (sample E)

		Mass yield (%)	Ash content (%)
Without yeast	K	46,00	14,53
	O	54,00	46,19
	P	100	31,62
With yeast	K	72,33	14,01
	O	27,67	76,17
	P	100	31,21

Table 8: Results of bioflotoflocculations tests (sample C)

		Mass yield (%)	Ash content (%)
Without yeast	K	32,72	8,34
	O1	45,91	48,54
	O2	21,37	27,84
	P	100	30,99
With yeast	K	49,27	7,57
	O1	34,81	66,71
	O2	15,92	42,10
	P	100	33,65

Table 9: Results of bioflotoflocculations tests (sample D)

		Mass yield (%)	Ash content (%)
Without yeast	K	38,81	8,99
	O1	35,73	46,40
	O2	25,46	38,11
	P	100	29,77
Saccharomyces carlsbergensis brew-house Ostravar	K	50,38	9,25
	O1	26,15	50,23
	O2	23,47	49,38
	P	100	29,38

Table 10: : Results of bioflotoflocculations tests (sample E)

		Mass yield (%)	Ash content (%)
Without yeast	K	46,27	8,23
	O1	37,56	55,13
	O2	16,17	37,92
	P	100	30,64
Saccharomyces carlsbergensis brew-house Ostravar	K	62,49	8,44
	O1	24,58	58,65
	O2	12,98	60,23
	P	100	27,51

Legend for all tables:

P ... input K ... concentrate

O ... waste O1 ... waste after basic flotation

O2 ... waste after cleaner flotation

Results of flotoflocculation tests are given in Table 3.

From attained results it can be seen that best results were obtained with a 10 ml dosage, which was selected as an optimum dosage, which was applied in all further tests. Gained results are presented in Table 4 to Table 7. The lower yields were measured at lower dosages with approximately the same ash contens while at higher dosages with approximately the same ash contens while at higher dosages the production of concentrates was aproximately the same or about several percentage higher, but with the enhancement of ash content in the concentrates.

Flotoflocculation tests showed very good effect of yeast on the yeast concentrates. The best results were reached with Saccharomyces carlsbergensis Hansen from brew – house Ostravar.

CLEANER BIOFLOTOFLOCCULATION

In order to obtain the required ash content below 10 % in the concentrates bioflocculation technology consisting of one basic and one cleaner flotation, was implemented. These experiments were performed only on the samples C, D and E, due to specific technical reasons, and gained results of these experiments are presented in Table 8 to Table 10. From the results follows that application of yeasts is very successful. In all samples was achieved quality flotation concentrates below 10 % of ash and yields of these concentrates were about 15 % higher with the usage of clean culture Saccharomyces carlsbergensis Hansen from brew – house Ostravar.

THE RESULTS

This report deal with the application of beer yeasts in the flotation of black coal slurries from sludge pond in Mine Frantisek, OKD,a.s. The results of the work show that influence of clean culture Saccharomyces carlsbergensis Hansen as a bioflocculant in flotation of black coal is very prosperous comparing to the classic flotation, giving the required quality of flotation concentrate with the ash content below 10 % while enhancing the flotation concentrate yield to about 15 % higher then in other tests.

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