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TECHNOLOGICAL POSSIBILITIES FOR PULP DENSITY ALTERATION AT ELATZITE FLOTATION MILL

Antoaneta Boteva

University of Mining and Geology
“St. Ivan Rilski”,
1700 Sofia
Bulgaria

ABSTRACT
The pulp density expressed in percent solids is an important technological factor, depended upon the mineralogical-technological characteristics of the treated ore, the type of the flotation cells employed and the quality characteristics required for the products obtained. During several years the Elatzite flotation mill has been operating at 32 % pulp density for rougher flotation. The lab and industrial scale investigations performed have provided an opportunity to raise this parameter up to 42 % at a concomitant technological values increase.

INTRODUCTION

The ore from Elatzite deposit is known as gold bearing copper-pyrite ore, having copper content about 0.4 % and 0.5 % sulphur. Chalcopyrite, bornite, chalcozine and coveline are the principal copper minerals. The amount of oxidised copper minerals does not exceeds 6-7 %. Very unevenly distributed molibdenite is met in the ore with mean concentration ca 0.004 % Mo. Gold is present both in metallic form, finely dispersed inside copper minerals and quartz, as well as an inclusions inside copper sulphides and pyrite crystal lattices. Metallic gold is from 1 to 5 μm in size. It is liberated during fine grinding. The liberated particles of metallic gold either sticks onto larger mineral particles or floats in thickeners overflow waters. Gold is either recovered in the collective flotation circuit or is inevitably lost in the tailings with the intergrowths. Fine clay or iron hydroxides slime fractions are rarely met only in limited sections of the deposit.

The described peculiarities for the mineralogical and technological characteristic of the ore provide a challenging avenue for testing the possibilities for pulp density increase in rougher flotation. The flotation cells employed at present in the mill are of Denver 500 D-R type. They offer possibilities for maintaining higher pulp density. Moreover, various companies around the world treating copper sulphide ores with the same cell types sustain pulp solids of 40 % and higher (Pima, Pallabora, Betlehen, Sperita etc.). Our objective at first instance, was to study the influence of pulp density under lab and industrial scale upon grade and recovery of copper in the copper concentrates.

EXPERIMENTAL

The study has been performed under lab and industrial scale. The laboratory experiments have been carried out by the help of Denver lab machine with cell volume 8 L and impeller speed of 1500 min^{-1}. In order to figure out precisely the pulp density influence, the laboratory tests were performed under different flotation regimes. The flowsheets used copy part of the existing in the mill flowsheet. Four tests with different respective densities of 17.85, 33.03, 42.52 and 51.90 % solids, were performed following the flowsheet described at Figure 1. At Figure 2 the relationships between pulp density and Cu/S ratio in concentrate I and II, the recovery of copper in concentrate I and copper losses in the tailings are studied.

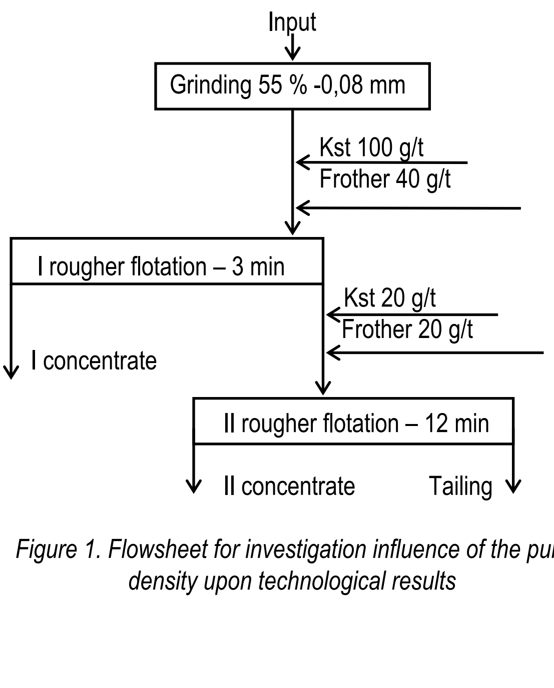

Figure 1. Flowsheet for investigation influence of the pulp density upon technological results

The relationships shown at Figure 2 suggest that the optimal value for pulp density concerning the technological results is shifted from 32 % (the density under which the mill operates) to 42 %. Moreover, this density increase will lead to increase in grinding mills capacity at no sacrifice in technological quality, since maintaining an increased density promotes coarser mineral grains to float in the concentrate.

Table 1. Technological results (flow sheet fig. 1)

Input I rougher flotation, solid, %	Products	Yield %	Containse, %		Recovery, %	
			Cu	S	Cu	S
17,85	I c-te	1,48	24,8	28,9	74,84	68,73
	II c-te	1,27	1,27	8,43	10,249	17,204
	Tailing	97,25	0,08	0,09	15,697	14,064
	Ore	100,00	0,495	0,62	100,00	100,00
33,03	I c-te	5,50	9,19	9,01	86,46	84,15
	II c-te	2,96	0,51	0,68	2,58	3,42
	Tailing	91,54	0,07	0,08	10,96	12,43
	Ore	100,00	0,5846	0,5889	100,00	100,00
42,52	I c-te	4,64	10,10	9,90	88,24	92,30
	II c-te	8,34	0,54	0,25	8,48	4,20
	Tailing	87,0	0,02	0,02	3,28	3,50
	Ore	100,00	0,531	0,4976	100,00	100,00
51,90	I c-te	7,602	5,86	4,78	83,60	83,44
	II c-te	5,384	0,65	0,37	6,60	4,57
	Tailing	87,014	0,06	0,06	9,80	11,95
	Ore	100,00	0,5327	0,4385	100,00	100,00

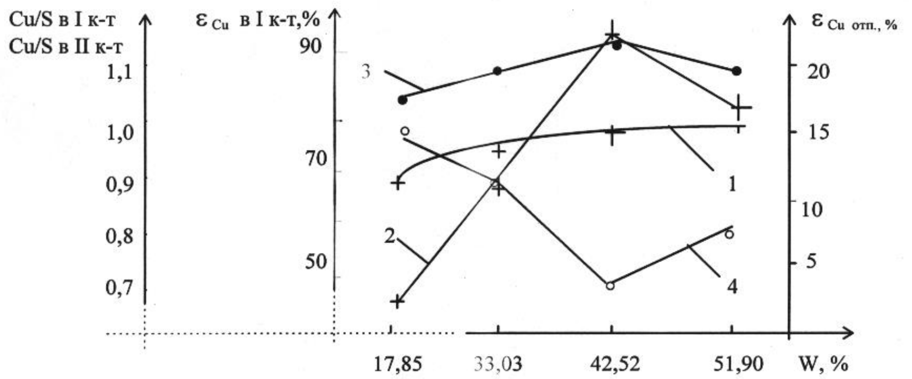

Figure 2. Influence of the pulp density (W, %) on the ratio Cu/S in: I concentrate (1); II concentrate (2); recovery of the Cu in concentrate (3); losses Cu in tailing (4)

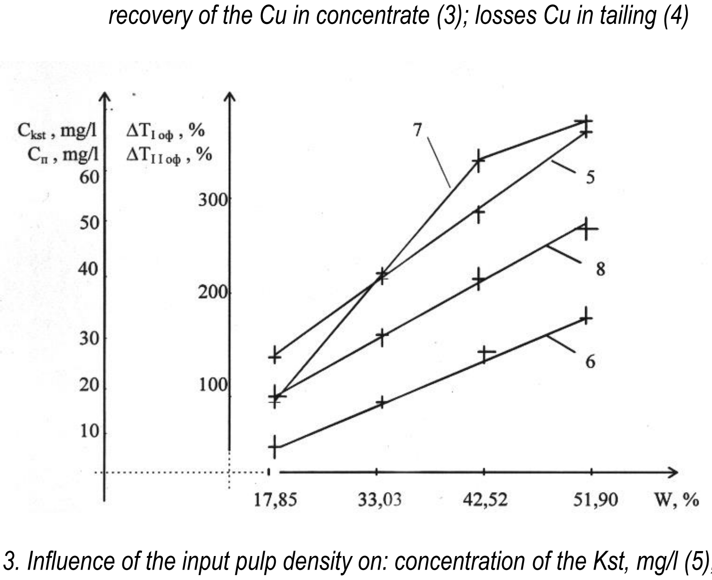

Figure 3. Influence of the input pulp density on: concentration of the Kst, mg/l (5); floter, mg/l (6); flotation time in I rougher flotation, min (7); flotation time in II rougher flotation, min (8)

When the pulp throughput remains the same, the increased density is leading to reagent savings at increased flotation time. The later fact with no doubts is leading to higher recovery of the principal components. However, the increase in pulp density for copper rougher is leading to lower copper content in the rougher concentrate. Owing to the specific flowsheet employed in the mill, an objective was set up to study how the increased density influence further upgrading and cleaning of rougher concentrate, provided it is not subjected to regrinding. Laboratory tests following the flowsheet shown at Figure 4 were performed.

The results obtained are presented in Table 2. They indicate, that the intergrowths which usually are recovered in first rougher flotation and are leading to lower grade of the concentrate, could be successfully directed in the first rougher tail and further on subjected to regrind together with the concentrate coming from second rougher flotation.

The final evaluation concerning the pulp density influence upon the flotation performance and for choosing the correct density value has been accomplished following the flowsheet shown at Figure 6.

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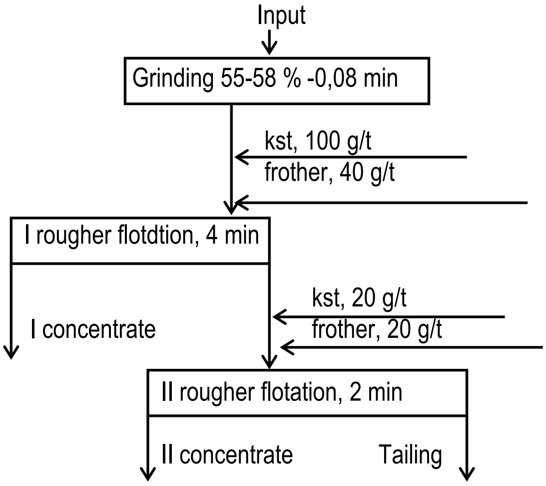

Figure 4. Flowsheet in open cicuite

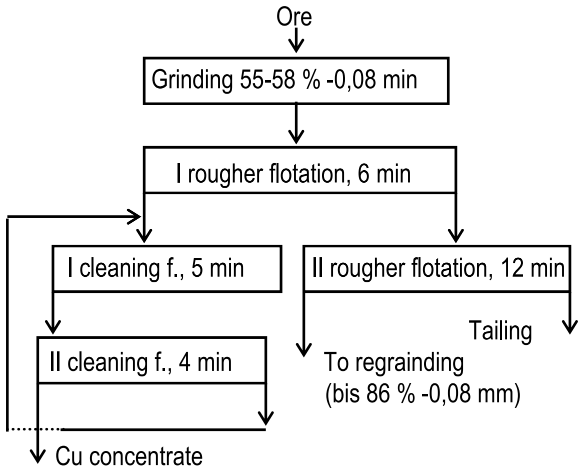

Figure 5. Flowsheet for investigation the influence of the grate on to recovery in I rougher flotation

Table 2. Technological results (flowsheet fig. 5)

Solid in I rougher flotation, %	Products	Yield, %	Contains, %		Recovery, %	
			Cu	S	Cu	S
32,22	Cu c-te	1,64	25,60	24,60	81,64	77,41
	Product for regrinding	7,73	0,64	0,70	9,55	10,39
	Tailing	90,63	0,05	0,07	8,81	12,17
	Ore	100,00	0,51	0,52	100,00	100,00
49,84	Cu c-te	1,96	24,40	24,70	81,64	77,41
	Product for regrinding	14,29	0,50	0,57	9,55	10,39
	Tailing	82,75	0,05	0,06	8,81	12,17
	Ore	100,00	0,58	0,61	100,00	78,66
40,00	Cu c-te	2,07	18,60	22,06	86,64	84,27
	Product for regrinding	5,07	0,62	0,94	7,09	8,88
	Tailing	92,86	0,03	0,04	6,27	6,85
	Ore	100,00	0,44	0,54	100,00	100,00

Table 3. Technological results (flow sheet fig. 6)

Solid in input in rougher flotation %	Products	Yield %	Contains, %		Recovery, %	
			Cu	S	Cu	S
32	Cu c-te	1,92	23,75	23,18	88,97	85,13
	Tailing	98,09	0,057	0,079	11,03	14,87
	Ore	100,00	100,00	100,00	100,00	100,00
40	Cu c-te	2,27	19,41	23,45	94,75	91,80
	Tailing	97,83	0,025	0,048	5,25	8,20
	Ore	100,00	0,466	0,58	100,00	100,00
51	Cu c-te	3,24	12,80	15,50	90,06	88,12
	Tailing	96,76	0,047	0,054	9,94	9,18
	Ore	100,00	0,46	0,57	100,00	100,00

Table 4. Technological results with high density pulp in plait conditions

Solid in input in rougher flotation, %	Cu in ore, %	Cu in concentrate, %	Cu recovery in concentrate, %
41,08	0,491	24,07	86,67
41,57	0,408	26,25	88,15
42,39	0,440	27,73	89,39
43,17	0,419	26,32	87,36
43,32	0,414	25,65	86,36
average 42,16	average 0,440	average 26,42	average 87,30
average 32.00	average 0,410	average 24,70	average 86,80

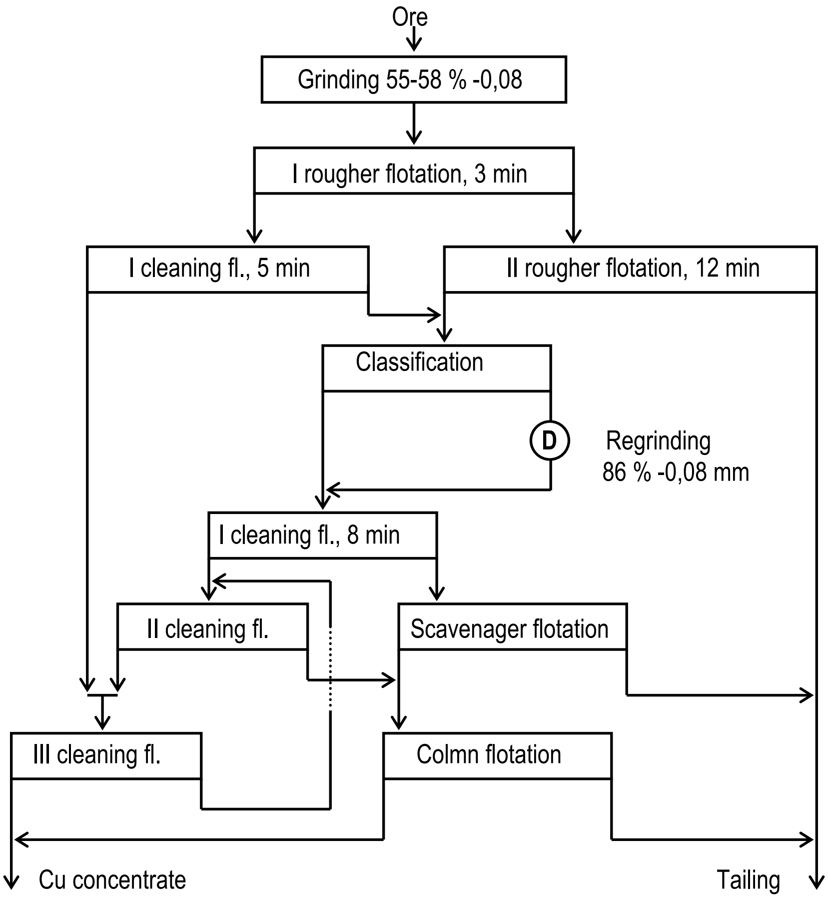

Figure 6. Flowsheet with colmn flotation

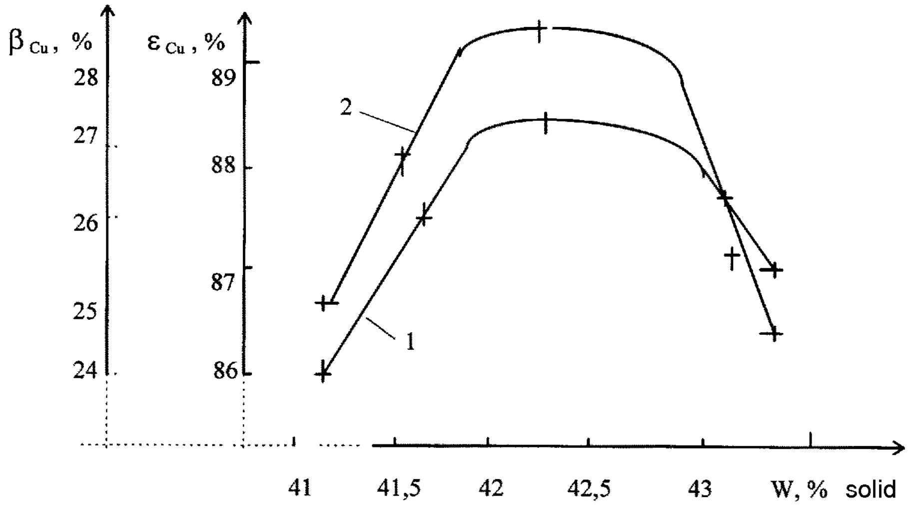

Figure 7. Influence of pulp density (W, % solid) on quality of concentrate (β_{Cu}, %) – 1 and recovery Cu (ε_{Cu}, %) - 2

The results obtained are presented in Table 2. They indicate, that the intergrowths which usually are recovered in first rougher flotation and are leading to lower grade of the concentrate, could be successfully directed in the first rougher tail and further on subjected to regrind together with the concentrate coming from second rougher flotation.

The final evaluation concerning the pulp density influence upon the flotation performance and for choosing the correct density value has been accomplished following the flowsheet shown at Figure 6. The obtained results are shown in Table 3. They suggest that 42 % pulp density seems to be the optimal one for Elatzite ore flotation.

Industrial tests were performed at mill site in order to confirm the above findings. The results are presented in Table 4, while the mill operates under the flowsheet shown at Figure 6 without column flotation stage.

Figure 7 presents the relationships between pulp density [W, % solids] for rougher flotation and copper grade (β_{Cu}, %) and recovery (ε_{Cu}, %) in the final concentrate. Industrial results have confirmed the findings deriving form the lab scale tests that the optimal pulp density is 42 %.

CONCLUSIONS

The performed laboratory investigations, which have been validated at industrial scale indicate that the increase in pulp density from 32 % to 42 % could lead to the following:

1. Copper recovery increase, most probably due to the intergrowths recovered during rougher flotation stage, which are subjected to regrinding and thus are leading to copper recovery increase without decrease in concentrate grade;
2. The increased rougher flotation pulp density offers the possibility for increase in grinding mills capacity and for reagents savings;
3. The fact that there is no need to finely regrind the whole ore, but the intergrowths are subjected to fine regrinding only is leading to energy saving during mineral liberation;
4. Further studies are warrant in direction of gold recovery, which is anticipated to benefit from the suggested approach as well.

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