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ПРОБЛЕМ НА ЕФЕКТИВЕН ИЗБОР ВО ФЛОТАЦИЈА НА БАКАР: ПОВРАТНА ВОДА ИЛИ СВЕЖА ВОДА

THE PROBLEM OF THE EFFECTIVE CHOICE IN COPPER FLOTATION: THE RECYCLED WATER OR FRESH WATER

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Introduction

Recycling of water from the decant is becoming more important due to pressures from governments and environmentalists. As much water as re-use in the mill and the volume of fresh make-up water used must be kept to a minimum. The difference between the total volume of water entering tha tailings pond and the volume of water reclaimed plus evaporation losses must be stored with the tailings in the dam.

The general concept about the construction of the tailing dam by Bucim copper mine was the three-phases formation upstream tailing dam starting from the point 582,0 m, across the point 610,0 m and finally to the point 630,0 m. The mineral processing operation in flotation plant have ensured the recovery of the chalcopyrite concentrate, discharging the tailing in the tailing dam. The tailing mill slurry consists composition of fine sand's and fine powder's masses with relative mass from 99% by the total mined copper ore.

The mill tailing is discharged by means of the gravity open canal system. The procedure involves the use of cyclones to produce sand for the dam construction, discharging the cyclone overflow in the tailing pond, thus allowing the solids to settle and produce a clear decant, the possible recycled water.

The Material Balance of the Tailing Pond Waters

The following tables (Table 1. and Table 2.) and Figure 1. show generalised representation of water gain and loss at a tailing impoundment.

$$Q_{vl} = Q_{izl}$$
$$Q_{vl} = Q_{tp} + Q_{Tr} + Q_{iz} + Q_{vr}$$
$$Q_{izl} = Q_{pv} + Q_{dr} + Q_{gub}$$
$$Q_{gub} = Q_{isp} + Q_{pon} + Q_{pg} + Q_{z}$$

where are:

Q_{vl} - input water;
Q_{izl} - output water;
Q_{tp} - pulp water;
Q_{Tr} - Topolnica river water;

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Q_{iz} - source water;
Q_{pv} - recycled water;
Q_z - capture water;
Q_{dr} - drainage water;
Q_{gub} - loss water;
Q_{isp} - evaporation water;
Q_{pon} - sinking ground water;
Q_{pg} - loss water in plant and transport;
Q_{vr} - raining water;

Table 1. Input water

Year	Pulp water	Topolnica water	Raining water	Total input
1979	888.087	843.239	101.010	1.832.336
1980	4.351.214	1.383.776	203.840	5.938.830
1981	3.940.735	938.991	161.120	5.040.846
1982	5.616.870	636.290	125.660	6.378.820
1983	6.292.876	815.439	183.480	7.291.795
1984	5.224.375	546.715	138.060	5.909.150
1985	4.665.005	543.626	149.600	5.358.231
1986	5.815.411	720.716	161.875	6.698.002
1987	5.934.815	736.676	242.078	6.913.569
1988	5.131.110	712.892	251.572	6.095.574
1989	6.250.152	833.973	318.600	7.402.725
1990	6.039.228	1.037.832	421.680	7.498.740
1991	5.863.257	1.336.963	553.080	7.753.300
1992	5.922.463	1.012.504	462.198	7.397.165
1993	6.150.816	1.057.292	513.450	7.721.558
1994	5.756.112	1.021.662	442.400	7.220.174
TOTAL	83.842.526	14.178.586	4.429.703	102.450.815
	81.8%	13.8%	4.4%	100%

Table 2. Output water

Year	Recycled water	Evaporation water	Drainage water	Capture water	Total output
1979	1.217.928	229.058	1.075.378	203.555	2.725.919
1980	4.638.940	251.963	1.075.378	997.320	6.963.601
1981	4.233.453	297.775	1.075.378	903.237	6.509.843
1982	4.469.124	335.951	1.075.378	1.287.415	7.167.868
1983	5.420.289	386.458	1.075.378	1.442.362	8.324.487
1984	3.220.772	390.508	1.075.378	1.197.453	5.884.111
1985	132.755	446.662	1.075.378	1.069.242	2.724.037
1986	2.486.191	484.628	1.075.378	1.332.923	5.379.120
1987	2.266.203	528.550	1.075.378	1.360.288	5.230.419
1988	688.036	582.447	1.075.378	1.176.079	3.521.940
1989	3.004.050	622.239	1.075.378	1.432.566	6.134.233
1990	3.341.345	651.598	1.075.378	1.384.223	6.452.544
1991	4.601.925	680.363	1.075.378	1.343.889	7.701.555
1992	4.050.620	702.309	1.075.378	1.364.886	7.192.193
1993	4.397.936	741.306	1.075.378	1.402.371	7.606.991
1994	3.563.702	780.074	1.075.378	1.265.403	6.684.557
TOTAL	51.733.269	8.111.889	17.206.048	19.163.212	96.214.418
	53.8%	8.4%	17.9%	19.9%	100%

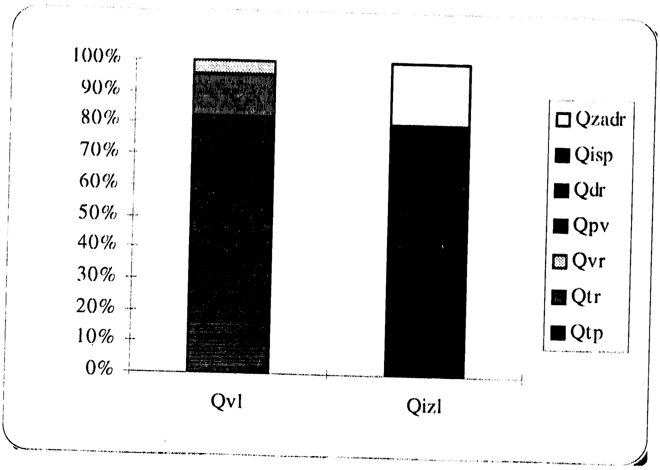

Fig. 1. Schematic shown of the input - output waters

Experimental Investigation for Ratio Recycled and Fresh Waters

The laboratory investigation on the copper ore samples are performed for determination of the influence from the various ratio: RECYCLED WATER : FRESH WATER, to recovery/grade features and characteristics using the following operation conditions:

Table 3. Experimental results from laboratory investigations for influence about recicled: fresh water on grade/recovery

Test N°	Products	Mass %	Recycling water fresh water	Grade			Recovery (%)		
				Cu (%)	Au (g/t)	Ag (g/t)	R_{Cu}	R_{Au}	R_{Ag}
1.		4.58	100% : 0%	4.80	4.75	6.50	92.28	65.51	32.43
2.		5.97	75% : 25%	3.87	3.19	6.40	93.49	59.13	38.46
3.	C	3.86	50% : 50%	6.00	5.55	7.80	94.16	61.41	34.29
4.		3.52	25% : 75%	6.80	5.61	8.00	92.70	67.18	30.98
5.		2.92	0% : 100%	7.60	6.42	9.50	92.51	65.86	30.53
1.		95.42	100% : 0%	0.020	0.12	0.65	7.72	34.49	67.57
2.		94.03	75% : 25%	0.017	0.14	0.65	6.51	40.87	61.54
3.	T	96.14	50% : 50%	0.015	0.14	0.60	5.84	38.59	65.71
4.		96.48	25% : 75%	0.019	0.10	0.65	7.30	32.82	69.02
5.		97.08	0% : 100%	0.019	0.10	0.65	7.49	34.14	69.47
	Total feed	100.0		0.247	0.32	0.92	100.0	100.00	100.0

Concerning the previous laboratory investigations from the effects of the varians ratio recycled: fresh water on the technological indicators of the chalcopyrite flotation, were carried and tests using the different pH-value effecting on the flotation kinetic.

The following experimental operating conditions were used:

◊ grinding time 23 min (KEX; KBX) 10 g/t
◊ pH-values 10.5 and 12
◊ conditionig time 4 min (NaIPX) 7.5 g/t

◊ flotation time:
◊ C_1 - t_1 = 30 sec D_{250} = 2x20 g/t   2x30 g/t
◊ C_2 - t_2 = 30 sec
◊ C_3 - t_3 = 30 sec
◊ C_4 - t_4 = 30 sec D_{250} = 2x20 g/t
◊ C_5 - t_5 = 120 sec D_{250} = 3x15 g/t
◊ C_6 - t_6 = 120 sec D_{250} = 1x5 g/t + NaIPX 4x5 g/t
◊ C_7 - t_7 = 120 sec D_{250} = 2x5 g/t
◊ C_8 - t_8 = 120 sec D_{250} = 1x7.5 g/t + NaIPX 4x2.5 g/t
◊ C_9 - t_9 = 240 sec D_{250} = 4x5 g/t

Table 4. Result from the flotation kinetic tests (pH = 10.5)

	M (g)	M (%)	Cu (%)	ΣCu (%)	R_{Cu} (%)
F	7951.3	100.000	0.236	23.684	100.000
C_1	176.8	2.223	4.40	9.781	41.297
C_2	76.8	0.965	4.60	4.439	18.742
C_3	46.9	0.589	4.40	2.591	10.939
C_4	35.0	0.440	3.30	1.452	6.130
C_5	100.6	1.265	1.40	1.771	7.477
C_6	56.0	0.704	0.90	0.633	2.672
C_7	37.0	0.465	0.64	0.297	1.254
C_8	31.0	0.389	0.56	0.217	0.916
C_9	57.8	0.726	0.40	0.290	1.224
T	7333.5	92.234	0.024	2.213	9.349

Table 5. Results from the flotation kinetic tests (pH = 12)

	M (g)	M (%)	Cu (%)	ΣCu (%)	R_{Cu} %
F	7966.1	100.00	0.248	24.811	100.000
C_1	55.0	0.690	14.70	10.143	40.881
C_2	34.7	0.435	12.00	5.220	21.039
C_3	46.8	0.587	7.20	4.226	17.032
C_4	52.0	0.652	3.20	2.086	8.407
C_5	31.7	0.397	1.40	0.555	2.236
C_6	51.8	0.650	0.70	0.455	1.833
C_7	41.0	0.514	0.40	0.205	0.826
T	7653.1	96.075	0.02	1.921	7.746

Conclusion

Assuming good control of the inputs and out puts of dam water the most important factor in achieving pollution control is the method used to remove surplus water from the dam. Floating, or moveable, pumphouse situated close to the tailings pond, or on the tailings pond, are in common use in the Bucim mine. As much water as possible must be reclaimed from the tailings pond for re-use in the mill and the volume of fresh make up water used must be kept to a minimum. The recovery of the useful minerals and gold/silver recovery is very important using a various ratio of the recycled: fresh water.

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