UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION, DECEMBER 13, 2001

Fourth Year – Program LME

MIN 475H1F – Flotation

Examination Type X

Examiner – G. Labonté

ANSWER ALL QUESTIONS

Two pieces of linear graph paper are supplied.

Marks

15 1) Samples of the feed, lead rougher concentrate, and lead rougher tailings of a lead-zinc concentrator were analyzed by size classes.

a) Calculate, and plot, the lead and zinc recoveries into the rougher concentrate by size

b) What are the challenges with the current rougher circuit and suggest one possible solution for each challenge

Size (μm)	Assays (%)					
	Feed		Concentrate		Tailings	
	Pb	Zn	Pb	Zn	Pb	Zn
150	3.97	1.79	20.00	15.00	3.80	1.63
106	5.14	3.27	35.20	14.00	1.24	2.94
75	5.19	2.97	47.30	15.30	0.88	2.53
53	5.51	4.02	33.80	17.00	0.85	3.01
45	5.97	3.79	35.50	12.00	1.05	2.81
38	6.84	4.71	34.20	17.30	1.43	3.15
-38	7.86	4.63	32.20	15.30	2.01	2.10

10 2) A series of incremental flotation tests on a porphyry copper ore grading 1.0% copper was performed with progressively longer grind times. All other conditions were kept the same.

a) Plot the release curves and determine which grind yields the best separation

b) Estimate the ultimate copper recovery that can be reasonably achieved by flotation from this ore

c) Is liberation the only challenge with this ore? Explain

Time (sec)	Recoveries (%)							
	Test 1		Test 2		Test 3		Test 4	
	Weight	Cu	Weight	Cu	Weight	Cu	Weight	Cu
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.5	19.8	0.6	26.8	1.4	43.2	1.8	44.2
30	0.9	33.3	1.0	39.2	3.2	70.0	5.0	70.4
60	2.4	54.0	2.5	68.7	3.9	75.3	6.0	75.6
120	3.0	60.5	3.1	75.3	5.8	82.3	7.4	82.8
180	4.5	70.0	4.7	81.1	6.7	85.3	8.3	85.9
240	5.7	75.6	6.0	85.2	9.1	89.2	9.7	90.0
300	8.1	82.3	8.9	89.5	9.7	90.2	10.0	90.5

15 3) Describe the three zones of importance in a flotation cell and give the similarities and differences between a conventional flotation cell, a flash flotation cell, a flotation column, and a Jameson cell.

5 4) What are the definitions, relation to thermodynamic quantities, and physical significance in the flotation process, of the following abreviations for electrochemical potentials:

a) E^{o}

b) E'

c) REDOX

d) Ep

10 5) Describe and explain the main requirements for the sensing electrode for the measurement of the electrochemical potential in a mineral slurry?

10 6) What are the reaction mechanisms for induction of hydrophobicity of sulphide minerals in the absence of collectors? Provide examples on how they can occur in a concentrator?

10 7) Collectorless flotation may have un-desireable impacts on flotation selectivity, especially if a scavenging stage with a collector is required to achieve adequate recovery. Provide one example of such situation and a possible method for prevention of the un-desireable impacts.

15 8) You are to design bench scale flotation cells using a nominal 3 l active volume (15 x 15 x 15 cm), 1000 g cell with a 7 cm impellor normally ran at 1200 rpm as base cell.

a) From the base cell, suggest cell sizes and impellor sizes which may be capable of treating feed weights of 250 g, 500 g, 5000 g under rougher conditions.

b) Demonstrate that the proposed cells would be properly scaled for hydrodynamic and oxidation-reduction conditions using appropriate dimensionless numbers.

c) Suggest a possible suite of impellor speed for each cell so that the 5000 g cell would be a rougher cell, the 1000 g would be a first cleaner cell, the 500 g a second cleaner cell, and the 250 g a third cleaner cell.

10 9) There are a number of equations for the conversion of electrophoretic mobilities to Zeta Potentials. These equations differ by their assumptions about the system and give different Zeta Potentials from the same set of experimental data.

a) What are the assumptions implied by each one of the three main equations?

b) There is one data point for which all equations will give the same Zeta Potential. Which one is it?

c) Is the calculated Zeta Potential absolutely required for the study and interpretation of surface charge phenomena?