Faculty of Applied Earth Sciences

EMEC Examination – Data Reconciliation

Date : 9th November 2004
Time : 14h00-17h00

Answer all questions clearly and completely. This paper contains 2 pages and 1 computer disk with data. This is an open-book examination. You are permitted to use Excel to solve this question.

1. Data Reconciliation – Theory

Below is given sample data for the cells of a rougher flotation bank for the flotation of a copper ore. Due to pipe layout etc. only the given data are available.

Table 1 – Flotation Data for 4 cells in a rougher bank (On Disk)

Size (µm)	+ 595	-297/595	-210/+297	-149/+210	-105/+149	-74/+105	-53/+74	-53	TOTAL
Feed 1 % wt.	5.180	12.840	9.170	9.400	8.250	7.940	5.900	41.330	**100.01**
% Cu	0.335	0.425	0.495	0.635	0.795	1.005	1.145	0.915	
Pulp 1	0.320	0.320	0.360	0.330	0.340	0.390	0.430	0.370	
Conc.1		29.500	29.600	32.000	34.300	36.200	37.000	34.400	
Pulp 2	0.330	0.300	0.280	0.250	0.230	0.220	0.230	0.230	
Conc. 2		27.200	23.700	23.900	25.100	27.700	29.800	33.000	
Pulp 3	0.310	0.310	0.240	0.156	0.106	0.091	0.087	0.100	
Conc. 3		16.800	18.700	19.100	20.700	23.600	25.700	23.300	
Pulp 4	0.340	0.290	0.220	0.139	0.089	0.068	0.068	0.076	
Conc. 4			9.500	10.800	9.000	7.400	5.600	2.400	

Hints/Suggestions
For mass balances please use an accuracy of 0.0001
For sum of squares use 0.001
Use an error of 0.01% for Cu-analyses accuracy
Use an error of 100% for flow rate accuracy
Use a starting value for the concentrate flow rate as 1% of feed

Please derive the equations that would permit you to reconcile the data given in this Table.

2. Solving the Reconciliation Equations and Derive a Population Balance Model

Use the equations that you derived in Question 1 and answer the following questions:

- Calculate the recovery for Cell 1 of each particle size. Present your answer in graphical form.

- Calculate the total recovery for Cell 1.

- If it can be assumed that the model for recovery based on pulp is $\frac{\overline{C}}{C_0} = \frac{1}{(1+k\cdot\tau)^N}$ *(where N number of cells)* and that the mean residence time is τ=1 min in a cell, derive an equation that relates reaction rate to particle size. *(The given equation is derived from* $\frac{\overline{C}}{C_o} = \int_0^\infty E(t)\cdot C(t)\cdot dt$ *and holds per particle size.)*

- Derive a suitable population balance model for flotation, based on this relationship that relates particle size to reaction rate. This means, please derive an equation that provides the average concentration in the pulp after it has flown through cell 1.

3. Generalisation of Population Balance Model

Repeat the above and answer the following question:

- Calculate the recovery for cells 2 to 4.
- Calculate the overall recovery after cell 4 for all particle sizes.
- Generalise your population balance model on the basis of these data.

Do not forget to hand in your model on Excel on the provided disk. Please put your name on the disk or on the Excel file or name the Excel file after your surname.

Also summarise your results on the given disk.