



UNIVERSITY OF GHANA

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BSc. ENGINEERING

SECOND SEMESTER EXAMINATIONS: 2015/2016

SCHOOL OF ENGINEERING SCIENCES

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

MTEN 318: PRINCIPLES OF EXTRACTIVE METALLURGY (3 CREDITS)

ANSWER ALL QUESTIONS

TIME ALLOWED: THREE (3) HOURS

1.
 - a. Define Acid-Base Accounting.
 - b. Briefly explain two (2) each of physical, chemical, biological and ecological effects of Acid Mine Drainage (AMD) and propose two mechanisms of mitigating AMD effects.
 - c. Mining concessions are often granted after AMD analyses of the deposits to ensure safe environmental standards. Ghana Australian Goldfields (GAG) expressed interest in a decommissioned mine previously operated by Tebrebe Gold Ltd in Tarkwa Ghana. Samples from the different sites of the mine were collected for AMD analyses to be able to grant GAG the permit for Gold extraction. The mineralogical studies showed a relatively high grade along with some amount of carbonate, Sulphur, Paste pH, etc. The results show that;
 - 3% of the samples had NP:AP values less than one and these same samples had negative NNP values suggesting AMD potential
 - 57% of the samples had no sulphur in the samples, clearly implying that they will not generate AMD.
 - The remaining 40% had NP:AP values above 2 and thus will not generate AMD.

Based on the results above,

- i. Justify why the permit should be granted to GAG to mine the ore.
- ii. Describe briefly how you would dispose the waste knowing that there is about 3% potential for AMD to occur.

d. From the data in the table above;

Sample	%CO ₃	%S	Paste pH	AP	NP
Site A	3.25	0.00	7.9	0.00	5.4
Site B	2.32	0.21	6.6	6.6	3.9
Site C	0.05	0.01	8.4	0.2	0.1

Calculate the following;

i. The Net Neutralization Potential (NNP)

ii. The Net Potential Ratio (NPR)

iii. Explain if there will be neutralization of the acidity based on NNP values in (i) above.

(30 Marks)

2.

a) Define Double Refractory Ores as associated with gold deposits and how they affect the mineral recovery in extractive metallurgy.

b) Briefly explain Pregrobbing and propose three ways of reducing pregrubbing in gold metal recovery.

c) Different theories have been used to explain the mechanism of adsorption of aurocyanide on a carbonaceous matter (CM). Of all these, state and explain three of the major facts about the adsorption of aurocyanide on a carbonaceous matter (CM).

d) A number of bacteria and fungi have been tested for the deactivation of different grades of CM, and there are reports of increase in overall gold extraction. Give one example each of bacteria and fungi that can be used in mitigating CM effect and explain the mechanism for CM degradation for each bacteria and fungi stated.

e) Newmont Gold Ghana Ltd mines an Ore with a grade of 0.9% Au and a concentrate grade of 26% Au will cost GHc2.45. Upon upgrading, the cost will amount to GHc4.00/t and GHc3.60/t respectively for the Ore and Concentrate. If the cost of Refining is GHc220.00/t of payable Gold and the Smelter pays at GHc1965.00/t of the agreed Gold assay with freight cost of GHc40.00/t of concentrate or Ore.

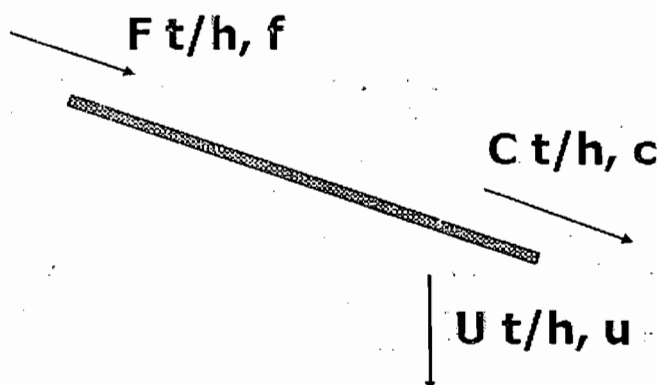
i. Calculate the revenue of the ore with and without upgrading at a recovery rate of 96.5%.

ii. Based on the results obtained in (i) above, what are the implications of the decision to upgrade or not to upgrade the ore before export. Justify this to the management of Newmont Gold Ghana Ltd.

(30 Marks).

3.

- a. Explain the DVLO theory and state its significance.
- b. Define and explain the following terms as used in the solution purification, dewatering and concentration of pregnant solution after leaching.
 - i. Sedimentation (Thickening)
 - ii. Flocculation
 - iii. Coagulation
 - iv. Flotation
 - v. Solvent extraction
- c. In brief sentences, explain the principle of sedimentation as a concentration method and a solid-liquid separation technique.
- d. Consider a screen to which a feed of F (t/h); C (t/h) reports as oversize and U (t/h) as undersize in the Figure below. Let f - be the fraction of material above the separation size in the feed, c - fraction of material above the separation size in the oversize u - fraction of material above the separation size in the undersize material. The efficiency (E) of screening equation can be derived from the mass balance equation of an oversized and undersized material;



- i. Prove the relation for the recovery of the undersize material into the screen underflow.
 - ii. Deduce the efficiency of the screening process.
 - iii. Deduce the relation for a perfect screen and clearly state all your assumptions.
- e. Justify this equation in (iii) and state its significance in screening processes.

(25 Marks)

4.

- a. Briefly describe how you would distinguish a pure gold metal from a "fool's" gold.
- b. State five (5) recovery routes in which gold can be recovered from its mineral associations.
- c. Design a typical flowsheet for a Carbon-In-Pulp/ Carbon in Leach (CIP/CIL) process showing clearly the adsorption agitator units, desorption unit, the electrolytic cells and the carbon regeneration system indicating the path of the pregnant solution and the activated carbon.
- d. During the smelting of a charge in the production of minerals, fluxes are added to facilitate the extraction process. Describe briefly four (4) functions of fluxes with the support of appropriate chemical reactions.
- e. Distinguish clearly the differences between speiss, matte and slag during charge smelting.

(25 Marks)