

Examination: TA3210 Extractive metallurgy

3 April 2006

Time: 9:00 AM – 12:00 AM

This examination contains 8 questions with total mark of 70. This accounts for 70% of the total evaluation of the course. The rest 30% is accounted for by 3 reports for 3 case studies. The deadline for submitting the reports is 10 April.

Question 1: Processing route for oxide and sulphide concentrates (5 marks)

Metals occur mostly in two types of ores: oxide and sulphide ores. To extract metals from these two types of ores, different processes are applied. Please state briefly typical processing routes for both types of ores, and compare similarities and differences.

Question 2: Cost of metals production (5 marks)

Cost for metal production is affected by many factors. Please explain these factors and how these factors could affect the production cost.

Question 3: Feed preparation (5 marks)

What are typical feed preparation operations? What types of chemical reactions are involved? Please try to explain why these preparation stages are necessary?

Question 4: Ironmaking processes (10 marks)

- (1) Please describe how metallic iron (hot metal) is produced in Blast Furnace Process. Your description should include at least the following aspects: raw materials, main chemical changes of feed along the movement in the furnace, various zones of the blast furnace, and different products of smelting operation.
- (2) Do you know any other ironmaking processes? What is the status in comparison with the blast furnace process?

Question 5: Steelmaking processes (10 marks)

- (1) Please state the main objectives of steelmaking process. How many steps are distinguished in BOF steelmaking process?
 - (2) What are the main impurities in steelmaking process (brought by both hot metal and steel scrap)? How are they removed from the steel melt?
 - (3) Removal of impurities is carried out mainly by the oxidation reactions. But why we still need one deoxidation step before the steel is cast into solid products? How in general it is carried out?
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sulphide ores extraction
↳ refining
smelting matte
oxidation

Question 6: Copper smelting and refining

(10 marks)

- (1) Copper occurs in majority as sulphide ores. Please describe the main extraction and refining steps (including their objectives) of coppermaking.
- (2) Matte smelting is the very important step in coppermaking process, and a large variety of processes are competitive with one another. Please describe a few copper smelting processes (matte smelting), and make necessary comparison.

Question 7: Hydrometallurgical processes

leaching (15 marks)

- (1) What are the typical hydrometallurgical unit operations? *electrorefining, molten salt smelting, electrolyser*
- (2) Leaching is one of the most important unit operations in hydrometallurgical processes. Please describe what types of leaching processes can be identified? What are their main characteristics? *oxygen, carbon*
- (3) Where precipitation processes are used in hydrometallurgical processes? What are their basic principles?

Question 8: Electrolysis

(10 marks)

- (1) Please compare the similarities and differences for electro-winning, molten salt electrolysis and electro-refining processes. *Hegrovsky's cell*
- (2) What are the various components of cell voltage? Why cell voltage is a very important process parameter in electrolysis process?
- (3) Why manganese can still be precipitated through electro-winning process in aqueous solutions, while aluminium and magnesium cannot? *stoichiometric*

(End)