Advanced Master Course
Process Technology of Metals
(Part: Ferrous Process Metallurgy)
Prof. Dr.-Ing. D. Senk

16-04-2010
(2/2010)
Hörsaal H201, Intzestraße 3, IME

Time: 14:00-16:00

Last name, first name: ____________________________ Register No. (Matrikel-Nr.): ____________________________

Signature: ______________________________________

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Total: 25

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Task 1: Pelletizing and Sintering 3 Points

1.1 Pellet production can be divided into 3 distinct stages:

Stage 1 – Preparation of raw materials
Stage 2 – Formation of green pellets
Stage 3 – Firing of green pellets

(a) Give the grain size of iron ore to be suitable for pelletizing. (0.5 point)

(b) What is the function of bentonite in the second stage? (0.5 point)

(c) What is the main task of the firing step? (0.5 point)

1.2 Sintering may be defined as “the agglomeration of fine particles into lump”

(a) Which material can be used as a source of heat? (0.5 point)

(b) Give one advantage and one disadvantage of sintering process. (1.0 point)
Task 2: Blast Furnace 3 Points

2.1 Why is sulphur removal from hot metal much easier than that from raw steel?  

(0.5 point)

2.2 Is the direct reduction possible at temperature lower than 1000°C and why?  

(1.0 point)

2.3 Define the following terms:

(a) Cohesive zone  

(0.5 point)

(b) Raceway gas  

(0.5 point)

(c) PCI  

(0.5 point)
Task 3: Oxygen Steelmaking 3 Points

3.1 Give one advantage and one disadvantage of OBM compared to classical BOF shop? (1.0 point)

3.2 What are the tasks of lime in steelmaking? (1.0 point)

3.3 What are the main factors necessary to obtain low phosphorus in the finished molten steel? (1.0 point)
Task 4: Slags and Fluxes 4 Points

4.1 What are the reactions take place between hot metal and slag during desulphurisation? (0.5 point)

4.2 (a) Why CaF$_2$ is sometimes used in iron- and steelmaking processes? (0.5 point)

(b) What is a disadvantage of fluorine? (0.5 point)

4.3 (a) What happens to steel melt and slag if the slag viscosity increases? (0.5 point)

(b) How can you decrease the viscosity of slag? (0.5 point)

4.4 Give equation represent:

(a) Formation of di-calcium silicate (0.5 point)

(b) Formation of alumina slag (0.5 point)

(c) Slag basicity (0.5 point)
Task 5: Electric Steelmaking 4 Points

5.1 What are the advantages of steelmaking using an electric arc furnace in comparison to basic oxygen furnace?
(Give at least 2 items)  
(1.0 point)

5.2 What is post combustion? and When is it useful in EAF process  
(1.0 point)

5.3 What are benefits of DRI used in electric arc furnace process?
(Give at least 2 items)  
(1.0 point)

5.4 How can diminish the consumption of graphite electrodes in EAF-process?
(Give at least 2 items)  
(1.0 point)
Task 6: Secondary Metallurgy (Ladle Metallurgy) 4 points

6.1 Which gases can dissolved in their atomic state in molten steel? (1.0 point)

6.2 What are the benefits of Ar stirring in the ladle? (Given at least 2 items) (1.0 point)

6.3 Give equation to represent:
(a) Vacher-Hamilton Equilibrium (0.5 point)

(b) Sieverts’s law (0.5 point)

6.4 What are the following items meaning? (1.0 point)
(a) VD

(b) AOD
Task 7: Continuous Casting (CC)  4 points

7.1 What is the purpose of the mould oscillation during casting?  (0.5 point)

7.2 What are the tasks of continuous casting mould powder?  (1.0 point)
   (Give at least 2 items)

7.3 What is primary dendrite arm and secondary dendrite arm?  (1.0 point)
   (Make a sketch and mark the position of precipitate)

7.4 Give definition for:
   (a) Non-metallic inclusions  (0.5 point)
   (b) Killed steel  (0.5 point)
   (c) Leidenfrost temperature  (0.5 point)