

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:

Task	Points (max.)	Points	Signature	Approval date	Final points (total)
1	3				
2	3				
3	3				
4	4				
5	4				
6	4				
7	4				
Total:	25		Total after approval:		

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 de-sulphurisation? *(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?
(Give at least 2 items) (1.0 point)
- 7.3 What is primary dendrite arm and secondary dendrite arm?
(Make a sketch and mark the position of precipitate) (1.0 point)
- 7.4 Give definition for:
- (a) Non-metallic inclusions (0.5 point)
- (b) Killed steel (0.5 point)
- (c) Leidenfrost temperature (0.5 point)