

Advanced Master Course Process Technology of Metals (Part: Ferrous Process Metallurgy)

Prof. Dr.-Ing. D. Senk

23-02-2010

(1/2010)

Hörsaal H212, Intzestraße 1, IEHK

Time: 10:00-11:00

Last name, first name:

Register No. (Matrikel-Nr.):

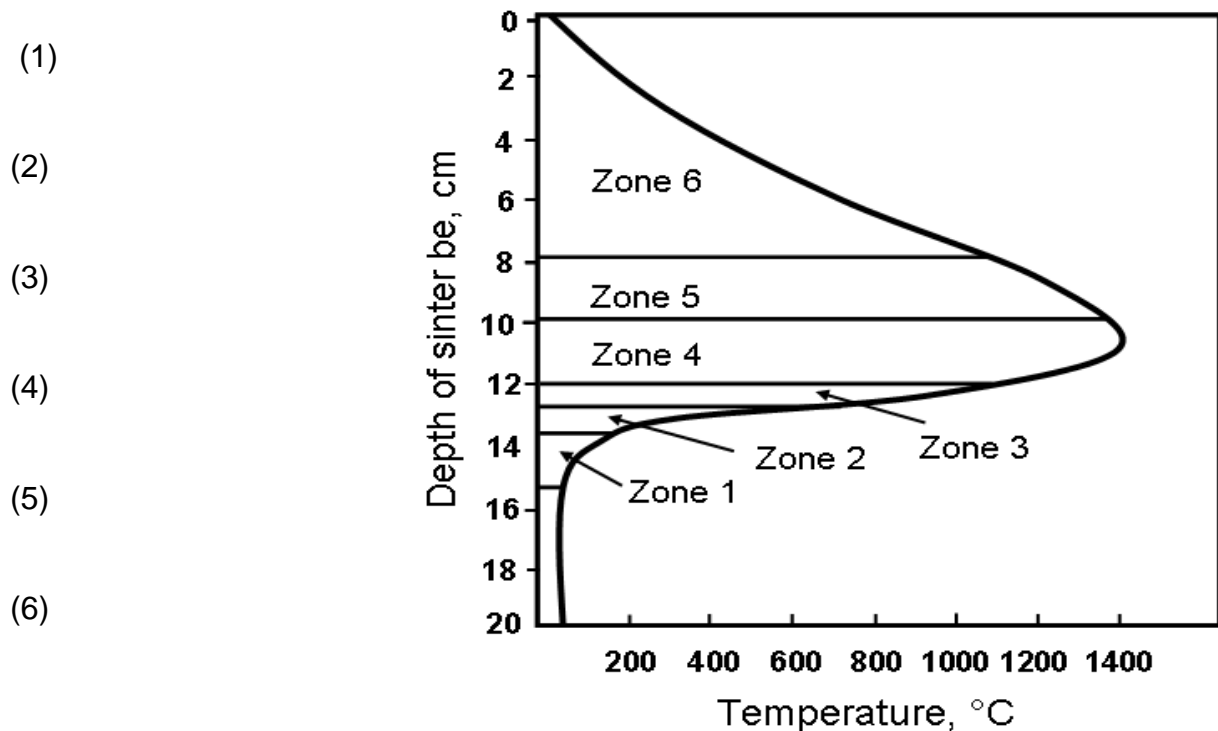
Signature: _____

Task	Points (max.)	Points	Signature	Approval date	Final points (total)
1	6				
2	8				
3	8				
4	6				
5	6				
6	8				
7	8				
Total:	50		Total after approval:		

Task 1: Pelletizing and Sintering **6 Points**

1.1 Describe the process of green pellets formation.
(Give 6 steps) (3.0 points)

1.2 In the following diagram you can see the zones during the sintering process and the distribution of the temperature. Give the name for these zones.
(3.0 point)



Task 2: Blast Furnace

8 Points

2.1 Sketch a blast furnace properly and show the place of coke windows, cohesive zone, lumpy zone, tuyeres, hot metal, and slag. *(3.0 points)*

2.2 What are the most important functions of coke in the blast furnace?
(Give at least 2 items) *(1.0 point)*

2.3 Is direct reduction possible at temperature lower than 1000°C? Why?
(1.0 point)

2.4 Give the chemical compositions and temperature of raceway gas? (1.0 point)

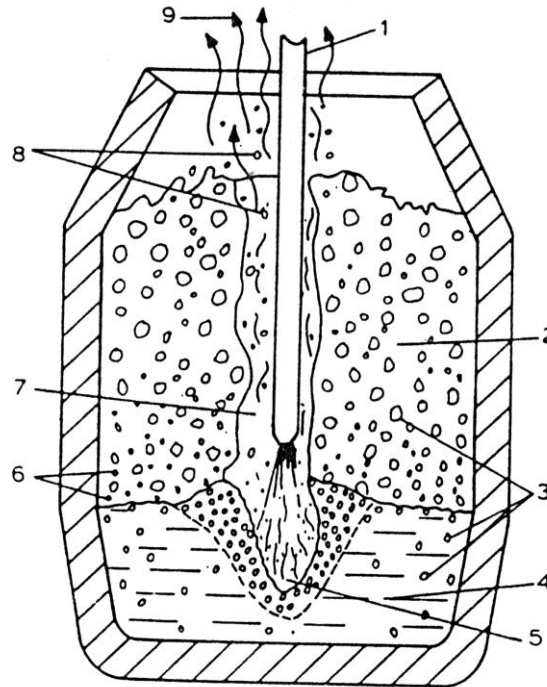
2.5 What is PCI in blast furnace operation? What is the influence of PCI on the blast furnace process? (1.0 point)

2.6 What is (a) the typical temperature and (b) carbon concentration of hot metal produced from blast furnace? (1.0 point)

Task 3: Oxygen Steelmaking

8 Points

3.1 The drawing shows the converter during the main phase of decarburisation.
Name the numbers 1-8 (4.0 points)



3.2 What are the tasks of lime in steelmaking?

(1.0 point)

3.3 Draw the OBM process and illustrates its advantages and disadvantages compared to the classical BOF process. (2.0 point)

3.4 In which process [N] concentration of liquid raw steel is higher and why?
(a) BOF (b) EAF (1.0 point)

Task 4 : Slags and Fluxes **6 Points**

4.1 What are the reactions take place between hot metal and slag during de-sulphurisation? *(1.0 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 Which two main factors can increase the viscosity of molten slag? *(1.0 point)*

4.4 What are the tasks of the ladle top slag? (Give at least 2 items) (1.0 point)

4.5 FeO- containing slag from EAF or BOF processes must be reduced after tapping in terms of oxygen activity. By which method can that be done?

(Give the chemical reaction formula) (1.0 point)

4.6 Give equation represent the formation of:

(a) di-calcium silicate (0.5 point)

(b) alumina slag (0.5 point)

Task 5: Electric Steelmaking **6 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 How can diminish the consumption of graphite electrodes in EAF process?

(Give at least 2 items)

(1.0 point)

5.3 Explain the procedure and also write down chemical reactions for generation of foaming slags in electric arc furnace process.

(1.0 point)

5.4 Give a proper sketch to represent the difference between AC-EAF and DC-EAF.
(1.0 point)

5.5 What are benefits of DRI applied to the electric arc furnace process?
(Give at least 2 items) (1.0 point)

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

Task 6: Secondary Metallurgy (Ladle Metallurgy) **8 points**

- 6.1 What are the tasks of “Secondary Metallurgy” in view of chemical measures?
(Give at least 2 items) *(1.0 point)*
- 6.2 What are the main factors necessary to obtain low phosphorus contents in the finished steel? *(1.0 point)*
- 6.3 Which method can be used for the determination of oxygen activity of steel? *(1.0 point)*
- 6.4 Which gases can be dissolved in their atomic state in molten steel? *(1.0 point)*

6.4 What is Vacher-Hamilton equilibrium?

What is Sieverts' s law?

(1.0 points)

6.6 What are the benefits of Ar stirring in the ladle?
(Given at least 3 items)

(1.5 point)

6.7 What are the following items meaning?

(1.5 point)

(a) VD

(b) AOD

(c) CC

Task 7: Continuous Casting **8 points**

7.1 Give the definitions for the following: *(1.0 point)*

(a) Micro-inclusions

(b) Micro-segregation

7.2 What is primary dendrite arm and secondary dendrite arm? *(1.0 point)*

(Make a sketch and mark the position of precipitate)

7.3 What are the tasks of continuous casting mould powder “Casting Flux”? *(1.0 point)*
(Give at least 2 items).

7.4 Give the main components of Casting Flux powder.

(2.0 point)

(Give at least 4 components)

7.6 (a) What is the “Leidenfrost” phenomenon?

(0.5 point)

(b) Give a typical value of “Leidenfrost” temperature.

(0.5 point)

7.7 What is “nozzle clogging” and how can you suppress that? *(1.0 point)*

7.8 Describe the term "negative strip time" of mould oscillation and sketch the figure. *(1.0 point)*