



Mastercourse
Metallurgical Engineering
(Ferrous Process Metallurgy)
2009-01-23

Last name, first name:

Matrikel-Nr.:

Signature:

Task	Points (max.)	Points	Signature	Approvaldate	Finalpoints (total)
1	5				
2	5				
3	5				
4	5				
5	5				
6	5				
7	5				
8	5				
9	5				
10	5				
Total:		Total after approval:			

Mastercourse

Metallurgical Engineering

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2009-01-23

1. Task: Pelletizing und Sintering

5 points

a)

1. Give at least 3 reasons for fine ore agglomeration.

2. Name at least 3 kinds of fine ore agglomeration.

3,0 points

b) Name two different types of iron ore and the corresponding iron contents.

2,0 points

2. Task: Metallurgical Coke

5 points

a) Name the first three stages of the coking process and the corresponding temperature ranges.

3,0 points

b) Give two “disadvantages” of using coke in the blast furnace.

1,0 points

c) There are several options to reduce the specific coke consumption in blast furnaces. Name at least 2 of these options.

1,0 points

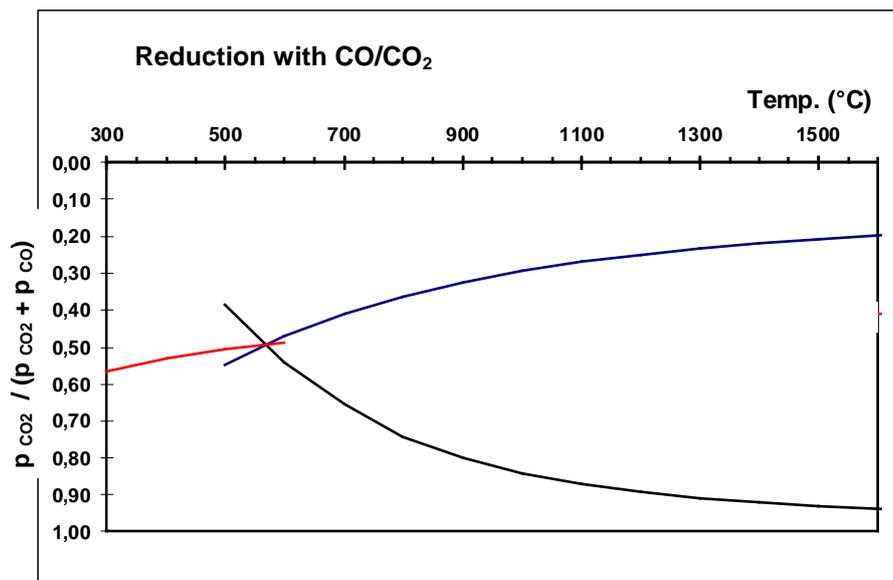
3. Task: Blast Furnace

5 points

a) The following figure shows the Baur-Glaessner-Diagram for the reduction of iron oxides with CO/CO₂ gas-mixtures.

1. Mark and name the regions in the diagram, where hematite, magnetite, wustite and metallic iron are stable.
2. Determine the amount of carbon monoxide in the CO–CO₂ gas mixture, necessary to reduce Fe₃O₄ to FeO at 1000°C.

3,0 points



b) Name two tasks of the blast furnace top charging device.

1,0 points

c) What are the so-called “coke-windows” in the blast furnace, which task do they fulfil?

1,0 points

4 Task: Thermodynamics

5 points

- a) Sketch the Iron-Carbon-Diagram including the most important data and mark the region of liquid hot metal in the diagram.

3,5 points

b) Calculate the oxygen partial pressure above pure iron oxide at 1500°C.

Given:



$$\Delta G^0 = 63500 - 16,8 * T \text{ [cal/mole]}$$

1,5 points

5. Task: Converter

5 points

- a) 1 t of cooling scrap are added to a 350 t converter. Calculate the heat discharged from the converter.

(Assumption: the scrap contains to 100 % iron)

Given:

Charging temperature of scrap: 25°C

Melt temperature: 1600°C

$c_p = 41,9 \text{ kJ/kmole}\cdot\text{K}$

(Assumption: $c_{p(\text{liquid})} \approx c_{p(\text{solid})}$, change of the overheat can be neglected)

Melting enthalpy: 13832 kJ/kmole

$M_{\text{Fe}} = 56 \text{ g/mole}$

2,5 points

b)

- 1) Which element is oxidised strongest at the beginning of the converter process?

- 2) Name an chemical element, which is oxidised at the beginning of the converter process, reduced at the main phase and again oxidised during the end phase of the converter process.

1,0 points

- c) Oxidation of carbon in converters can be divided into 3 phases: the starting, the main and the end decarburisation phase.

Explain in short words the decarburisation velocity in these 3 phases (qualitatively!).

1,5 points

6. Task: Direct and Smelting Reduction

5 points

a) Explain the Midrex process.

2,0 points

b) Explain the Corex process.

2,0 points

c) Which products are produced in the

a. Midrex process?

b. Corex process?

1,0 points

7. Task: Electric Steelmaking

5 points

- a) Name at least 2 advantages of oxygen blowing during steel production in electric arc furnaces.

1,0 points

- b) Draw a schematical sketch of an AC- and a DC-electric arc furnace and name the most important furnace parts.

4,0 Punkte

8 Task: Secondary Metallurgy

5 points

a)

1. Name at least two chemical treatment methods of steel melts in ladle metallurgy.

2. Name at least two physical treatment methods of steel melts in ladle metallurgy.

2,0 points

b) Name two secondary metallurgical processes which are mostly operated under vacuum metallurgical conditions and give the reason why these processes are operated under vacuum.

1,5 points

c) Deduce the nitrogen solubility in steel melts as function of the nitrogen partial pressure in the ambient atmosphere.

1,5 points

9. Task: Continuous Casting

5 points

- a) What are the tasks of casting powder during continuous casting of steel?
(at least 2 answers)

1,0 points

- b) What is micro segregation? What is the reason for micro segregation?

1,0 points

- c) Give one reason for unwanted oxidic-inclusions in steel.

0,5 points

d) Name the characteristic components of a continuous casting machine (facilities) by means of a sketch.

2,5 points

10 Task: Protection of Environment, Recycling 5 points

a) Give a definition of "Sustainable Development".

1,0 points

b) Name 4 potentials for the reduction of the specific energy consumption in steel making.

2,0 points

c) Give 4 residual or waste materials in iron and steel production, which are used as secondary raw materials.

2,0 points