

TA 3330 course

Written examination on 17.01.2002, 14:00 h

1. A new plant was built for manufacturing 500 000 pumps/year. The total capital investment has been 12 million €. The proportional cost are 20 €/pump. The fixed operating cost (excl. depreciation and interest) are 1.32 million €/year. Capital charges: Linear depreciation is over 10 years, interest rate is 8 %/years (both refer to total capital investment). What is the break-even sales price of manufactured pumps to cover total fixed cost, incl. capital charges?
2. What are the fundamental differences in recycling metals and plastics?
3. A copper ore contains in average 0.75 % Cu as CuO. Melt this ore directly (for material balance neglect carbon as a reductant) with 20 % silicon addition as a flux for proper slag forming. The slag will dissolve 0.3 % Cu. What is the copper recovery?
The ore is upgraded to a concentrate with 12 % Cu. The copper recovery from ore to concentrate is 82 %. Melt this Cu-concentrate under conditions above. What is now the copper recovery referred to the original Cu-content in the ore?
4. The international sales prices may be noted as follows:
 - 2.31 US\$/lb Ni
 - 23310 Pts/100 kg Al
 - 3673 hfl/sht Cu.
 What are the prices expressed in €/t of respective metal? Use the conversion rates: 1.12 €/US\$; 166.386 Pts/€.
5. You have to transport Magnesium scrap to the new plant at Delfzijl. The bulk density of the scrap is 0.2 t/m³. The trucks to be used can carry 20 m³/trip. Due to safety aspects the transportation cost are as high as 80 €/truck*hour. The average speed of the trucks is 70 km/h. According to your own profitability analysis you cannot afford to pay more than 100 €/t

Mg-scrap. What is the max. distance from where you can purchase Mg-scrap?

6. (a) Steel sheets are hot dip galvanized with a layer of 30 μm of zinc metal. In Europe 58.5 million t of steel sheets with a width of 3 m and a thickness of 2.5 mm are produced. What is the total demand in t zinc/y for hot dip galvanizing in Europe?
- (b) Assume that 50 % of the steel sheets are recycled to electric arc furnace smelters, where the zinc evaporates and is bound into a dust with 26 % zinc content. What is the specific dust generation in [kg EAF dust/t steel sheet] ?
7. One cell of a primary electrolytic aluminium winning plant has the following operational data: 200 kA - 4.5 V – 94 % current efficiency – 13.5 kWh/kg Al energy consumption. What is the yearly production output of this plant, when 210 cells are in operation during in average 8000 hours/year?
8. A die-caster produces laptop boxes from magnesium metal (density 1,74 t/m³). The average wall thickness of the boxes is 7 mm. Various holes are drilled into the cast boxes producing turnings. Average length of turnings is 15 cm, average thickness is 1 mm. The turnings oxidise quickly and are finally covered by a MgO-layer of 150 μm (density of MgO is 2,2 t/m³).
- (a) What is the average metal content of the oxidised turnings? The oxidised turnings are melted in a crucible together with 10 % flux addition. During melting 1.5 % magnesium metal is burnt to oxide. Oxide plus flux are skimmed from the liquid metal but entrap 60 wt % metallic magnesium.
- (b) What is the metal recovery of melting these turnings?

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Udo Boin