WASTE MANAGEMENT (KBT135)

Exam in Waste Management 2014-08-29, 08:30 – 12:30

Examiner: Professor Britt-Marie Steenari

Contact person: Professor Britt-Marie Steenari ext. 2890 (mob 0730-794201)

Grading: Total points: 50 + points from project work (max 6 p)

Points	**Grading**
<25	Failed
25-32	3
32.5-39.5	4
40-56	5

Closed book exam – a non-technical language dictionary and calculator with wiped memory is permitted.
Please note: Each question must be answered on separate paper.

1. **Ashes (7 p)**
   Combustion of solid fuels produces ash which is a waste.
   a. Consider combustion of forestry litter (branches, twigs, roots, leaves etc). Suggest a suitable use for the ash from such a combustion unit and also suggest necessary restrictions for that utilization option. Give relevant motivation for your answer. (5 p)
   b. Describe the chemical and physical differences between the fly ash and the bottom ash from a grate fired combustion unit firing municipal solid waste? (2 p)
2. **Waste flows in society (5 p)**
   b. What is the Basel convention and what does it cover? (2 p)
   c. What does "e-waste" mean? (1p)
   d. How large fraction of the total amount of municipal waste i EU does the e-waste take up and what is the trend for the amount of e-waste formed? (2p)

3. **Hydrothermal waste treatment (6 p)**
   Describe the three main hydrothermal waste processes. Give a brief and generic explanation of each one of them. Also discuss which waste flows that are preferably treated with this type of processes and why.

4. **Thermal waste treatment (6 p)**
   a. Describe pyrolysis including the following concepts:

i. Temperature range
ii. Atmosphere
iii. Heating methods used
iv. Products formed
v. Use of products

5. **Bioremediation / Material balances for biological waste handling methods / Modeling and optimization of biological treatment systems (10 p)**
   In a society not so close to you there is a need for degradation of a poisonous component (Substrate S) in a contaminated flow with the original concentration of 22,0 g/l. The engineers are thinking about how to perform this degradation process and wants to explore the possibility to perform the degradation in two continuous (ideally stirred) reactors connected in serie, with the active organism "*international studenticus*" X.

   Data:
   The concentration of biomass in the contaminated flow is 0 and the yield coefficient is $Y_{X/S}$ = 0,08 (g/g). The total flow in to the system is 0,5 l/h and the reactor volumes are 4 and 8 (liter)

$$r_X = \mu_{\max} \frac{S}{S + K_S} X$$

   μ_{max} = 0.08 1/h
   K_s =0,2 g/l

   a. Which reactor would you place first to maximize the degradation (motivate)?

   b. Calculate the degradation of the poisonous component for the suggested reactors position?

6. **Recycling of metals (5 p)**
   Discuss the advantages and disadvantages of hydro and pyro processing for separating metals.

7. **Radioactive waste (5 p)**
   Describe the steps from uranium ore to fuel pellet.

8. **Recycling of plastics (6 p)**
   a. How can the traditional bulk polymer be produced from renewable raw material? (2 p)
   b. How can the quality of mechanically recycled material be increased? (2 p)

c. Describe the difference between a thermoplastic material and a thermoset and describe why thermosets are more difficult to recycle mechanically (re-melting and shaping into new products). (2 p)