Separation Processes, ChE 4M3, 2012

Assignment 2

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Objectives: Wrapping up the sedimentation section; dealing with more open-ended questions and moving on to other solid-fluid separation systems.

Question 1

A rectangular settling basin is used for clarifying a mixed water-biomass stream at a feed rate of 130 m^3 per hour. The basin area is 5000 m^2.

There are biomass particles with approximately the following sizes present: 5μm, 8μm, 12μm and 20μm and these particles have a density of 1100kg.m^{-3}.

1. Which particle sizes will be completely separated out?
2. What will happen with the other particle sizes?

Question 2

A flocculant test on laboratory samples appears to quadruple the settling time from 0.5mm.s^{-1} to almost 2mm.s^{-1} for a given waste stream. What is the effect on the tank diameter, and the approximate effect on the capital cost?

Question 3

A thickener is operating at the designed feed rate of 180m^3hr^{-1} but needs to be operated at 225m^3hr^{-1} due to increased upstream production. It is the last step before discharging the overflow stream to municipal treatment. Since your company is under investigation from government authorities already, there can be absolutely no risk of discharging additional solids in the overflow.

Clearly explain at least 3 options you can realistically investigate to handle the increased flow; and be as creative as possible. Also, be clear on the expected magnitude of your effect: is it linear or some other function?

Question 4

It is required to settle dust particles from a moving air stream. One option that could be used is to pipe the incoming dust/air mixture to a large rectangular container with a dissipator at the container entrance. A moving conveyor belt on the bottom of the container will remove any solid particles that settle out of the air. The clean(er) air can be withdrawn from the other side of the container. Your company is trying to do this as cheaply as possible, so they are using a standard shipping container.

The particles have density of 1300kg.m^{-3}. Pick a container size and calculate the minimum theoretical particle size that will drop out. Apply an overdesign factor of 10 to the settling velocity.

Question 5

Provide 3 examples where cyclones are used in industrial practice. Please cite your references for this question.

Would a cyclone have been an better option for the previous question? Please explain.

END