

Separation Processes, ChE 4M3, 2014

Assignment 2

Kevin Dunn, kevin.dunn@mcmaster.ca

Due date: 26 September 2014

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

Question 1 [10]

A rectangular settling basin is used for clarifying a suspended solid stream at a feed rate of 150 m^3 per hour. The basin's size is 45 meters long by 10 meters wide.

There are sand particles with approximately the following sizes present: $24 \mu\text{m}$, $36 \mu\text{m}$, $42 \mu\text{m}$ and $60 \mu\text{m}$ and these particles have a density of $1200 \text{ kg}\cdot\text{m}^{-3}$.

1. Which particle sizes will be completely separated out?
2. Draw the trajectories of the 4 particles in a sketch.

Question 2 [3]

We are modifying an sedimentation unit. A flocculant test on laboratory samples appears to triple the settling time from $0.5 \text{ mm}\cdot\text{s}^{-1}$ to almost $1.5 \text{ mm}\cdot\text{s}^{-1}$ for a given waste stream. Assume hindered settling is occurring.

What does this imply about how we can improve the overall system's performance?

Question 3 [5]

A thickener is operating at the designed feed rate of $180 \text{ m}^3 \text{ hr}^{-1}$ but needs to be operated at $225 \text{ m}^3 \text{ hr}^{-1}$ 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 [6]

Calculate the sphericity of a rectangular object whose sides are in the ratio $1 : 1 : x$, where x is any value between 1 and 10. Plot the result as x vs sphericity (y -axis).

Question 5 [10]

Plot the differential and cumulative analysis (only show the percent passing curve) for the following sieve test results:

| Mesh number | Mass retained [g] |
|-------------|-------------------|
| 6 | 0.0 |
| 8 | 4.8 |
| 12 | 15.3 |
| 16 | 144.4 |
| 20 | 209.7 |
| 30 | 150.6 |
| 40 | 74.2 |
| 50 | 47.2 |
| 70 | 29.7 |
| 140 | 13.2 |
| 170 | 9.3 |
| 230 | 8.4 |
| Pan | 3.2 |

Question 6 [4]

Provide 2 examples where centrifuges are used in industrial practice. Please cite your references for this question.

Explain whether a cyclone be a better option in any of these cases.

END