

Homework #4

1. Dry Cleaning

Each month the Speedy Dry Cleaning Company buys one barrel (0.160 m³) of dry cleaning fluid per month. Ninety percent of the fluid is lost to the atmosphere and 10% remains as residue to be disposed of. The density of the cleaning fluid is 1.5940 g/mL.

- Draw a mass balance diagram
- Estimate monthly mass emission rate to the atmosphere in kilograms per month

2. Corrosion Control

Near the end of a drinking water treatment plant we often add a chemical to inhibit corrosion of pipes in the water distribution system. Suppose a plant treats a flow of 4 million gallons per day (MGD) (or 175 L/s) and wants to achieve a dose (or concentration) of 2 mg/L of orthophosphate (PO₄³⁻) for corrosion control. A dosing pump is used to inject a high concentration feed stock of the orthophosphate. If the dosing pump flow rate is 0.20 L/s what is the required concentration of orthophosphate in the feed solution? Assume steady state, complete mixing and a conservative substance.

3. Sludge

In water and wastewater treatment processes a filtration device may be used to remove water from the sludge formed by a precipitation reaction. The initial concentration of sludge from a softening reaction is 2% (20,000 mg/L) and the volume of sludge is 100 m³. After filtration the sludge solids concentration is 35%. Assume that the sludge does not change density during filtration and that liquid removed from the sludge contains no sludge. Using the mass-balance method, determine the volume of sludge after filtration.

4. Radon

A 90 m³ basement in a residence is found to be contaminated with radon coming from the ground through the floor drains. The concentration of radon in the room is 1.5 Bq/L (becquerels per liter) under steady state conditions. The room behaves as a CMFR, and the decay of radon is a first-order reaction with a decay rate constant of $2.09 \times 10^{-6} \text{ s}^{-1}$. If the source of radon is closed off and the room is vented with radon-free air at a rate of 0.14 m³/s, how long will it take to lower the radon concentration to an acceptable level of 0.15 Bq/L?

Your Name: _____

5. Reactor kinetics

Compare the reactor volume required to achieve 95% efficiency for a CMFR and a PFR for the following conditions; steady-state, first-order reaction, flow rate = $14 \text{ m}^3/\text{d}$, and reaction rate coefficient = 0.05 day^{-1} .

Assigned: 7 Oct 19

Due: 16 Oct 19

Answer Page

Fill in the boxes with the correct answer.

You will only get credit for a problem if you (1) fill in the box with the correct answer, (2) your answer is legible, and (3) you include attach page(s) with calculations backing up your answer, when requested for the problem.

Problem #

1	a (diagram)		
	b		kg/month

2		g/L
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3		m^3
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4		min
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5	CMFR		m^3
	PFR		m^3