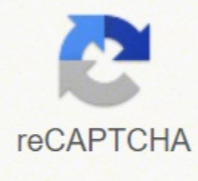




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SEPARATION PROCESS
PRINCIPLES SEADER HENLEY
SOLUTION MANUAL

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TABLE OF CONTENT

- Introduction
- Brief Description
- Main Topic
- Technical Note
- Appendix
- Glossary

Institute of Process Engineering
Prof. Dr. M. Mazzotti

March 3, 2016

Separation Process Technology I

Series 1: Ideal Absorption Cascades and Kremser Equation

Exercise 1: Ideal Cascades

Acetic acid must be extracted from an aqueous solution (6 mole of acid per liter of water) using chloroform at a temperature of 25 °C, in order to separate the acetic acid (B) from the water soluble impurities. Water (A) is completely insoluble in chloroform (C).

Calculate which is the percentage of acetic acid extracted when the acetic acid is extracted from an aqueous solution (10 L/s of water) using a 10 L/s stream of chloroform under the following conditions:

- (i) The solvent is totally fed in a cross-current process with only 1 stage, see Figure 1.

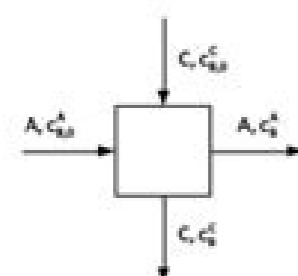


Figure 1: 1-stage cross-current absorber.

- (ii) The solvent is divided in 3 equal parts; each third of solvent is fed in a stage of a 3 stages cross-current process, as shown in Figure 2.

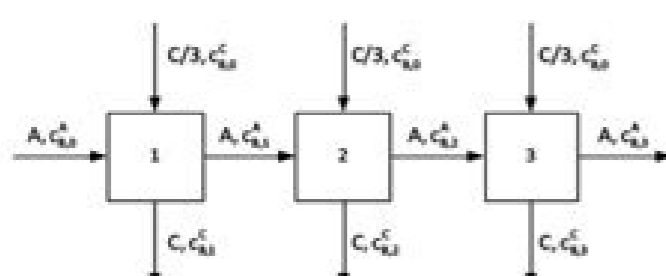


Figure 2: 3-stage cross-current absorber.

- (iii) Use 5 L/s of solvent in the 1st stage, 3 L/s in the second stage and 2 L/s in the third stage of a 3 stages cross-current process.

CHAPTER FOUR

- 4.1 a. Continuum, Transient
b. Input - Output = Accumulation
No reaction \Rightarrow Generation = 0, Consumption = 0
$$6.00 \frac{\text{kg}}{\text{s}} - 3.00 \frac{\text{kg}}{\text{s}} = \frac{dM}{dt} = \frac{dM}{dt} = 3.00 \frac{\text{kg}}{\text{s}}$$

c.
$$t = \frac{100 \text{ m}^3 \left[\frac{1000 \text{ kg}}{1 \text{ m}^3} \right] \left[\frac{1 \text{ s}}{300 \text{ kg}} \right]}{3.00 \text{ kg/s}} = 333 \text{ s}$$
- 4.2 a. Continuum, Steady State
b. $k = 0 \Rightarrow C_1 = C_2$ $k = \infty \Rightarrow C_1 = 0$
c. Input - Output - Consumption = 0
Steady state \Rightarrow Accumulation = 0
A is a reactant \Rightarrow Generation = 0
$$V \left(\frac{dC_A}{dt} \right) = V \left(\frac{dC_A}{dt} \right) - V \left(\frac{dC_A}{dt} \right) + V C_1 \left(\frac{dC_A}{dt} \right) \Rightarrow C_1 = \frac{C_2}{1 + kV}$$
- 4.3 a.

1000 kg/h	\rightarrow	\rightarrow	\rightarrow
0.250 kg/h	\rightarrow	0.850 kg/h	0.150 kg/h
0.450 kg/h	\rightarrow	0.100 kg/h	0.100 kg/h
	\rightarrow	0.164 kg/h	0.164 kg/h
	\rightarrow	0.084 kg/h	0.084 kg/h

(1) Total Mass Balance: $1000 \text{ kg/h} = m_1 + m_2$
(2) Benzene Balance: $[0.250 + 1000] \text{ kg/h} = 0.850 m_1 + 0.100 m_2$
Solve (1) & (2) simultaneously $\Rightarrow m_1 = 29.7 \text{ kg/h}, m_2 = 40.3 \text{ kg/h}$

b. The flow chart is identical to that of (a), except that mass flow rates (kg/h) are replaced by molar flow rates (kg). The balance equations are also identical (initial input = final output).

c. Possible explanations: \Rightarrow a chemical reaction is taking place, the process is not at steady state, the feed composition is incorrect, the flow rates are not what they are supposed to be, other species are in the feed stream, measurement errors.

SOLUTION MANUAL

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SEPARATION PROCESS ENGINEERING.
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3rd Edition

(Formerly published as *Equilibrium-Stage Separations*)

by

Phillip C. Wankat

CHAPTER 2

The Recurring Process

Assignment	Number	Points	Hours	Prerequisites
1. Assignment	1	1	1	
2. Assignment	2	1	1	
3. Assignment	3	1	1	
4. Assignment	4	1	1	
5. Assignment	5	1	1	
6. Assignment	6	1	1	
7. Assignment	7	1	1	
8. Assignment	8	1	1	
9. Assignment	9	1	1	
10. Assignment	10	1	1	
11. Assignment	11	1	1	
12. Assignment	12	1	1	
13. Assignment	13	1	1	
14. Assignment	14	1	1	
15. Assignment	15	1	1	
16. Assignment	16	1	1	
17. Assignment	17	1	1	
18. Assignment	18	1	1	
19. Assignment	19	1	1	
20. Assignment	20	1	1	

