Engy-5140: Chemical and Nuclear Waste Processing Fall 2019 UMass Lowell; Prof. V. F. de Almeida **06Dec2019**

Final Project 01 18Dec2019

Name: `your name`

Guidance:

- Work within your team only. Be clear and complete in your answers.
- Save your work frequently to a file locally to your computer.
- During your work and before submitting the final version do: `Kernel` -> `Restart & Run All`, to verify your notebook runs correctly.
- Save your file again.

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Problem Statement

A solvent-cleanup plant consists of an absorber column followed by a stripper column. 90% of benzene (B) in the inlet air stream (A) which contains 0.06 mol B/mol B-free gas, is to be removed from the air in the absorber. The silicon oil, polydimethylsiloxane (PDMS), entering the top of the tower contains 0.01 mol B/mol of pure PDMS. The operating temperature is 25 C and pressure 1 bar, and the molar flow rate of the air is 45 kmol/h.

Superheated steam (S) is used in the stripper to remove benzene from the benzene-rich PDMS at 110 C. Concentration of benzene in the oil is 0.01, in mole ratio, at the outlet of the oil. The PDMS (pure)-to-steam (benzene-free) flow rate ratio = 2.0. The benzene equilibrium data are provided in the following table:

$X_{B,P}$ (in Oil)	$X_{B,A}$ (in Air), 25 C	$X_{B,S}$ (in Steam), 110 C
0	0	0
0.04	0.011	0.10
0.08	0.0215	0.21
0.12	0.032	0.33
0.16	0.042	0.47
0.20	0.0515	0.62
0.24	0.060	0.795
0.28	0.068	1.05

Using the network modeling approach covered in this course, provide answers to the questions below (based on Seader, Henly, and Roper textbook Separation Process Principles Chap. 6, 2016) .

Problem 1 (100 pts)

1. Design both columns and provide construction/operation parameters.
2. What is the efficiency of your stripper and absorber?
3. If the air is vented to the environment what is the mass of benzene per day released?
4. What is the mass of benzene stored per day?
5. Describe the hazards to humans if exposed to the air released.

Answers: