HW7_4

March 29, 2022

1 Homework 7

1.1 Problem 4

Estimate flowrate in $\frac{kg}{hr}$ for various solvents when given the feed flowrate, compositions of feed and raffinate streams, and partition coefficients

Starting with a mass balance on each component,

$$\omega_A^F F = \omega_A^R R \tag{1}$$

$$\omega_B^F F = \omega_B^R R + \omega_B^E E \tag{2}$$

$$S = \omega_C^E E \tag{3}$$

(1), (2), and (3) can be combined to get,

$$W_B^F F_A = W_B^E S + W_B^R F_A \tag{4}$$

where $W_B^i = \frac{\omega_B^i}{\omega_A^i}$ and $F_A = \omega_A^F F$

The partition coefficient can be found by

$$K_D = \frac{\omega_B^E}{\omega_B^R} \tag{5}$$

or

$$K'_D = \frac{W_B^E}{W_B^R} = K_D \frac{1-\omega_B^R}{1-\omega_B^E} \tag{6}$$

(4) and (6) can be combined to get

$$\frac{W_B^R}{W_B^F} = \frac{1}{(1+\frac{K'_D S}{F_A})}$$

which can be rearranged to get

$$S = \frac{(\frac{W_B^F}{W_B^R} - 1)F_A}{K'_D} \tag{7}$$

To find K'_D, ω_B^E can be found using (5)

[ ]:
```
import numpy as np
```

[ ]:
```
wBF = 0.08                                  #mass frac B in feed
wAF = 1-wBF                                 #mass frac A in feed
wBR = 0.01                                  #mass frac B in raff
wAR = 1-wBR                                 #mass frac A in raff

F = 13500                                   #feed flowrate kg/hr
FA = F*wAF                                  #flowrate of A in feed

KD = np.array([1.273,.429,.312,.178])       #partitioin coeffs (mass frac)

wBE = KD*wBR                                #mass frac B in extract

KDp = KD*(1-wBR)/(1-wBE)                    #partition coeff (mass ratio)
```

[ ]:
```
def S(wbF,waF,wbR,waR,FA,KDp):
    XbF = wbF/waF
    XbR = wbR/waR
    S = (XbF/XbR-1)*FA/KDp
    return S
print(S(wBF,wAF,wBR,wAR,FA,KDp))
```

```
[ 74029.38656002 221550.22250477 304989.51048951 535306.94586313]
```

Solvent	S (kg/hr)
Methyl Acetate	74,029
Isopropyl Ether	221,550
Heptadecanol	304,990
Chloroform	535,307