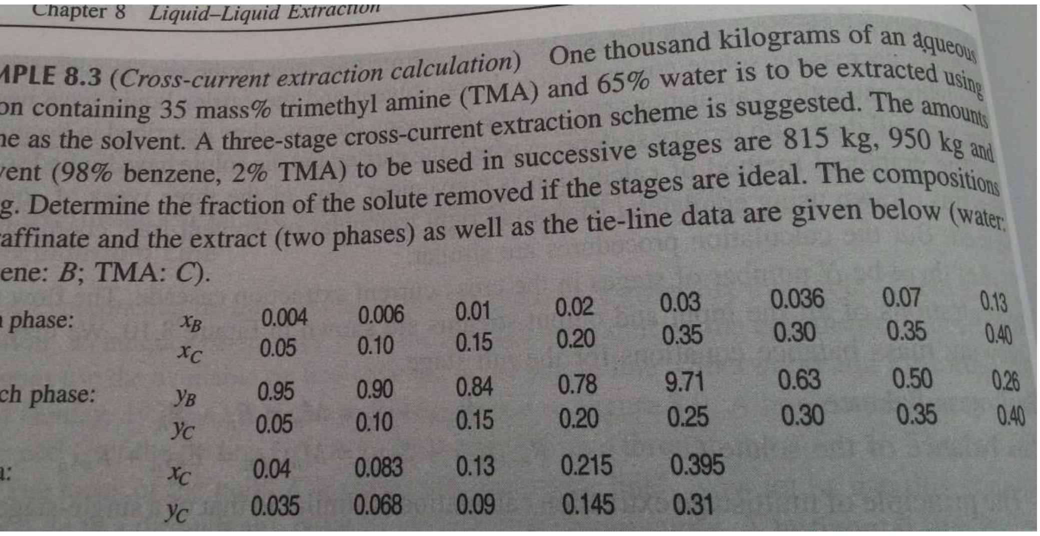
MT2: Extraction **Practice Quiz 1**

2: Cross-current extraction calculation [Use MATLAB/python to solve this problem]



Chapter 8 Liquid–Liquid Extraction

MPLE 8.3 (*Cross-current extraction calculation*) One thousand kilograms of an aqueous on containing 35 mass% trimethyl amine (TMA) and 65% water is to be extracted using ne as the solvent. A three-stage cross-current extraction scheme is suggested. The amounts vent (98% benzene, 2% TMA) to be used in successive stages are 815 kg, 950 kg and g. Determine the fraction of the solute removed if the stages are ideal. The compositions affinate and the extract (two phases) as well as the tie-line data are given below (water: ene: *B*; TMA: *C*).

phase:	x_B	0.004	0.006	0.01	0.02	0.03	0.036	0.07	0.13
	x_C	0.05	0.10	0.15	0.20	0.35	0.30	0.35	0.40
ch phase:	y_B	0.95	0.90	0.84	0.78	9.71	0.63	0.50	0.26
	y_C	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40
:	x_C	0.04	0.083	0.13	0.215	0.395			
	y_C	0.035	0.068	0.09	0.145	0.31			

The ternary equilibrium curve on the right-angled triangular co-ordinate system is plotted in the following MATLAB code . Locate feed point and solvent point. xbf = 0; xcf = 0.35; ybs = 0.98;ycs = 0.02; Solvent amount for stage 1: 815 kgs.

a. Fit two polynomials [in the form, $y = ax^n + bx^{n-1} + \ldots\ldots + c$], one with the raffinate phase (order n= 3) and one with the extract phase data (order 2) using polyfit function. [5]
b. Plot the actual points in blue circles for the raffinate phase (only raffinate phase or water rich phase) and predicted points in red circles [using the polynomial that you have fitted for the raffinate phase]. Plot the polynomial using points from 0.003 to 0.13 in an interval of 0.001. [5]
c. The slope of 5 tie lines are given as follows:
[-0.0052 -0.0162 -0.0443 -0.0849 -0.1758]. You need not to draw the existing tie lines.
Suppose for the first stage the mixture point M1 is given by $x_{c,M}$=0.19, $x_{B,M}$ =0.45. Using these slopes calculate the slope through the point Mx=0.45, My=0.19. What is the equation for this tie line? Based on this find the composition of raffinate and extract from stage 1 using vpasolve/fsolve function. And show the tie line through M1 point. [25]
d. Calculate the flow rate of the raffinate and extract for this stage [stage 1] using solve function.
e. Suppose you want to use the same flow rate for solvent (S) for three stages [Please do not use the solvent scheme mentioned in the problem above] . Plot the removal of solute [solutes present in extract phases] as a function of solvent amount in each stage [from 600 to 840 kg, in an interval of 20]. Also determine the solute removed [in E1, E2 and E3 phases] at each stage in the **equal sovent ineach stage** scheme.

Hints:
LLE data

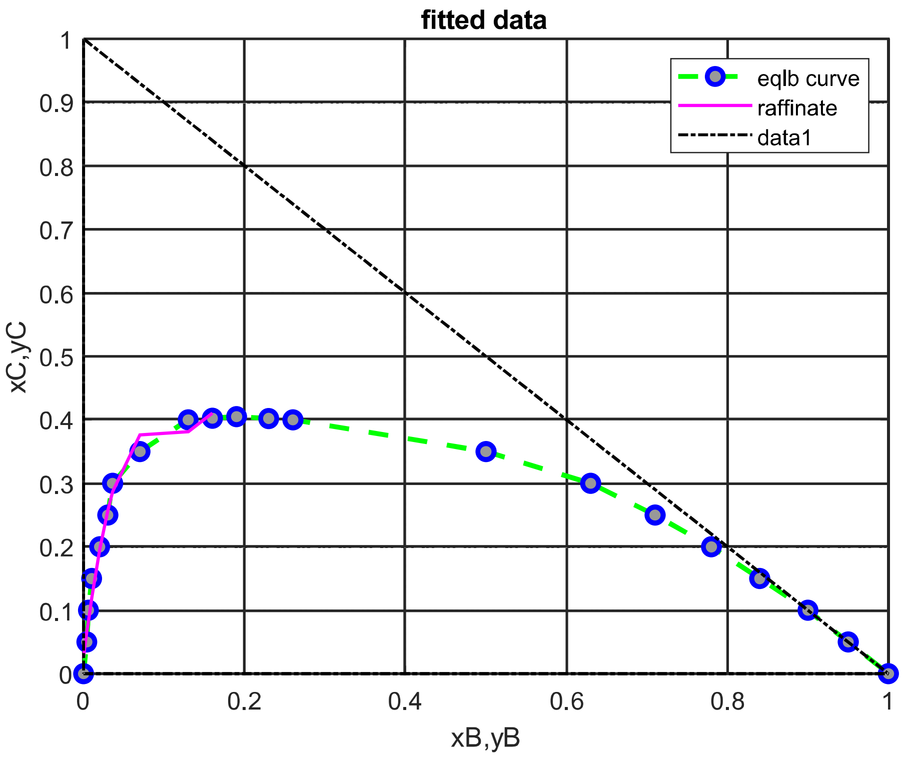
```
B = [0 0.004 0.006 0.01 0.02 0.03 0.036 0.07 0.13 0.16 0.19 0.23 0.26 0.5 0.63 0.71 0.78 0.84 0.9 0.95 ];
C = [0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.4025 0.405 0.402 0.4 0.35 0.3 0.25 0.2 0.15 0.1 0.05 ];
```

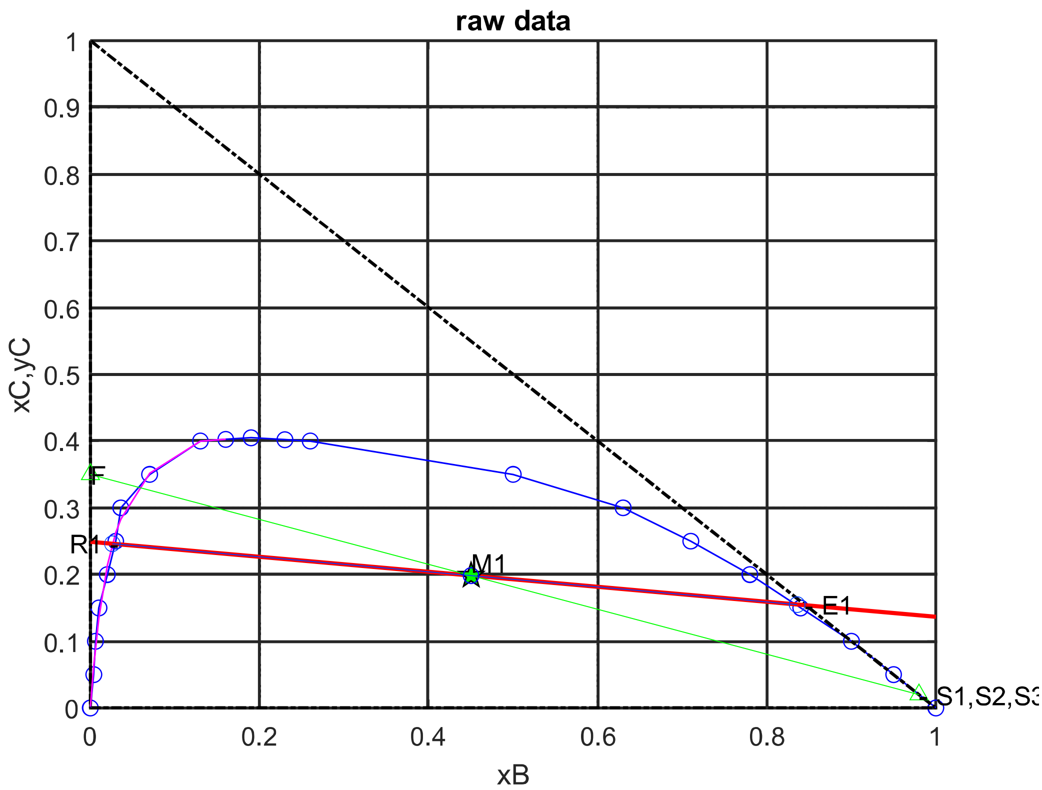
FS line

```
F1 = [0 0.995];
S1 = [0.5 0.005];
plot(F1,S1,'g^-','linewidth',0.35)
text(0,0.5,'F')
text(0.995,0.005,'- S')
```

tie line intervals

```
if  ((0 < My) && (My <= 0.04));
      slope = 0 + (My - 0)*tie_slope(1)/(0.04);

   elseif((0.04< My) && (My <= 0.083));
      slope = tie_slope(1) + (My - 0.04)*tie_slope(2)/(0.083 - 0.04);

   elseif ((0.083 < My) && (My <= 0.13));
      slope = …………………………

   elseif ((0.13 < My) && (My <= 0.215));
      slope = ……………………………

   elseif ((0.215 < My) && (My <= 0.395));
      slope = ……………………………..

   elseif((My > 0.395));
      slope = tie_slope(5) + (My - 0.395)*(-0.155)/(0.4 - 0.395);

   end
```


fitted data
eqlb curve
raffinate
data1
xC,yC
xB,yB
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.2
0.4
0.6
0.8


raw data
xC,yC
xB
F
R1
M1
E1
S1,S2,S3
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.2
0.4
0.6
0.8