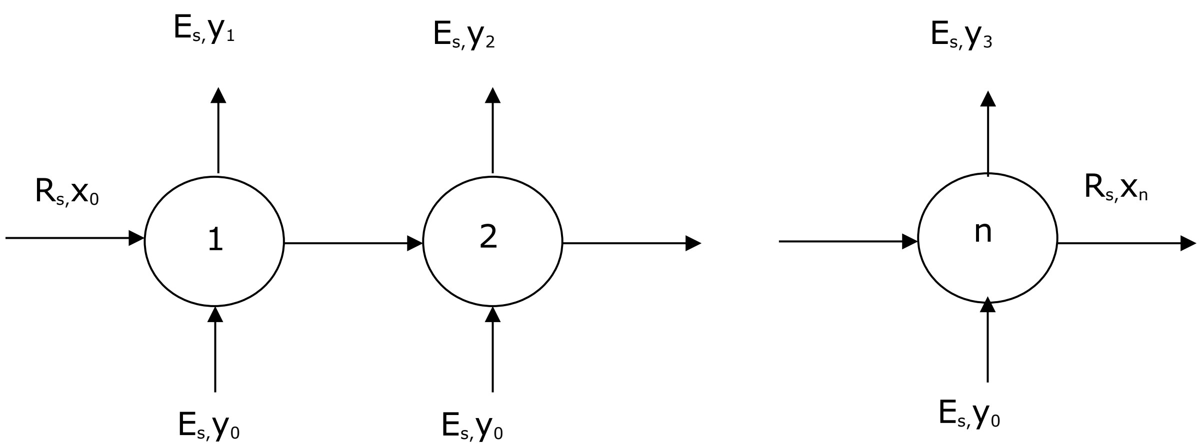
1. Liquid-liquid extraction: multistage crosscurrent extraction, insoluble liquids



The equilibrium distribution of the solute C between solvents A and B (upto 30% of C in solution of A) is given by, Y=3.7X. X and Y are concentration of C in A and B respectively, both in the mass ratio unit (i.e. mass of the solute per unit mass of solute free solvent). The solvents A and B are practically immiscible (insoluble liquids).

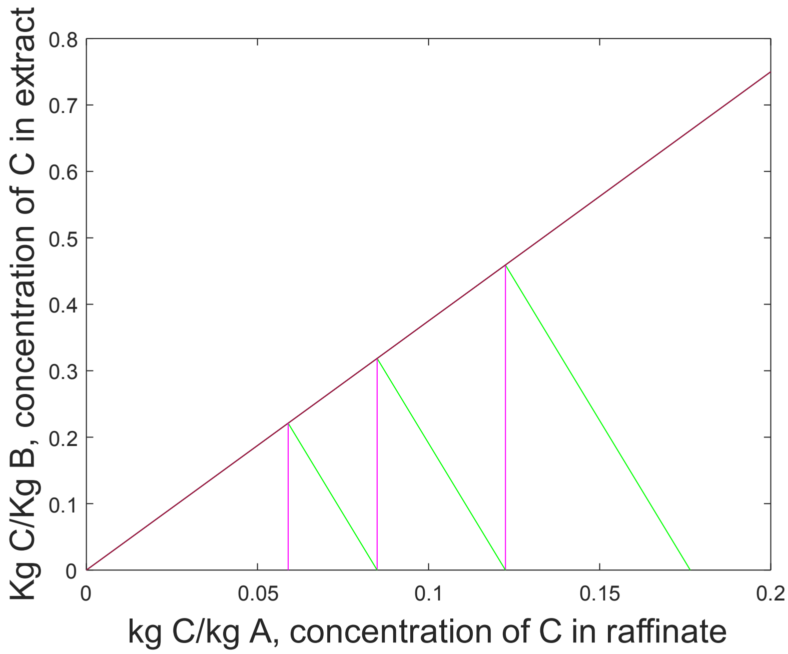
1. It is required to calculate the amount of solvent B required to separate 95% of C from 1000 kg of a 15% (by mass) solution of C in A for the following separation schemes. (b) an ideal three stage crosscurrent contact, the amount of the solvent used in each stage being equal. Since it is not possible to draw the slope [as the solvent level is not mentioned I the problem], we need to find the percentage removal for various amount of solvent/stage.

A: Generate the equilibrium data using x from 0 to 0.2 with an interval of 0.01 and plot concentration of solute in extract vs concentration of solute in raffinate.

```
x=
y=
plot(x,y);
xlabel('kg C/kg A, concentration of C in raffinate','Fontsize',16), ylabel('Kg C/Kg B, concentration of C in extract','Fontsize',16);
```

B. Keeping a while loop, construct three by drawing the operating line through the feed point and calculate the composition of extract and raffinate for stage i. [as shown in figure in the next page]
C: Plot the stage construction (n=3) for various values of solvent using a for loop in solvent amount.
D: Plot the percentage removal of the solute C as a function of solvent amount/stage [in the range of 250 kg to 500 kg].

Construction of stages for liquid-liquid extraction for insoluble liquids



STEP 1: Put the counter for solvent amount used. Put the for loop for solvent amount. Store the solvent amount in an array with the counter for solvent.

STEP 2: Assignment of values for solvent amount, feed composition, feed rate (R) and solvent rate (E)

1. l=1000;
2. x0 = 0.15;
3. y0 = 0;
4. R = …..;
5. E = ….;
6. X0 = x0/(1-x0);
7. Y0 = y0/(1-y0);

%Calculation of slope for the operating line for stages

8. slope = ….;

STEP 3; Initial concentration of the raffinate

9. x_init = ;
10. y_init = ;
11. p = 0;

STEP 4: Put the condition (while loop)

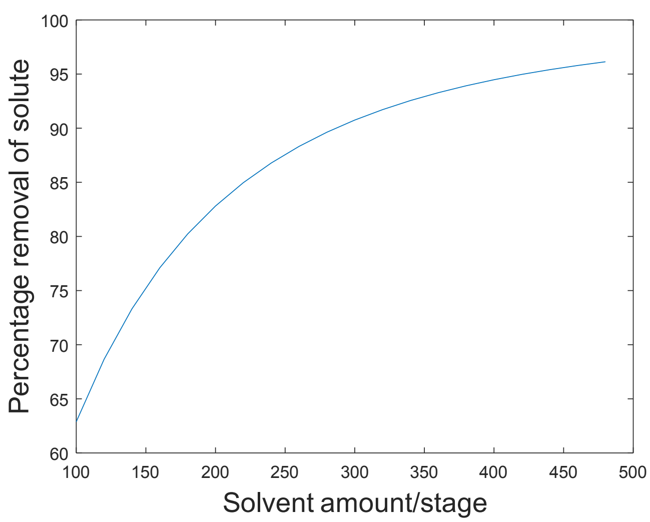
```
        %We have two equations for finding composition at each stage
    syms y_new x_new
    [x_new,y_new] = solve(…………… , …………., x_new,y_new);
    x_next = double(x_new);
    y_next = double(y_new);
    figure(10*j0+j0)
    plot(…,…);
 xlabel('kg C/kg A, concentration of C in raffinate','Fontsize',16), ylabel('Kg C/Kg B, concentration of C in extract','Fontsize',16);
    hold on;
    plot([…., ….],[….,…..],'g-');
    hold on;
    x_init = ….;
    y_init = …;
    plot([…., …..],[….,….],'m-');
    hold on;
% p is the counter for stages
    p=….;

end
```

STEP 5: Calculation of solute removal for a particular amount of solvent

```
xout(j0)= (x_init)/(x_init+1);
sol = …..;
rem_sol(j0)= …….;
premoval(j0) = ((sol-rem_sol(j0))*100)/sol;
% j0 is the counter for solute amount in each stage
j0=……;
end
```

STEP 6: Constructing the curve for percentage solute removed as a function of solvent amount in each stage.

```
figure(2)
plot(…….,…..);
xlabel('rate','Fontsize',16), ylabel('Percentage removal of solute','Fontsize',16);
hold on;
```



Use for loop instead of while loop for stage construction and save all the compositions of raffinate and extract in each stage.