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Here I have shown how to code for the Stead-State Material Balance on a Separation Train.

Contents

Defining the Constants :

Here I have defined the constant compositions that are used to solve the equations of Mass Balance :

```
%The row vectors are in the order : D1,B1,D2,B2 are the respective
%compositions according to the question
xf1 = [ 15 ; 25 ; 40 ; 20 ]/100 ;
xd1 = [ 7 ; 4 ; 54 ; 35 ]/100 ;
xb1 = [ 18 ; 24 ;  42 ; 16 ]/100 ;
xd2 = [ 15 ; 10 ; 54 ; 21 ]/100 ;
xb2 = [ 24 ; 65 ; 10 ; 1 ]/100 ;
F = 70 ;        % mol/min, Feed Flowrate
```

Solving for the Feed Column :

Here I will find the molar flowrates of each species :

```
%Solving the System of Linear Equations defined below :
lin_sys = [ xd1 xb1 xd2 xb2 ] ;
flow_sol = F*inv(lin_sys)*xf1 ;
d1 = flow_sol(1) ; b1 = flow_sol(2);
d2 = flow_sol(3) ; b2 = flow_sol(4);
mol_flow_rates = [d1;b1;d2;b2];
d = d1+d2 ; b = b1+b2 ;
```

Solving for Second Column :

Here I will find the compositions of each species in #2 column :

```
%Defining the funcion to solve the equations :
F1 = @(x) [ x(1)*(d1+b1) - xd1(1)*d1 - xb1(1)*b1;
            x(2)*(d1+b1) - xd1(2)*d1 - xb1(2)*b1;
            x(3)*(d1+b1) - xd1(3)*d1 - xb1(3)*b1;
            x(4)*(d1+b1) - xd1(4)*d1 - xb1(4)*b1; ] ;
x0 = [ 0.1 ; 0.1 ; 0.1 ; 0.1] ;
options = optimoptions('fsolve','Display','None');
xd = fsolve(F1,x0,options) ;
```

Solving for Third Column :

Here I will find the compositions of each species in #3 column :

```
%Defining the funcion to solve the equations :
F1 = @(x) [ x(1)*(d2+b2) - xd2(1)*d2 - xb2(1)*b2;
            x(2)*(d2+b2) - xd2(2)*d2 - xb2(2)*b2;
            x(3)*(d2+b2) - xd2(3)*d2 - xb2(3)*b2;
            x(4)*(d2+b2) - xd2(4)*d2 - xb2(4)*b2; ] ;
x0 = [ 0.1 ; 0.1 ; 0.1 ; 0.1] ;
xb = fsolve(F1,x0,options) ;
```

Displaying Results :

```
streams = ['D1';'B1';'D2';'B2' ] ;
tab1 = table(streams,[mol_flow_rates],'VariableNames',{'Stream','Molar Flowrate, mol/min'});
species = ["Xylene";"Styrene";"Toluene";"Benzene"];
tab2 = table(species,xd,xb,'VariableNames',{'Compound','Stream D','Stream B'});
disp(" Below is the Flowrates of each stream : ");
disp(tab1);
disp(" Below is the Composition of each stream : ");
disp(tab2);
```

```
 Below is the Flowrates of each stream :
    Stream    Molar Flowrate, mol/min
    ______    _______________________

      D1                26.25
      B1                 17.5
      D2                 8.75
      B2                 17.5

 Below is the Composition of each stream :
    Compound     Stream D    Stream B
    _________    ________    ________

    "Xylene"      0.114          0.21
    "Styrene"      0.12       0.46667
    "Toluene"     0.492       0.24667
    "Benzene"     0.274      0.076667
```

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