**Example**

Using the following equilibrium data for the n-pentane and n-hexane system for calculating the relative volatility of each concentration and plotted it versus the liquid composition.

XA 1 0.867 0.591 0.398 0.254 0.145 0.059

YA 1 0.984 0.925 0.836 0.701 0.521 0.221

Solution

XA + XB =1 and yA + yB =1

αAB = (yA / xA ) / ( yB / xB) = yA xB / yB xA = yA ( 1-xA) / xA (1-yA)

At XA =1 , yA =1 then αAB = 1( 1-1) / 1(1-1) = 0/ 0

At XA = 0.817 , yA =0.984 then αAB  0.984( 1-0.867) / 0.867 (1-0.984) = 9.43

XA 1 0.867 0.591 0.398 0.254 0.145 0.059

YA 1 0.984 0.925 0.836 0.701 0.521 0.221

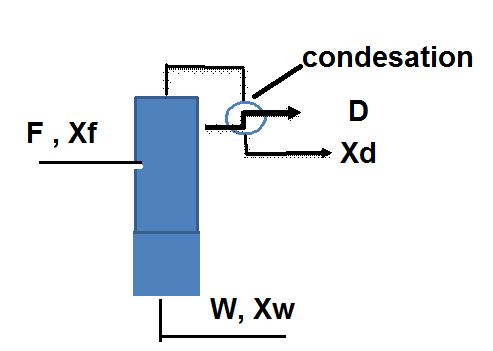
αAB 0/0 9.43 8.42 7.71 6.88 6.41 5.92

( αAB ) average ( 9.43 + 8.42 + 7.71 + 6.88 + 6.41 + 5.92 ) / 6 = 7.46

**Non-Continuous / Differential distillation**

**The simplest example of batch distillation is a single stage, differential distillation, starting with a still pot, initially full, heated at a constant rate. In this process the vapour formed on boiling the liquid is removed at once from the system .**

**If S is the number of moles of material in the still, x is the mole fraction of component A and an amount dS, containing a mole fraction y of A, is vaporised, then a material balance on component A gives:**

****

**F= D+W then D = F-W , D X d =F X f – W X w where X d, X f, X w mole fraction of volatile material at distillate, feed and waste materials .**

**Xd = F X f – W X w / D X d ˃ X f  ˃ X w**

**If S is the number of moles of material in the still , XA is the mole fraction of component A and an amount ds , containing the mole fraction yA is the vaporized , then a material balance on component A gives**

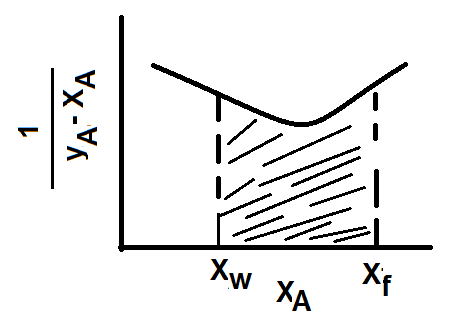
**yA dS = d (S XA) [ yA dS = Sd XA + XA dS ] by dividing S**

**yA (dS / S) = d XA + XA (dS / S) yA (dS / S) - XA (dS / S) = d XA**

**(yA - XA)(dS / S) = d XA  **

**The integral on the right- hand side of this equation may be solved graphically, if the eq. relationship between yA and XA is available**

1. **Graphically by area under the curve**



1. yA= m XA +C , ln w / F = 1 / m-1 ln [ (m-1) X m +C / (m-1) X f +C ] , m=slope , C=0 or

w / F = ( yw-Xw / yF-XF ) 1/ m-1 where Xw (m-1) = yw - Xw  and

XF(m-1)= y F -XF

1. if the equation data is given through relative volatility αAB assumed constant , then yA = αAB XA / ( 1+ (αAB-1)XA and substitute in to