**Packed Column with Straight Operating Line and Straight Equilibrium Line**

* Countercurrent operation with liquid entering at the top and gas at the bottom.
* Integral for NTU can be evaluated analytically. Results are shown here, along with the appropriate equation numbers.
* Can use overall coefficients since there is no additional penalty for doing so.

**For mV/L = 1 (Operating and equilibrium lines are parallel)**

16-31

**For mV/L ≠ 1 (Operating and equilibrium lines straight, but not parallel)**

16-34a ,where

16-34b

Note that is the mole fraction in the vapor that would be in equilibrium with the liquid entering at the top of the column

A similar expression can be written in terms of the liquid

16-34b ,where

16-35b

Remember that we have assumed countercurrent flow with the liquid entering at the top and the gas at the bottom.

The HTU values are obtained from measurements or correlations.

Example Problem

Water is to be used to remove ammonia from an air stream containing 1% ammonia by volume. The water entering the column contains no ammonia. The mole fraction of ammonia in the effluent gas must be less than 0.000001. The equilibrium relationship is linear with y/x = 0.85. The flow rate of gas is 1000 lbmol/hr. The column operates at 1 atm and 72oF.

Density of water: 62.3 lbm/ft3

Density of air: 0.074 lbm/ft3

Molecular weight of air: 29

Molecular weight of water: 18

HOG = 1.25ft

* 1. Determine the liquid flow rate (lbmol/hr) and the mole fraction of ammonia in the liquid leaving the column.

(L/V)min = 0.8499; L = 1190 lbmol/h; xout = 0.0084

* 1. Determine the height of a packed column to perform this separation. Assume that the packed column operates at 70% of flooding and contains 1.5 in Berl saddles.

