6.2.1 Determination of the limiting concentration X_l

In Fig. 6.5c the straight line tangent to the curve F_v and passing through X_l can be written as:

$$F = m\cdot(X - X_r) \qquad (6.16)$$

Where:

m = gradient of the straight line = $(dF/dX)_{X=Xl} = v_0\cdot(1 - k\cdot X_l)\cdot\exp(-k\cdot X_l)$

At the tangential point, the value of curve F_v is equal to the value of the straight line so that:

$$F = (X_l - X_r)\cdot v_0\cdot(1 - k\cdot X_l)\cdot\exp(-k\cdot X_l) = X_l\cdot v_0\cdot\exp(-k\cdot X_l) \text{ or}$$

$$X_l = (X_r/2)\cdot[1 + (1- 4/(k\cdot X_r))^{0.5}] \qquad (6.17)$$

Now the limiting flux can easily be determined as the value of vertical axis of the straight line Eq. (6.16) for X = 0 (see Fig. 6.5c):

$$F_l = m\cdot X_r = X_r\cdot v_0\cdot(k\cdot X_l - 1)\cdot\exp(-k\cdot X_l) \qquad (6.18)$$

Where X_l is given by Eq. (6.17)

Using Fig. 6.5c, the downward velocity of the liquid phase in the lower part of the settler is given by:

$$u = F_l/X_r = v_0\cdot(k\cdot X_l - 1)\exp(-k\cdot X_l) \qquad (6.19)$$