6.2.2 Determination of the critical concentration X_c

The tangential straight line passing through the point X_c at the horizontal axis is also described by (6.16), but the gradient of the line is now maximum as in Fig. 6.6. Hence:

$$(dm/dX) = (d^2F_v/dX^2)_{x=xi} = 0 \text{ or } X_i = 2/k \text{ and } F_i = 2 \cdot v_0/(k \cdot e^2) \quad (6.20)$$

Where:

X_i = sludge concentration at the inflection point of curve F_v
F_i = batch settling flux at the inflection point of F_v
e = natural logarithm basis ≈ 2.71

The gradient of the straight line through (X_i, F_i) and (X_c, 0) is equal to the derivative of F_v at (X_i, F_i):

$$m = (dF_v/dX)_{X=2/k} = -v_0/e^2 \quad (6.21)$$

Hence, the straight line is given by:

$$F - 2 \cdot v_0/(k \cdot e^2) = -v_0/e^2 \cdot (X - 2/k) \text{ or } F = -(v_0/e^2) \cdot (X - 4/k) \quad (6.22)$$

Now, the critical concentration can be determined, knowing that F = 0 when X = X_c:

$$X_c = 4/k \quad (6.23)$$

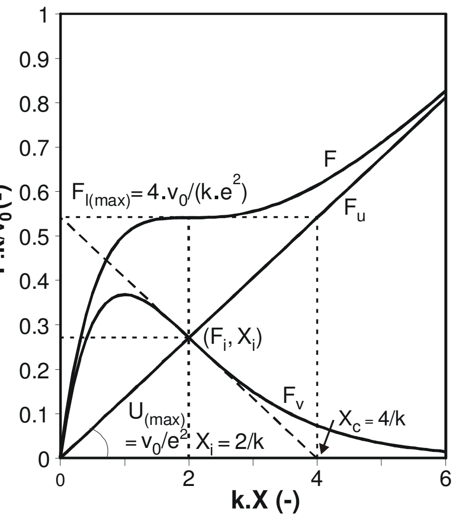

Figure 6.6
F_v and F_u curves as functions of the sludge concentration for $X_r = X_c = 4/k$ (the coordinates are adimensional)

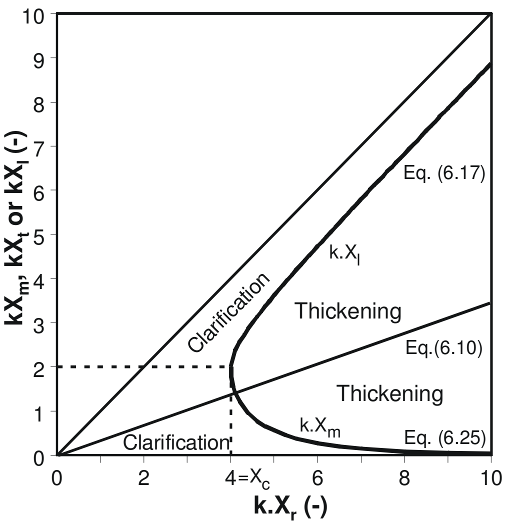

Figure 6.7
$k \cdot X_l$ and $k \cdot X_m$ values as functions of $k \cdot X_r$, showing whether clarification or thickening is the limiting process