DISCRETIZATION OF THE TWO-PHASE PRESSURE & SATURATION EQUATIONS

PRESSURE EQUATION :

$$\frac{\partial}{\partial x}\left[\lambda_T(S_o)\left(\frac{\partial P}{\partial x}\right)\right] = 0$$

SATURATION EQUATION

$$\phi\left(\frac{\partial S_o}{\partial t}\right) = \frac{\partial}{\partial x}\left[\lambda_o(S_o)\left(\frac{\partial P}{\partial x}\right)\right]$$

After applying finite differences to each equation we get :

PRESSURE EQUATION :

$$\frac{(\lambda_T(S_o^{n+1}))_{i-1/2}}{\Delta x^2} P_{i-1}^{n+1} - \left[\frac{(\lambda_T(S_o^{n+1}))_{i-1/2}}{\Delta x^2} + \frac{(\lambda_T(S_o^{n+1}))_{i+1/2}}{\Delta x^2}\right] P_i^{n+1} + \frac{(\lambda_T(S_o^{n+1}))_{i+1/2}}{\Delta x^2} P_{i+1}^{n+1} = 0$$

SATURATION EQUATION (Form A)

$$S_{o_i}^{n+1} = S_{o_i}^{n} + \frac{\Delta t}{\phi}\left\{\left[\frac{(\lambda_o(S_o^{n+1}))_{i+1/2}}{\Delta x^2}\left(P_{i+1}^{n+1} - P_i^{n+1}\right)\right] - \left[\frac{(\lambda_o(S_o^{n+1}))_{i-1/2}}{\Delta x^2}\left(P_i^{n+1} - P_{i-1}^{n+1}\right)\right]\right\}$$