

CONSTITUTIVE PARAMETERS

For the settling scenario without creep, the compressibility and permeability relationships can be defined as stationary functions using constitutive parameters that do not change with time. For the case scenario without creep, computer program ConCreep_01 adopts relationships from CONDES0 (see Yao and Znidarcic 1997)

In CONDES0, the compressibility relationship is expressed as:

$$e = A(\sigma' + Z)^B \quad (2)$$

where A, B and Z are the constitutive (model) parameters.

The hydraulic conductivity is defined as:

$$k = C e^D \quad (3)$$

where C and D are the constitutive (model) parameters.

To account for the creep mechanism, ConCreep_01 allows for the constitutive parameters A, B and Z to change with time. I.e., to describe the creep behavior observed in laboratory experiments on tailings samples, A and B are expressed as the algebraic functions of time. The following relationships are adopted in the ConCreep_01 program:

$$A = A(t) = Af + (A0 - Af) \left\{ a1 \left[\left(\frac{1}{a1} \right)^{\frac{1}{a2}} + t \right]^{a2} \right\} \quad (4)$$

$$B = B(t) = Bf + (B0 - Bf) \left\{ b1 \left[\left(\frac{1}{b1} \right)^{\frac{1}{b2}} + t \right]^{b2} \right\} \quad (5)$$

and

$$Z = Z(t) = Zf + (Z0 - Zf) \left\{ z1 \left[\left(\frac{1}{z1} \right)^{\frac{1}{z2}} + t \right]^{z2} \right\} \quad (6)$$

Equations (4), (5) and (6) allow for the time-dependency of constitutive properties A, B and Z by introducing additional (creep) parameters. At time equal to zero, parameters A, B and Z are defined by their initial values A0, B0 and Z0. Experimental evidence suggests that there is a limit in the change of parameters A, B and Z. Therefore, parameters Af, Bf and Zf are introduced to define the final (limiting values) of parameters A, B and Z at infinite time. Parameters a1 and a2 are defined by fitting laboratory data to Equation (4), i.e. by finding the “best-fit” of a1 and a2 to match the values of A=A(t) determined at selected (discrete) time increments. Similarly, parameters b1 and b2 in Equation (5) are matched to the values of B=B(t), and parameters z1 and z2 are matched to the values of Z=Z(t) in Equation (6), based on laboratory compressibility measurements at selected time increments. Selected parameters A0, B0, Z0, Af, Bf, Zf, a1, b1, z1 and a2, b2, z2 are used in ConCreep_01 to account for changes in the material compressibility due to creep.