Solution Mining Research Institute Spring 2022 Technical Conference

Rapid City, South Dakota, USA 4-5 May 2022

Steady-State Creep is Deficient in Modeling Deformations in Salt and Potash Structures

Jack Chieslar, AES Inc. Piedmont, South Dakota, USA

Abstract

Steady-state creep has increasingly been deemed sufficient for the modeling of salt and potash structures, largely because this is the closest or most relevant constitutive model offered by commercial software. While this response is dominant it is not adequate. The creep transient as well as dilation contribute meaningfully to the deformation. A simple constitutive model, compounding creep and damage mechanics, is fit to routine laboratory test data, including creep, dilation and tensile limits. This model captures the essence of these tests without resort to more complex phenomenological constitutive models. Example simulations are provided for room-and-pillar as well as solution mines. Each is run as a steady-state creep, a steady-state plus transient creep, and a steady-state plus transient creep plus damage (dilation) simulation. Closures are compared over time. These highlight the importance of the transient creep as well as the dilation in contributing to deformations. Furthermore, if a failure criterion is to be considered, the amount of damage strain (dilation) is the most suitable candidate.

Keywords: Alberta, Bedded Salt Deposits, Canada, Caverns for Liquid Storage, Caverns for Waste Disposal, Computer Modeling, Potash, Rock Mechanics, Rock Salt and Potash Mining, Saskatchewan, Waste Isolation Pilot Plant (WIPP)