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ANALYTICAL SOLUTIONS FOR STRESS DISTRIBUTIONS AND CREEP CLOSURE AROUND OPEN-HOLES OR CAVERNS USING A MULTILINEAR SEGMENTED CREEP LAW

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Abstract

Creep is the dominant deformation mode for open-hole wells or caverns created in salt deposits. Creep is a multimechanism deformation process that primarily depends on the stress distributions and rock temperature. The stress distribution around the structure also depends on the creep mechanism involved. Certain ranges of stress magnitude and temperature have their dominant creep mechanism, but at the overlap of these ranges, the mechanisms may contribute equally (the individual deformation contributions by mechanism are additive). This complex mathematical representation of creep can be simplified by using a piece-wise linear (or multilinear segmented) representation of the additive multimechanism creep law. Previous publications by these authors and others (e.g., Dr. Pierre Berest) have developed stress distribution and closure rate solutions for both single- and two-mechanism creep laws around cylindrical and spherical openings. This paper develops a more general solution for multilinear creep law with three or more power-law segments. This analytical generality allows quick estimation of the influence posed by using a particular combination of "stress to the power" ranges with different stress exponents. The solution is presented in terms of equations that easily adapt to a spreadsheet formulation. Examples of the influence of a combination of power-law creep segments are also presented.

Keywords: Creep, Stress Distribution, Multimechanism Creep Law, Caverns, Wells