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Developments on the Relationship Between Pore Pressure and Salt Deformation

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Abstract

The influence of pore pressure on the elastic deformation of geologic materials is well understood, and for almost a century students of geomechanics have validated the theories developed by Terzaghi, Biot, and others that describe how pore pressure affects the deformation of rocks. This field of study has become known as poromechanics, and the fundamental premise for elastic-poromechanic theory is that an *effective* stress exists that is a function of the difference between the total stress in the solid portion of a material and the fluid pressure in the material pore space. However, a widely-accepted theory on how the effective stress influences the ductile (time dependent) deformation of geologic materials, such as rock salt, does not exist.

This paper discusses shortcomings of the current effective-stress concept as it pertains to the ductile deformation of rock salt. An overview of recent experimental results will be provided that illustrates how porosity and pore pressure change the deformation rate of rock salt. Following this, a conceptual explanation for the observed experimental results is provided and a proposed poromechanical constitutive model is presented. Based on the presented experimental results and constitutive model, conclusions are made regarding how an effective stress can influence the stability of a cavern in salt.

Key words: Pore Pressure, Effective Stress, Constitutive Model