SOLUTION MINING RESEARCH INSTITUTE

679 Plank Road
Clifton Park, NY 12065, USA

Telephone: +1 518-579-6587
www.solutionmining.org

Technical Conference Paper

Microstructural Investigation of Heterogeneous Rock Salt Permeation: Unraveling the influence of Anhydrite and Mega-Grain content on Fluid Transport

Joyce Schmatz, Eva Wellmann, Mingze Jiang, Jop Klaver

Microstructure and Pores GmbH, Junkerstraße 93, 52064, Aachen, Germany

Richard R. Bakker, Marinus den Hartogh

Nobian Industrial Chemicals B.V., Van Asch van Wijckstraat 53, 3811 LP Amersfoort, The Netherlands

Johannes Herrmann, Christopher Rölke and Dirk Naumann

IfG - Institut für Gebirgsmechanik GmbH, Friederikenstraße 60, 04279 Leipzig, Germany

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Microstructural Investigation of Heterogeneous Rock Salt Permeation: Unraveling the influence of Anhydrite and Mega-Grain content on Fluid Transport

Joyce Schmatz[1], Richard Bakker[2], Johannes Hermann[3], Eva Wellmann[1], Christopher Rölke[3], Dirk Naumann[3], Mingze Jiang[1], Jop Klaver[1], Marinus den Hartogh[2]

1Microstructure and Pores GmbH, Junkerstraße 93, 52064, Aachen, Germany, 2Nobian Industrial Chemicals B.V., Van Asch van Wijckstraat 53, 3811 LP Amersfoort, The Netherlands, 3Institut für Gebirgsmechanik GmbH, Friederikenstraße 60, 04279 Leipzig, Germany

Abstract

This study investigates the micro-scale process of permeation behaviour. Permeation is crucial in governing long-term cavern pressure post-abandonment, which is considered crucial for reliable numerical modelling of cavern pressure evolution. Uncertainties persist regarding the most suitable permeation model for upscaling from grain-size to field scales. The investigation focuses on microstructural analyses of laboratory permeation tests conducted on heterogeneous natural rock salt samples. These tests were designed to assess hydraulic properties under varying effective stresses, emphasizing the impact of anhydrite inclusions and mega-grains on fluid flow within the salt matrix. Utilizing a radial flow geometry within a standard triaxial apparatus, experiments were conducted over 30-50 days using saturated brine as the fluid medium while applying a differential stress of 1 MPa. Microstructural analysis integrated micro-CT, optical microscopy, and SEM techniques, providing insights into the intricate pore networks and internal structure of rock salt. Findings highlight preferred permeation pathways such as the interfaces of halite mega-grains with matrix grains and/or with thin anhydrite bands, which can be the dominating pathway compared to also present dilatant matrix-halite grain boundary networks. These results offer valuable insights into permeation behaviour of rock salt, particularly under saturated brine conditions, contributing to a deeper understanding of cavern pressure dynamics and improving future modelling efforts.

Key words: heterogeneous salt, permeation processes, microstructures, laboratory testing, long-term creep behavior, axial (differential) stress, confining pressure, temperature