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Technical Conference Paper

Laboratory Investigations of Fracture Propagation in Rock Salt in Hollow Test Specimens – LARISSA Research Project

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Abstract

Since 2021, the 'LARISSA' project at the Institute of Geotechnical Engineering (Dept. IUB) has been researching the stress conditions where macroscopic fractures occur on rock salt under laboratory conditions. For this purpose, hollow cylindrical test specimens are used. These are loaded with an axial load and a circumferential pressure on the one hand, and an internal pressure generated by nitrogen inside the test specimen on the other hand.

The stress and pressure conditions in the laboratory can be simulated in the order of magnitude of the in-situ conditions of a cavern. At a constant internal and circumferential pressure, the axial stress is reduced during the testing scheme. The condition thus created represents the stress state at a cavern wall during temperature reduction due to a gas withdrawal in a simplified way, leading to the fracture of the specimen in the experiments. These processes of fracture propagation are investigated location-specifically, since it is to be expected that different rock salt formations also behave differently with respect to their hydro-mechanical properties.

The setup and procedure of the ongoing laboratory experiments in 'LARISSA' are described in this paper. Additionally, the obtained test results for rock salt samples from Avery Island are presented and discussed together with further tested specimens from other locations. The Avery Island specimens show predominantly similar stress-strain curves during the axial unloading phase at different initial stress conditions. The measured effective tensile stresses leading to rupture show differences in magnitude depending on the initial stress state and location, ranging from 0.99 MPa (144 psi) to 4.87 MPa (706 psi). A temperature dependency of the required effective tensile stresses leading to the rupture of the specimen in laboratory experiments cannot be observed yet.

Keywords: rock mechanics, infiltration fractures, thermodynamics, gas storage, rock salt caverns, effective tensile stress