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ACOUSTIC MONITORING OF THERMO-MECHANICAL TESTS IN A SALT MINE

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Abstract

The natural gas storage in salt caverns requires faster injection withdrawal cycles due to the increasing dynamics of the energy market. These cycles induce rapid changes in the internal pressure of the stored gas causing important temperature changes that can damage the rock salt mass. Several theoretical studies have been conducted to estimate this type of damage (Brouard et al, 2011; Sicsic and Berest, 2014). To experimentally observe this damage, the Solution Mining Research Institute (SMRI) has cofounded the Starfish project between 2013 to 2016 and led by Storengy in partnership with Mines-ParisTech, INERIS and the Salins du Midi. The main objective of this project was to initiate and characterize the damage by purely thermal stresses at the surface of a large bloc of salt partially slotted in a rock mass of the salt Mine of Varangéville (France). This was to determine the type of failure mechanism involved, the nature and extent of the cracks induced, as well as amplification of the damage of the solid mass with repeated cooling stages.

The salt being favorable to the generation of Acoustic Emissions (AE) and the propagation of the stress waves, acoustic monitoring has been chosen as one of the methods to follow the impact of the salt cooling. In addition to thermal and mechanical sensors, an acoustic monitoring device consisting of 16 ultrasonic sensors has been installed on the free surface and in boreholes. It enabled to record and locate a large number of AE (58,426) with good accuracy (2.5 cm or 1 in). Those AE can be correlated to the evolution of salt fracturing. Acoustic monitoring provided a very good insight in the physics of the damaging process and quantitative answers to the three issues mentioned here above.

Key words: Instrumentation and Monitoring, Seismic, Underground mine, Gas Storage, Rock Mechanics, France