Thermo-Mechanical Modelling of Gas Storage Applications in Salt Caverns

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ABSTRACT

This work summarizes the development of a numerical model for simulating the thermo-mechanical behaviour of salt caverns during cyclic gas storage. Salt caverns can be used for short term energy storage applications such as power-to-gas or compressed air energy storage. Those applications are characterised by highly fluctuating operation pressures. Compression and expansion of gases during loading and unloading stages may lead to major temperature amplitudes within the cavern interior. The rapidly changing temperatures affect the material behaviour of the host rock within a zone that extends several meters into the rock mass adjacent to the cavern wall, induce thermo-mechanical stresses and alter the creep response.

The proposed model features the thermodynamic behaviour of the storage medium, conductive heat transport in the host rock, as well as temperature dependent material properties of rock salt using different thermo-visco-plastic material models [1,2]. The utilized constitutive models are well known and state-of-the-art in various salt mechanics applications. The model has been implemented into the open-source software platform OpenGeoSys [3]. Thermal and mechanical processes are solved using a finite element approach, connected via a staggered coupling scheme.

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