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The Influence of Bentonite on the Rheology of Geothermal Grouts

Authors : A. N. Ghafar, O. A. Chaudhari, W. Oettel, P. Fontana

Abstract : This study is a part of the EU project GEOCOND-Advanced materials and processes to improve performance and cost-efficiency of shallow geothermal systems and underground thermal storage. In heat exchange boreholes, to improve the heat transfer between the pipes and the surrounding ground, the space between the pipes and the borehole wall is normally filled with geothermal grout. Traditionally, bentonite has been a crucial component in most commercially available geothermal grouts to assure the required stability and impermeability. The investigations conducted in the early stage of this project during the benchmarking tests on some commercial grouts showed considerable sensitivity of the rheological properties of the tested grouts to the mixing parameters, i.e., mixing time and velocity. Further studies on this matter showed that bentonite, which has been one of the important constituents in most grout mixes, was probably responsible for such behavior. Apparently, proper amount of shear should be applied during the mixing process to sufficiently activate the bentonite. The higher the amount of applied shear the more the activation of bentonite, resulting in change in the grout rheology. This explains why, occasionally in the field applications, the flow properties of the commercially available geothermal grouts using different mixing conditions (mixer type, mixing time, mixing velocity) are completely different than expected. A series of tests were conducted on the grout mixes, with and without bentonite, using different mixing protocols. The aim was to eliminate/reduce the sensitivity of the rheological properties of the geothermal grouts to the mixing parameters by replacing bentonite with polymeric (non-clay) stabilizers. The results showed that by replacing bentonite with a proper polymeric stabilizer, the sensitivity of the grout mix on mixing time and velocity was to a great extent diminished. This can be considered as an alternative for the developers/producers of geothermal grouts to provide enhanced materials with less uncertainty in obtained results in the field applications.

Keywords : flow properties, geothermal grout, mixing time, mixing velocity, rheological properties
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