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Geochemical modelling of EGS fracture stimulation applying weak and strong acid treatments

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Engineered Geothermal systems (EGS) provide geothermal power by tapping into the Earth's deep geothermal resources that are otherwise not exploitable due to lack of water and fractures, location or rock type. EGS technologies have the potential to cost effectively produce large amounts of electricity almost anywhere in the world.

The EGS technology creates permeability in the rock by hydro-fracturing the reservoir with cold water pumped into the first well (the injection well) at a high pressure. The second well (the production well) intersects the stimulated fracture system and returns the hot water to the surface where electricity can be generated. A significant technological hurdle is ensuring effective connection between the wells and the fracture system and to control the deep-rooted fractures (can exceed 5 000 m depth). A large area for heat transfer and sufficient mass flow needs to be ensured between wells without creating fast flowing paths in the fracture network. Maintaining flow through the fracture system can cause considerable energy penalty to the overall process. Therefore, chemical methods to maintain fractures and prevent scaling can be necessary to prevent excessive pressure build up in the re-injection wells of EGS systems.

The effect of different acid treatments on the porosity development of selected rock types was simulated with the aid of the Petrasim interface to the Toughreact simulation code. The thermodynamic and kinetic database of Aradottir et al. (2014) was expanded to include new minerals and the most important fluoride bearing species involved in mineral reactions during acid stimulation of geothermal systems. A series of simulations with injection waters containing fluoric acid, hydrochloric acid and CO_2 or mixtures thereof were then carried out and porosity development in the fracture system monitored. The periodic injection of weak acid mixtures into EGS systems may be cost effective in some isolated cases to prevent pressure build-up and therefore lowering pumping costs during operation. Selection of the acid is though highly dependent on the chemistry of the reservoir in question.

Reference

Aradottir, E. S. P., Gunnarsson, I., Sigfusson, B., Gunnarsson, G., Juliusson, B. M., Gunnlaugsson, E., Sigurdardóttir, H., Arnarson, M. T., Sonnenthal, E., 2014. Toward Cleaner Geothermal Energy Utilization: Capturing and Sequestering CO_2 and H_2S Emissions from Geothermal Power Plants. Transport in Porous Media. DOI 10.1007s/11242-014-0316-5