

Evaluation of the effect of treated geothermal brine after removal of oversaturated silica by a seed circulation method on geothermal reservoir

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The concentration of dissolved silica in geothermal brine is increased after vapor-brine separation and the solubility of silica is decreased with the temperature, so that dissolved silica in the brine becomes oversaturated. The oversaturated silica precipitates as amorphous silica and forms a silica scale. This scale causes clogging of the ground piping, the reinjection well and the surrounding formation, which causes a decrease in the amount of reinjected brine. As a solution to the silica scale, there is a seed addition circulation method (Kato et al., 2013, etc.) for removing oversaturated silica in the brine. However, the brine treated by this method affects the formation in the reservoir has not yet been clarified. The purpose of this research is to investigate the change in permeability of the brine with a column test and simulation.

In the column test, raw brine and treated brine from well SC-4 in the Sumikawa geothermal power plant in Akita Prefecture, Japan, were used. The raw hot water has pH 6.5 and the SiO₂ concentration is 1,130 mg/L and the treated brine has been reduced to about 700 mg/L. These hot water was passed through a column and the change in the flow rate was measured with a digital flow meter and by hand measuring. The column is made of SUS having an inner diameter of 5 cm and a length of 40 cm and internally filled with zirconia beads having a diameter of 1 mm.

In the test of the raw brine, since the silica precipitated on the bead surface, the water flow decreased by 25% in about 11 days. Based on this result, the simulation was carried out with the geochemical clogging model (water permeability changed due to silica precipitation from brine and clogging of particles; Yoo et al., 2013). Several parameters such as K_{25} and α are obtained to fit the observed flow change of the raw brine by this simulation. By using these parameters, several conditions of different silica concentration in the brine are examined by this clogging model. The results show that the silica concentration before reinjection to geothermal reservoir should be less than 400 mg/L.