# The role of physical and chemical processes of silica scale growth in geothermal wells

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One of the most significant problems faced in geothermal power plant is that of the deposition of amorphous silica, known as silica scaling. Currently there are a number of methods for controlling the deposition but the fundamental mechanisms that govern the precipitation of silica are not well understood. Although the method of calculating the deposition rate of silica based on reaction kinetics is widely available, it has been reported that the magnitude of deposition rate is extremely lower than that measured in the laboratories or in the fields (Malate and O'Sullivan, 1992; Weir and White, 1996). Since the inhomogeneous flow influences the deposition of the silica scale, which is an alternative process of scaling, the actual mechanism to transport colloidal silica to the wall surface in the flow should be considered in the deposition process, too. We established a scheme of the multi-scale simulation of silica scale precipitation considering the hydrodynamic effect to colloidal silica in the flow for understanding the mechanism.
The meso-scale approach is to investigate the motion of individual colloidal silica particles near the pipe wall with particle-wall interaction using Lagrangian method, while in macro-scale, we use a lattice Boltzmann method to model flow and solute-transport and use the scheme of building up silica scale. The meso-scale model is deployed to derive the deposition rate of colloidal silica, which is used for silica scale growth in macro-scale simulation. We then compare the amount of silica scale precipitation estimated from our simulation estimated with that of the observed both from laboratory experiments and from field observations.
Our results indicate that our simulation gives more realistic silica scaling qualitatively and quantitatively than the existing methods using only reaction kinetics. We conclude that the shear flow rate, which is closely related to the transport process of colloidal silica, is the one of the dominant factor, and that the hydrodynamic process needs to be taken into account to control the silica scaling.

Keywords: Silica scaling, Geothermal, Simulation

 