

A simple evaluation of silica scale inhibitors by a batch experiment immersing metal plates in geothermal water: Preliminary experiment

*Ryunosuke Terashi¹, Saefudin Juhri¹, Shunsuke Miyabe², Eiki Watanabe², Kotaro Yonezu¹, Takushi Yokoyama

1. Kyushu University, 2. KYUDEN SANGYO

In hot water dominated geothermal power plants, silica scaling on the surface of ground facilities and in the formation around re-injection wells has been a serious problem which prevent the constant operation. To retard the silica scaling, geothermal water is acidified by adding sulfuric acid. The pH controlling technique is employed in many geothermal power plants in the world. Thanks to the technique, silica scaling on the ground facilities has almost been retarded, however, the injectivity of re-injection wells has still continued to decrease gradually. Development of a new retardation technique which can maintain the injectivity is now required.

Silica scale inhibitor is a promising idea. However, no practically effective inhibitor has been found despite that there are commercially available scale inhibitors because of lack of the simple search and evaluation method. In addition, the concept concerning inhibition modes for each scale has not been established yet. In this study, whether polyacrylic acid, accumer 5000 and tiron work as a silica scale inhibitor or not was examined by a batch experiment immersing copper plate in pure geothermal water and geothermal waters in which each compound was added. The evaluation was performed by qualitatively and quantitatively analyzing elements adsorbed on the surface of copper plates using a mobile XRF, SEM-EDX and LA-ICP-MS.

Experimental

In this work geothermal water after water/vapor separation was used. The geothermal water of one liter after water/vapor separation was collected into a reaction vessel and five copper plates were immersed in the geothermal water for 1 h. One copper plate was taken out and was rinsed with pure water and ethyl alcohol, and air-dried. Every 1 h, the geothermal water was exchanged with new one and each copper plate was taken out one by one. The immersing experiments were totally conducted for 5 h. The same experiments were conducted using geothermal waters in which each chemical compound was added. The concentrations of Al, Si and Ca on the copper plates were analyzed by a mobile XRF, SEM-EDX and LA-ICP-MS. In case of the raw geothermal water without chemical compound, Al, Si Ca concentration increased smoothly with time. The fact indicates that the formation process of silica scales can be detected by this experiment. In the presence of PAA, the concentrations were almost similar compared with those of the raw geothermal water. On the other hand, in the presence of Tiron, Al, Si and Ca were not detected. In the presence of accumer 5000, the concentrations showed middle levels between PAA and Tiron. In conclusion, PAA cannot work as a silica scale inhibitor. Tiron is a candidate of practical silica scale inhibitor. Ability of accumer 5000 as a silica scale inhibitor may be weaker than that of Tiron.

Keywords: Silica scale, Inhibitors