An Experimental Study on Removal of Geothermal Scale with Self-Rotating Waterjets Nozzles

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Abstract

In geothermal fields, precipitation of geothermal scales such as silica and calcium carbonate occurs on the wall of casing pipes used for injection and pipe on the surface. Therefore, to improve the performance of injection wells, removal of geothermal scales have been required in many geothermal fields. Although, calcium carbonate scale can be removed by acid treatment, silica scale can hardly be removed chemically. Moreover, conventional mechanical removal method such as Poly Pigs cannot be applied to the well.

In this study, a method with high-pressure waterjets to remove hard silica scale have been proposed. To develop removal method for hard geothermal silica scale, we conducted an experimental study by using existing low-speed and high-speed self-rotating nozzles. In particular, to clarify the rotational speed of the nozzles in high ambient water pressure, we conducted tests for measuring the rotational speed of the nozzles. Furthermore, to clarify the scale removal performance of self-rotating waterjets in high ambient pressure, we prepared simulated specimens of hollow-cylindrical specimens of hard silica scale and conducted scale removal tests for various nozzle feed rates and rotational speeds. Main results obtained in this study are summarized as follows: (1) The rotational speed of the nozzles increases with the driving pressure. This is because the rotating torque increases with the driving pressure. (2) The low-speed self-rotating nozzle stopped to rotate at high ambient pressures. This is considered to be caused by the friction torque on rotating surfaces, which is larger than the rotation torque at high ambient pressures. (3) The average thickness of unremoved scale increases with the nozzle feed rate, and that obtained by the low-speed self-rotating nozzle is larger than that obtained by the high-speed self-rotating nozzle. Accordingly, the low-speed self-rotating nozzle may be superior to the high-speed self-rotating nozzle if the low-speed self-rotating nozzle can rotate in high ambient pressures.