



Experimental study of the silica precipitation kinetics from geothermal fluids under the exploitation conditions of the Bouillante power station (Guadeloupe, French West Indies)

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The hot geothermal fluid produced by the wells of the Bouillante power station, in Guadeloupe, contains various dissolved species such as silica or some metals (Zn, Pb, etc). During the exploitation, the geothermal fluid is flashing and cooling (from 260 to 160 °C for the high-pressure steam-liquid separation and down to 110°C for the low-pressure phase separation of a part of the separated liquid at 160°C). Consequently, the dissolved species can form scale deposits such as amorphous silica or poly-metallic sulphides, according to the exploitation conditions, and cause serious scaling problems on the production and the surface installations. These minerals could also precipitate during the partial underground re-injection of the production fluids which is being set up in the Bouillante power station.

In this study, in order to predict and prevent the possible silica precipitation at temperature lower than 160°C, during the partial underground reinjection of the production fluids of Bouillante or their thermal valorization down to 110°C temperatures, we propose to investigate on site the kinetics of silica precipitation as a function of temperature and pH. The experiments presented here were carried out on site on samples of separated waters collected after the steam-water separator at 160°C, containing about 600 ppm of SiO₂, at four cooling temperatures: 22, 50, 75 and 90°C, and for pH ranging from 4 to 9.

These experiments showed that the silica deposition was always initiated by a polymerization mechanism characterized by an order 2 kinetic law and the formation of a white colloidal gel, which slowed down the silica precipitation under solid form. This latter was observed much later, after the polymerization stage, and only in particular conditions (long time of atmospheric exposure, water stagnation,...). The results also confirmed that the silica precipitation kinetics is strongly dependent on pH. In acidic solution, a transition period is observed before the beginning to the silica polymerization. At neutral-basic pH, there is no transition period and the rate of polymerization is maximal for pH close to 8.

The undergoing modeling of these experimental data and specific surface area measurements on the colloidal gel will allow us to determinate the kinetics parameters useful for the prediction and prevention of silica precipitation under the specific exploitation conditions of Bouillante power station.

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