

NUMERICAL SIMULATION AND PERFORMANCE EVALUATION OF THE UENOTAI GEOTHERMAL FIELD, AKITA PREFECTURE, JAPAN

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ABSTRACT

This paper presents an evaluation of the performance of the Uenotai geothermal field, located in Akita Prefecture, Japan, during the first nine years of its operation (1994 – 2003). The performance evaluation was based on numerical simulation of reservoir behavior using the TOUGH2 software. The numerical simulation model includes a total area of 40 km² and extends from the surface at +600m msl (mean sea level) to a depth of -2,000m msl. Through a trial-and-error process, the pre-exploitation condition of the reservoir was satisfactorily matched by the model. The model was further calibrated by matching of the production-injection history of the field, primarily the changes in enthalpy and non-condensable gas content (NCG) at each production well, and the reservoir pressures at observation wells. Analysis of chemical, flow, and enthalpy data, combined with numerical simulation, indicates that most of the production decline and NCG increase in the field are due to the drying out of the reservoir. This drying out has resulted in a decline of reservoir pressure and scale deposition in some of the wells, further decreasing the available steam supply to the power plant. As the source of produced steam has migrated from the fractures to the rock matrix, NCG in the well flow has increased, thereby decreasing the efficiency of the power plant. Results of our analysis indicate that injection of supplemental water into this reservoir will be beneficial; vaporization of this additional water will mitigate reservoir pressure decline, dilute the NCG, and reduce downhole silica scaling.

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