Feasibility study on geothermal power generation system by CO_2 circulation

*Hiroshi Suenaga[1], Yoshinobu Nakao[1], Toshiaki Fukada[1]

1. Central Research Institute of Electric Power Industry

Three types of method exist to extract geothermal heat with CO_2 circulation: a coaxial method to circulate CO_2 inside and outside of a duplex tube in a well, a closed-loop method to circulate CO_2 in a looped well connected an injection well and a production well at the bottoms, and an open-loop method to circulate CO_2 in an injection well, reservoir rock, and a production well. For a closed-loop and an open-loop methods, numerical simulation models were constructed to calculate water and CO_2 flow in reservoir rock and drilled wells and applied them to Ogachi and Hijiori site where hot dry rock (HDR) research was conducted in the past. As a result, suitable conditions for the geothermal power system by CO_2 circulation could be found using the numerical simulation models to acquire high thermal power at the Hijiori site where showed the deeper reservoir depth and higher bottom hole pressure than the Ogachi site. A generated energy prediction method for the geothermal power generation system by CO_2 circulation was also constructed to calculate the generated energy for the combined cycle of CO_2 turbine and binary generator at the Hijiori site.
Laboratory experiments which simulate the geothermal power system by CO_2 circulation were conducted in this study. As a result, thermosiphon phenomena in which CO_2 could circulate in the looped pipe spontaneously caused by its density with temperature were demonstrated within injection pressure of 8 −18 MPa and reservoir temperature of 75 −200 degree-C. The results of the laboratory experiment were also reproduced by using the numerical simulation model.

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