Unsteady Numerical Simulation of Instability Flow in Geothermal Well with a Reservoir-Wellbore Simulator

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1. INTRODUCTION

Geothermal production wells sometimes show oscillations of wellhead pressure and flow rate when they are completed with multiple feed zones. This instability of the production leads to problems for power plant operation such as a lack in steam supply and an unstable turbine inlet pressure. Moreover oscillations may cease production of the well. Simulation studies were conducted with T2Well, which is an integrated wellbore-reservoir simulator, to examine the effect of shallow reservoir temperature (T_{SR}) on the well instability.

2. NUMERICAL SIMULATION and ANALYSIS CONDITION

Figure 1 shows a conceptual model of fluid flows in the reservoir and wellbore. A well is vertical of 2000m depth and 0.2 m diameter which penetrated two reservoirs at depths 1400m and 2000m. Temperatures of deep and shallow reservoir are 260℃ and 200℃, respectively. Initial conditions of steady state are calculated with the conditions above and wellhead pressure 7 bar. Then, the shallow reservoir temperature is changed to 169 and 170℃ and unsteady state simulations are conducted.

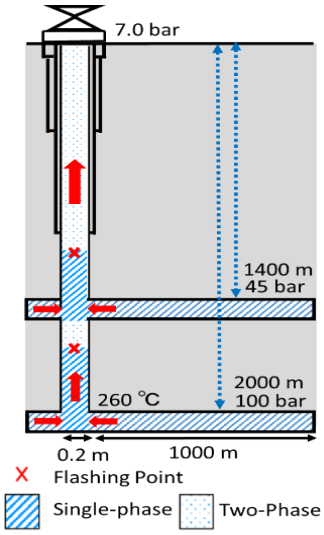

Fig.1 Conceptual model of fluid flow in reservoir and wellbore

3. RESULTS

Figure 2 shows mass flow rate (M) with time. Cyclic oscillation of M occurs from the beginning, then its amplitude becomes small with time for 170℃. Whereas for 169℃ an amplitude of M is getting larger with time. After 13000s M drops down to 0kg/s, implying stop of production. A period for one cycle for 169℃ becomes longer than that for 170℃. Figure 3 shows profiles of mixture velocity (u_m) in the wellbore at 12000s. u_m for 169℃ is smaller than that for 170℃ in the wellbore between wellhead and shallow feed zone. In short, u_m in the wellbore decreases, and the period for one cycle becomes long. Eventually Production stops.

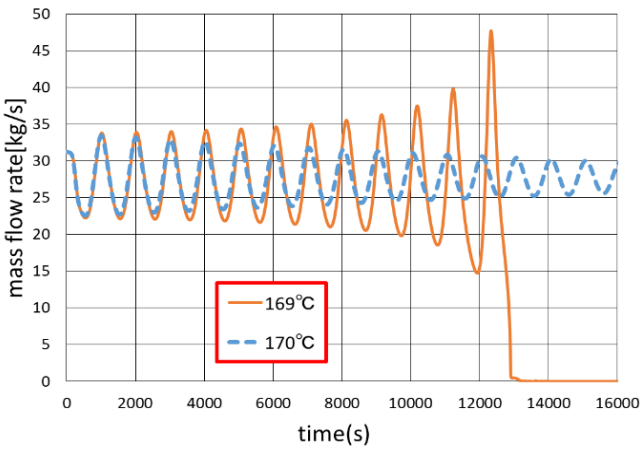

Fig.2 Mass flow rate vs time for T_{SR} =170, 169℃

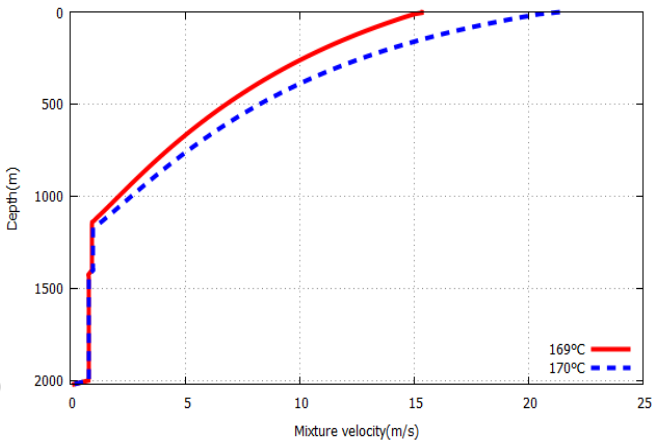

Fig.3 mixture velocity for T_{SR} =170, 169℃ (t=12000s)