Complete flow modelling of geothermal wells for different reservoir conditions

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The geothermal energy is exploited in numerous areas around the earth at depths ranging from some tens of meters up to a few kilometres, with a produced fluid temperature between ~30°C (low enthalpy) and ~500°C(high enthalpy), covering the whole range of the phase diagram since the exploitation from supercritical geothermal resources is being considered for the next generation of energy production systems. In all above cases, several technical challenges are being raised which required to be handled in the exploration phase to ensure the efficient delivering of clean energy. The extend of these issues and their solution depends strongly on the reservoir conditions, the fluid chemistry with sometimes considerable concentrations of minerals and dissolved gases, and the total geothermal flow rate. The correct design of the production and the injection wells, which are the link between the energy source and the energy production, is crucial, making the accurate modelling of the fluid and heat flow in the wells a key issue.

Within the GECO H2020 project ("Geothermal Emission COntrol"), aiming at producing high enthalpy geothermal energy with zero greenhouse and acid gases emission, a completion configuration is proposed ensuring the simultaneous re-injection of non-condensable gases and condensed water in the same well, based on a fully-coupled thermal multiphase flow model. This numerical tool models the one dimensional non-isothermal steady state single- and multi-phase flow in wells with deviated trajectories. An advanced thermodynamic model is integrated for the calculations of all physical properties as a function of temperature and pressure. Additionally, the one dimensional radial heat transfer with the host rock is modelled considering the heat capacity of all layers. The model has been designed to cover both the production and the reinjection wells.

Severe technical problems can raise due to scale deposition and corrosion in wells. To address these risks, the already developed model will be enhanced for assessing the deposition and corrosion trends along the well based on the flowing conditions (pressure, temperature, flow rate), the chemistry (components such as CO_2, H_2S, anions, cations) and the fluid physical state (supercritical, gas, liquid).

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