Evaluating Steam Circulation Process in SAGD by Transient Temperature Analysis

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Abstract

Steam circulation in SAGD start-up has significant impacts on the whole SAGD process. The start-up aims to heat the fluid sufficiently to establish mobility between the injector and producer. A quick way is needed to identify this communication to minimize steam circulation period. Furthermore, knowing the hot-zone size and shape distribution along horizontal wellbore formed by steam circulation can help better understand the start-up process and obtain a long-term SAGD performance thereafter.

This paper proposes a new method called Transient Temperature Analysis (TTA) to evaluate the steam circulation by interpreting the temperature fall-off data in injector and producer from fibre optics after the wells are shut-in. Because of the ready-to-use temperature data and the analytic solution, this method can provide quick and precise estimation of the hot-zone size. In this method, two mathematic models, two-system model and three-system model are setup to model the temperature behaviour after steam circulation. In two-system model, the initial temperature distribution after steam circulation is simplified into a hot-zone with uniform temperature and a cold-zone with initial reservoir temperature. In three-system model, a transition-zone between the hot-zone and cold-zone is considered. Also, superposition of multiple two-system models is utilized to model irregular hot-zone shapes and the scenarios with multiple non-communicated hot-zones.

Sensitivity analysis shows that the size and shape of hot-zone, the observation location directly affect the temperature falloff behaviour. Synthetic case studies and field case study suggested that the three-system model and superposition model are helpful in evaluating the performance of SAGD start-up process.