GeoConvention 2014
FOCUS
adapt
refine
sustain

# Instabilities Enhancing Steam Chamber Growth in SAGD

Steam-Assisted Gravity Drainage (SAGD) is the recovery process of choice to extract bitumen from Athabasca reservoirs in Alberta. In SAGD, steam injected into a horizontal well, flows to the outer edge of the steam chamber and heats the oil there. The mobilized oil flows under gravity to the base of depleted steam chamber and is produced to the surface through a horizontal well located at the base of the chamber. The viscosity of the bitumen at the edge of the chamber is decreased by five orders of magnitude. The oil drainage rate is directly linked to the growth of the steam chamber. In turn, the steam chamber grows according to the relationship between the steam flow, heat transfer, rate of oil viscosity reduction, and oil drainage that occurs at the interface at the edge of the chamber, in other words, the instabilities that occur at the edge of the steam chamber that drive mobilization and drainage of bitumen. Recently, Gotawala and Gates (2011) reported that in a 1D vertical Boussinesq model, the stabilities at the edge of the steam chamber is controlled by the quality of the injected steam and the difference between the Darcy-Rayleigh numbers of the steam chamber and the oil sands. They showed that the edge becomes unstable when the temperature difference and local steam qualities exceed a critical value. Here, we extend the analysis to two dimensions within heterogeneous reservoir to identify the types of instabilities that control the growth of the chamber including Rayleigh-Taylor (vertical density) at the edge of the steam chamber. We review the necessary conditions and growth rates of the instabilities in terms of temperature difference, steam quality, porosity, permeability, and oil viscosity and tie the results to overall SAGD chamber growth, oil drainage rate, and degree of heterogeneity of the reservoir.