IPTC-12750-PP

Comparative Investigation of Thermal Processes for Marginal Bitumen Resources

Jie Wang, Unversity of Calgary; Jonathan Bryan, TIPM Laboratory, and Apostolos Kantzas, University of Calgary and TIPM Laboratory

Abstract

With the depletion of conventional oil resources, heavy oil and bitumen play an increasingly important role as the main resources for crude oil. This is particularly true in Alberta since it has in excess of 400 x $10^9 m^3$ of heavy oil and bitumen. In Canada, most of heavy oil and bitumen resources are developed with thermal methods. Thermal methods for heavy oil and bitumen recovery include the injection of steam in the form of SAGD (steam assisted gravity drainage), CSS (cyclic steam stimulation), and steam flooding, whereby thermal energy is given to the oil, reduces its viscosity and allows it to flow towards a production spot. These methods have not been yet investigated for the large fraction (in excess of 50%) of oil sands that are thinner, less permeable, heterogeneous, or contacted by water. Electrothermal methods have attracted more and more attention as an alternative to conventional thermal methods for the difficult reservoirs where conventional thermal methods are not expected to work well.

In this study, a series of comparative studies are carried out using a simulation tool developed by CMG (Computer Modeling Group). In a series of marginal reservoirs such as thin reservoirs, low permeability reservoirs, and reservoirs with bottom water, both the SAGD process and the electrothermal process are applied. The resulting recoveries are compared and economics are evaluated for both methods for each case. The typical SAGD problem of the McMurray oil sands is used as the base case benchmark.

Our results to date indicate that under favorable conditions, electrothermal methods have the potential to recover thin bitumen reservoirs that cannot economically be produced by the SAGD process. Furthermore, electrothermal methods can achieve recovery factors superior to SAGD in terms of the production of thin bitumen reservoirs with bottom water and low permeability bitumen reservoirs. Controlled heating seems to be beneficial in electrothermal processes. Innovative well placement also appears to have favorable effects.

Introduction

With the depletion of the conventional oil resources, heavy oil and bitumen play an increasingly important role as the main resources for crude oil. This is particularly true in Alberta since it has in excess of 400 x $10^9 m^3$ of heavy oil and bitumen resources [1]. However, the production of heavy oil and bitumen requires more advanced technologies compared to conventional production techniques. To date, the most widely used heavy oil/bitumen recovery method is the injection of steam into the reservoir. The steam is injected in the forms of SAGD, CSS and steam flooding, whereby thermal energy is given to the oil, which reduces its viscosity and allows it to flow towards a production spot. Latent heat from the condensing steam provides considerable energy into the bitumen and helps in heating it. One of the potential alternatives to steam injection is the electrothermal method for heavy oil and bitumen reservoirs. The electrothermal process is a method that can convert electrical energy into heat in heavy oil and bitumen reservoirs. This method can be applied to the reservoirs where steam injection may not work well, such as reservoirs with low injectivity, or reservoirs that do not have good communication, etc. Alternatively, it can be used to preheat the reservoir before steam injection. Recent results of a field electrothermal pilot in Alberta showed that the electrothermal method is a promising technology for future heavy oil and oil sand development. More than 75% of bitumen recovery was achieved in this pilot project [2]. Based on this fact, it is believed that the electrothermal method is a