Using Inflow Control Devices (ICD) in SAGD Recovery of Heterogeneous Athabasca MCMurray Oil Sands

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Summary

In the pilot study, a new geomodeling technology is presented for developing 3D heterogonous geomodels for Athabasca McMurray (MCMR) oil sands. The geomodels were used to simulate SAGD thermal recovery. Both conventional SAGD completions and SAGD with ICD completions were tested. The simulation results show that for a heterogeneous Athabasca McMurray oil sand reservoir, the ICD completion technology enhances oil production and reduces steam consumption. As a result, the economics of SAGD recovery from the heterogeneous sands is improved.

Introduction

The heterogeneity of the Athabasca McMurray oil sands reservoirs is the result of the complex estuarine and fluvial depositional environments. Reservoir characteristics are further complicated by the biodegradation of the hydrocarbons present. The reservoir SAGD recovery result was influenced significantly by the reservoir heterogeneity. To improve the SAGD performance, inflow control devices (ICD) were introduced. The devices act to create a more uniform steam chamber to reduce steam consumption, improve steam sweep efficiency and enhance oil production efficiency. Some of the issues that affect steam delivery efficiencies in the SAGD process are the degree of steam conformance along the production/injection lateral from reservoir heterogeneities, steam trap controls and completions sizing with respect to wellbore hydraulics.

Oil Sands Heterogeneity Modeling

The study started with the modeling of the heterogeneity of the Surmount oil sands reservoir. The modeling of the reservoir architecture included the sand connection and quality variability, shale barriers extension and distribution, thief zone delineation and configuration of the MCMR sand in the area. Based on the same data set, different levels of heterogeneous geomodels were generated using different modeling methods (random disturbance as shown in Figure 1 and P-Field, etc.) and geostatistical settings. The geomodels were exported to a thermal simulator for SAGD recovery simulation.

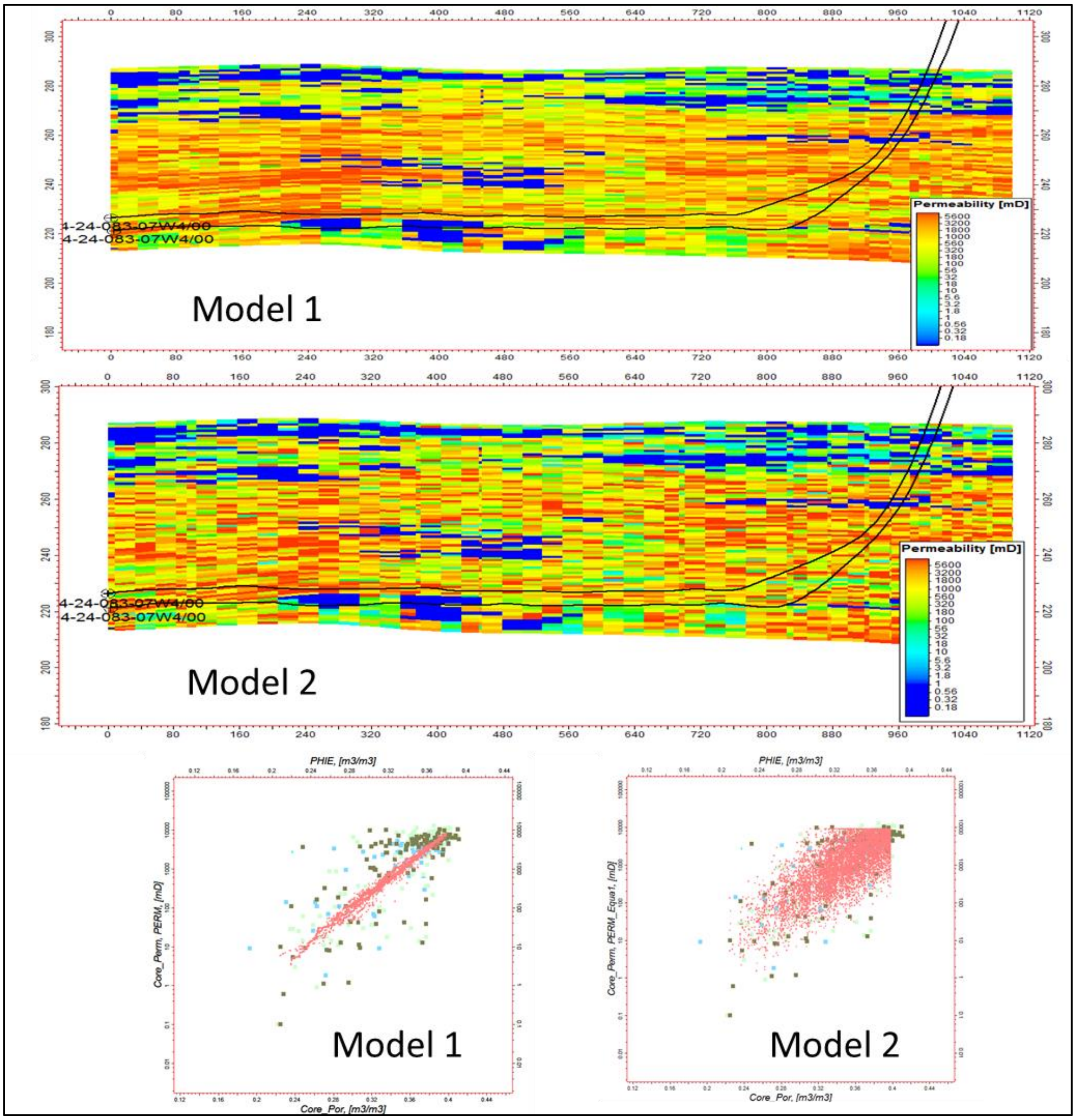

Figure 1: Examples of Permeability Model with/without Random Disturbance (Model1: Non-Disturbed, Model2: Disturbed)

SAGD Simulation with/without ICD

The study shows the comparison between traditional completion techniques various ICD arrangements have on the producer and injector wells. The significance of SAGD with ICD completion is evident in the effects of sub-cool, production rates, cumulative production, steam conformance and cumulative steam-to-oil ratio (CSOR). SAGD oil rates with and without ICD examples are presented in Figure 2. The comparison also quantifies the economic benefits of deploying the ICDs in SAGD wells. The economic comparison is based on net present value (NPV) analysis and payout of the various cases.

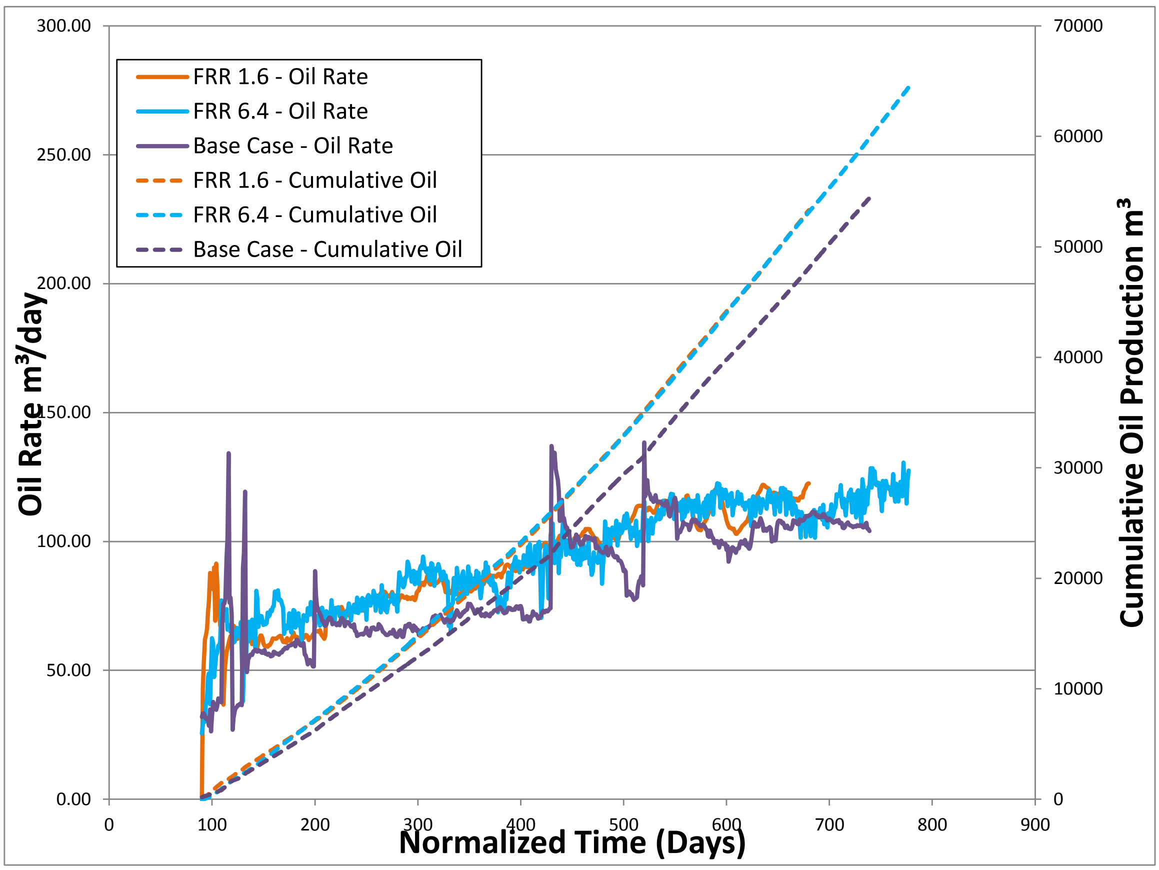

Figure 2: Example of SAGD Oil Rate Prediction with/without ICD Completions (Base Case: Non-ICD, FRR Case: with Two Different ICD Methods)

Conclusions

The heterogonous Athabasca McMurray oil sands can be successfully delineated and modeled with appropriate geostatistical methods. Compared with regular SAGD recovery, SAGD with the ICD recovery method improves oil production, reduces steam injection and increases the economic benefit significantly.

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