Capacitance Resistive Model (CRM) Application to Model and Optimize Waterflood in an Omani Oil Field

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Abstract

In petroleum engineering, there are wide and crucial usages of the reservoir simulation to develop, manage and monitor reservoirs. However, the traditional simulation methods are time consuming to prepare and model data. In addition, data uncertainty is another problem of old methods since they require many data to set up and run the simulator. Capacitance Resistive Model (CRM) offers rapid reservoir simulation with lower and more reliable data to manage and optimize production from hydrocarbon reservoirs.

Capacitance Resistive Model is a quantitative technique based on material balance that uses only injection/production rates and well coordinates to identify and quantify interwell connectivity in waterflooding. It deals with the reservoir as a system that has injection rates as the input and production rates as the output. CRM parameters are identified by estimating fractions of injected fluid and the time taken to reach a producer.

After calibrating the historical data with CRM, the model is used to predict the future oil production. Then, the future production is maximized and optimized by reallocating the water injection rates. This tool is preferred due to its simplicity, the short computation time and the usage of available field data such as injection/ production data of reservoir.

This research project aims to apply CRM to simulate waterflooding process in an Omani oil field using only injection/ production history data. Interwell connectivities are determined by fitting CRM over the historical data of the field. The effectiveness of the fitted model is examined through the historical events and then used to forecast and optimize the future production by reallocating the injection profile to the injectors.

The results of the study show good match for some producers and bad match for others with average error around 8.7%. In addition, ranking approaches of injectors indicate that I1 and I6 are good injectors and by injecting more water to them in the future, these wells can lead to higher production. The optimized scenario of the given field (59% of available water is for good injectors and 41% for normal injectors) leads to 29.90% increase in future oil production more than using the base case.