Lecture 12 summary

Major Elements of a Reservoir Simulation Study - Predictions

5.4. Predictions

The simulation study is often completed by making field performance predictions for use in economic analysis of possible operating strategies.

Prediction Process

It is usually necessary to ensure continuity in well rate when the modeler switches from rate control during the history match to pressure control during the prediction stage of a study.

The prediction process begins with model calibration.

The next step is to prepare a base case prediction. The base case prediction is a forecast that assumes existing operating conditions apply.

For example, the base case for a newly developed field that is undergoing primary depletion should be a primary depletion case that extends to a user-specified economic limit. By contrast, if the field was being water flooded, the water flood should be the base case and alternative strategies might include gas injection and WAG (water alternating gas).

Sensitivity and Risk Analyses

Sensitivity analyses are often needed in both the history matching and prediction stages.

Sensitivity analysis: Any method that quantifies the uncertainty or risk associated with selecting a particular prediction case. It can be used to

address very specific questions, such as determining the impact of fluid contact movement on hydrocarbon recovery.

Risk analysis: "any form of analysis that studies and hence attempts to quantify risks associated with an investment."

Risk analysis generates probabilities associated with changes in model input parameters.

The parameter changes must be contained within ranges that are typically determined by the range of available data, information from analogous fields, and the experience of the modeling team. Each model run using a complete set of model input parameters constitutes a trial. A large number of trials can be used to generate probability distributions.

Alternatively, the results of the trials can be used in a multivariable regression analysis to generate analytical expressions, as described below.

One of the most widely used techniques for studying model sensitivity to input parameter changes is to modify model input parameters in the history matched model.

Prediction Capabilities

Predictions are valuable for:

- preparation of a reservoir management plan

- Improving reservoir management.

- Estimate project life by predicting recovery versus time depending not only on technical issues, but also on commercial interests.

Economic Analysis

Predictions are frequently combined with price forecasts to estimate how much revenue will be generated by a proposed reservoir management plan.

The reservoir flow model determines how much money will be available to pay for wells, compressors, pipelines, platforms, processing facilities, and any other items needed to implement the plan represented by the model.

Validity of Model Predictions

Forecasts of reservoir behavior depend on the validity of the history match.

Decline curve analysis and material balance analysis, can generate performance forecasts, but not to the degree of detail provided by a reservoir flow simulation.

Reservoir simulation is best method for making performance predictions, particularly for fields that are being considered as candidates for a change in reservoir management strategy.