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Mathematical Modeling of the System of Reservoir-well for WI

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SUMMARY

The main purpose of the research is to simulate formation-borehole on the results of all available observations, changes in the reservoir and the definition of candidate wells for well interventions. The objectives of the work are: selection of the basic parameters have the greatest impact on the work of the well, development of the algorithm, the construction of an expert system of intellectual support. Determining task involves the mathematical modeling of the formation-borehole is based on a description of the means of generalizations of Bernstein polynomials, the construction of the optimal algorithm selection of wells.

Introduction

The dynamic development of the oil and gas industry in Russia and around the world poses new research challenges. Acquire an important role modeling behavior and effective exploitation in the final stages of development (Russian Congress of Geologists 2012).

Of particular importance are playing techniques to determine the feasibility, effectiveness and timeliness of secondary methods of the third stage of development of the field. In commercial practice, focusing too much on improving ultimate oil recovery, often without obtaining relevant information not used optimally resources aimed at this.

Mathematical modeling of the system of reservoir-well

Solving these problems is complex. It is determined by the geological structure of the reservoir, its formation reservoir properties, operational parameters, immovable oil and recoverable, the hydrodynamic properties, as well as the earlier history of the well interventions with the impact of a different nature.

The main purpose of the research is to simulate formation-borehole on the results of all available observations (reservoir pressure, well-head pressure, flow rate, temperature, water cut, porosity and permeability formation etc), changes in the reservoir and the definition of candidate wells for well interventions.

The problem is characterized by a large volume of heterogeneous data, which leads to the choice of methods to solve it. The main methods of planning and forecasting secondary enhanced oil recovery methods are the treatment of statistical data for the field and expert decision on the choice of wells , linear programming techniques with maximization objective function flow rate , the application of pattern recognition based on strict conditions and classification feature set effective application or that kind for well interventions (Surguchev et al. 1985). These methods differ failure and error statistics subjectivity expertise.

To improve the quality of simulation results, you can use non-linear models, such as applying the description of the system of reservoir-well means generalizations of Bernstein polynomials (GBP).

We construct the algorithm for optimal selection of wells, as well as expertise of the intellectual support of the secondary methods of the third stage of development of the field.

The application in solving the problem of mathematical models are based on the GBP, can effectively overcome a number of difficulties:

1. association of a large number of heterogeneous data sets into a single model (Big Data);
2. low accuracy of the measurement of certain parameters of the processes in the system of formation-borehole (instability in the small).
3. mate models with other systems (software compatibility issue).

These observations are linked to nodes GBP, coefficients characterize the measure of confidence in the measured data. As a result, we obtain the model presented in the form of GBP.

Using the principles and methods of fuzzy logic built model - the statement can be used to build more complex models (Mamdani et al. 1975). Previously proposed the use of fuzzy set theory for integrated assessment of permeability of various methods of influence on aggregate geological and physical parameters, and the solution of choice method of influence on reservoir (Eremin et al.1995).

Example

To illustrate this method imagine method the rank consider classification of evaluating the effectiveness of acid treatments in the form of GBP (Suchkov 2005). As a result, we obtain the model presented in the form of GBP (Figure 1)

Figure 1 Representation of the model in the form of GBP.

The measure of effectiveness of hydrochloric acid treatment is characterized by a change in color (from dark to light) to decrease the efficiency of its implementation.

The resulting representation is a simplification and a clear example of this method, which allows you to use this view as the GBP to build more complex models and systems.

Conclusions

Mathematical modeling of the system of reservoir-well for prediction the output for well interventions means GBP allows you to combine a large number of heterogeneous data sets into a single model (Big Data), the model can be repeatedly refined tools of fuzzy logic, the uniformity of the approximations OPB allows to minimize the influence of local errors associated with low precision measurement of some parameters of the processes in the system reservoir-well (to overcome the instability in the small for close to incorrect models).

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