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Introduction A Fast Simulation Method in Heterogeneous Hydrocarbon Reservoir

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ABSTRACT

The work flow of reservoir studies is an integration of interdisciplinary works by the geophysicists, reservoir geologists, petro physicists and reservoir engineers. Reservoir simulation helps to determine initiation of operating controls at the proper time, and to consider all important economic factors.. The original fine grids are generated by primary geological blocks which are output of geological software. The upscaling is necessary since geological software by means of statistical methods create models with millions and even billion of grid blocks and dynamic simulation on these models is practically not possible. In this paper we are going to introduce a fast simulation method in high heterogeneous multiphase reservoir which hot water flooding simulated as a thermal enhanced oil recovery. The principle of multi scale grid generation of this method is base on the trend of streamline which could be as a great map to find effective segments of a reservoir. The simulation results on the geological structure well compared with the results of upscaled models. The results confirm that this method consumes less run time with nearly accuracy of fine model.

Keywords: Geological Model, Thermal Recovery, Reservoir Simulation, CPU Time

1. INTRODUICTION

Geological models are ironically too complex and too large, i.e., they contain more information than we can handle in simulation studies. Therefore, we usually use a coarsened grid model, or a simulation flow model. The model consists of grid blocks with their petrophysical properties replaced by averaged or upscaled quantities based on variations of underlying geomodel quantities that occur at length scales below the simulation grid block. The main reason for using the upscaled models is computational limitations since it is usually impossible to perform flow simulations on the geomodel. However it is worth mentioning that, the advent of new computers with high computational capabilities gives a hope that the fine scale geological models will be directly used for flow simulation. To this hope one must notice that the sizes and complexity of geomodels have been increasing continuously and simultaneously with the enhancement of computer memory and processing power. Therefore, considering this current trend, the upscaling of geomodels seems an unavoidable stage of reservoir studies. The computational justifications of using a coarse upscaled model for flow simulation is more emphasized once we acknowledge the fact that in the geostatistical interpolation of data to create a fine geomodel, most of the information obtained is of a statistical kind and should be treated as such. To account for the uncertainty in our knowledge of the reservoir, multiple models should be produced (Farmer, 2005). Consequently it is more desirable to use a simulation model with less computational expenses for multiple runs that provides a reliable trend and are easier to history-match than using a geomodel for a single run that provides a detailed yet uncertain result. In the upscaling techniques that coarsen the geomodels to simulation models, the effective petrophysical properties are calculated in each cell of the simulation grids based on properties of the underlying geomodels. In this process, the aim is to preserve as much as possible the small scale effects in the large scale computations. Systematic small scale variations in permeability and porosity can have a significant effect on a larger scale, and this should be captured in the upscaled model. The quality of upscaling is usually assessed by comparing upscaled production characteristics with those obtained from a reference solution computed on an underlying fine grid