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Title A New Approach of Fractured Reservoirs
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Abstract

The basic tool for fractured reservoir studies is the dual-porosity (-permeability) model. Using the Warren and Root concept of rectangular parallelepiped blocks, this (sugar box) model is generally considered as unrealistic by geologists. On the other hand fluid flows within the matrix blocks are not simulated (one node) and the matrix-fracture exchanges within a cell are generally lumped in one connection including horizontal and vertical flows. This requires to compute and input pseudo kr-Pc curves which depend on the matrix petrophysical properties, block sizes and fluids present both in the matrix and the surrounding fractures.

To improve the accuracy and speed up the fractured reservoir studies, IFP developed a complete methodology of modelling and simulation which includes:

a software giving a realistic and stochastic picture of the fracture network after a geologic characterization of the different fracture sets;

a software taking the above picture as input and computing the equivalent parameters of a dual-porosity model so that the anisotropy of the fracture system and the oil recovery versus time of a matrix block surrounded by another fluid are the same in the simulator as in the geological model;

a dual-porosity, dual-permeability model which uses the above parameters and where the fracture-matrix flows are simulated according to their direction and to give the true kinetics and final recovery without using arbitrary pseudofunctions.

laboratory test technology and procedures to measure, in reservoir conditions, the required parameters. These tests also provided examples to benchmark our simulator. They are not described in the present paper1,2.

This paper describes the complete methodology and details the specific fracture-matrix flow formulation, which could be input in other dual-porosity simulators. The presented cases indicate that geologists and engineers can cooperate in a really-integrated fractured reservoir study based on a realistic picture of the fracture network. In addition, the modification of the matrix-fracture flow terms improves the model accuracy and speeds up the study as it does not require to prepare any pseudo curve.

Introduction

Fractured reservoirs are an extreme kind of heterogeneous reservoirs for which lFP developed specific methodologies and software in order to obtain reliable predictions of production profiles.

Actually, the challenge of fractured reservoirs can be taken up on the basis of a multidisciplinary approach involving the development of integrated software. Decisive fields of progress are:

the characterization of fracturing information into representative geologic models,
the use of an efficient link between geologic models and dual-porosity models,
the proper modelling of multiphase flows in dual-porosity dual-permeability simulators jointly with a sound appraisal of the physical production mechanisms involved.
Concerning the static description of fractured reservoirs, the quality and quantity of field information increased very much in the recent years. 3D seismic enables the detection of smaller-scale faults and new or improved logging tools provide a fine description of the fractures crossing wellbores.New software have therefore been developed to integrate field fracturing information, determine the spatial evolution and scale-dependence of fracturing attributes, in order to be able to construct representative images of natural fracture networks.This whole process of geological modelling is described and illustrated in the first section of this paper.