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ORIGINAL PAPER

Numerical study of the natural fracture using dual porosity-dual permeability model for Rumaila Field, southern Iraq

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Abstract
This paper presents an experimental and numerical study to investigate the hydrodynamics behavior of the fractured and nonfractured cores. The comparison between the simulated and experiments result is also presented. In this work, the Element Based Finite Volume Method (EbFVM) was used according to the Dual Porosity Dual Permeability Model (DPDP). The behavior of single-phase fluid flow in actual cores was studied for a fractured reservoir in Iraqi fields from Rumaila/Mishrif formation at different depths. ANSYS-CFX, a finite element based simulator was used to represent the pressure and velocity distributions. Therefore, the comparison between a fractured core and a nonfractured core was performed. The representation of fluid flow behavior in a fractured reservoir was presented. It is found that the presence of cracks increase the percentage of improvement in the productivity index to reach about (6.59% and 10.46%) for Rumaila core 14 and Rumaila core 15, respectively.

Keywords Darcy law · Fractured reservoir · Mishrif formation · Porosity · Permeability · Petroleum reservoirs

Introduction

Most promised events for oil/gas production in countries are concerned with the made or presence of fractures in their petroleum reservoirs. Therefore, the studying of the prototype model for HF makes the investigation of the flow and the parameters that effect on the fractured reservoirs is easy.

Hydraulic fracturing can be broadly defined as the process by which a fracture initiates and propagates due to hydraulic loading comes from pressure, see Refs. (Al-Mukhtar and Merkel 2015). Some reservoirs have low porosity and low permeability and are difficult to develop with a very low recovery rate. Hence, the fracture play a significant role in porosity and peramability, see Ref. (Xiu e 2003).

Fractures have a large effect on the fluid within the reservoir (Majeed et al. 2020; Soleimani 2017). In 1997, it was suggested that the DPDP model could be used for high oil and water productivity (Majeed et al. 2020). The more accurate results were obtained when Darcian and non-Darcian flow were combined, while in all previous editions Darcy's law was assumed in fracture and matrix zones, see Refs. (Majeed et al. 2020; Soleimani 2017). Therefore, the single porosity model cannot be used alone in such cases (Soleimani 2017). Hence, DPDP model is commonly used in simulating flow in a fractured reservoir. DPDP model is first established in 1960 (Warren and Root 1963). The basic theoretical concepts and model of fluid flow in fractured rocks were presented in Ref. (Warren and Root 1963). This model of DPDP was modified in the reservoir containing the natural fractures was represented by Warren and Root in 1963, see Refs (Majeed et al. 2020)(Warren and Root 1963).

It was found that the model of Warren and Root can be applied when the distribution of fractures is uniform and the difference between the permeability of the fracture and the matrix is large (Kazemi 1969). Since then, many studies have described dual-porosity models of fluid flow through a reservoir that naturally fractured (Adams et al. 1968; Li et al. 2017;

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