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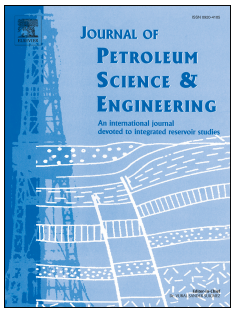

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Temporal Scale Analysis of Two Phase Flow in Fractured Well

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Abstract

Two phase flow between two fractures commonly exists around fractured wells. Due to the fracture network, the flow velocity is extremely variable in different regions and it can be described by the temporal scale analysis. The flow velocity also changes with time during the change in water saturation, but these changes cannot be captured by the conventional temporal scale analysis. The temporal scales are obtained based on a principal equation, so it is difficult to accurately estimate the formation properties and to determine the exploitation scheme. In this study, the two phase flow model between two fractures has been proposed for the temporal scale description.

The impact of reservoir heterogeneity on the temporal scales is considered in the model. Due to the tortuous flow channel shape between the fractures, the flow pressure affects the fluid flow afterwards. This is explained by the time lag effect in the model. The temporal scales are obtained by using finite element method and Laplace transformation at all time points with these considerations. Moreover, the well is soaked intermittently. The soaking duration is chosen based on temporal scales, and then discussed in terms of efficiency and recovery factor.

The results showed that the water saturation profile position is reflected by the temporal scales, the flow resistance and the flow velocity are represented by their zero status response contributions, while the initial flow pressure is described by their zero input contribution. The highest zero status response contribution is different for different properties. Moreover, the time lag effect promotes the initial pressure fluctuation, and also upscales the fluid flow in tortuous channels. Finally, the soaking duration is an approximation of the time required to reduce the fracture flow pressure.

Keywords: Fractured well; two phase flow; temporal scale analysis; Time lag effect

1. Introduction

Horizontal wells possess higher injection and production capacities than the vertical wells. However, the drilling cost of a horizontal well is higher than that of a vertical one. It is economized by two methods, the enhancement of fracture length and the lateral drive method (Michael et al. 2015; Ayasse 2015). In the lateral drive method, the fluid flows from one fracture to another around the same horizontal well. In both these cases, fewer horizontal wells need to be drilled to provide higher injection and production capacities. Furthermore, the fractures are opposite to each other to prevent water channeling and to avoid difficulties in water injection (Shiqing et al. 2017). The investigation of two phase flow between the two fractures is the key point of these methods.

After hydraulic fracture, the fracture fluid flows out of the formation. Due to the reduction of the moisture content, the impact of the flow channel radius on the permeability