

Development of a fuzzy system model for candidate-well selection for hydraulic fracturing in a carbonate reservoir

Abstract

With current technology, it is only possible to extract 20% to 25% of the original oil in place from Iranian carbonate reservoirs, 10% less than the world average. In addition, formation damage is a serious problem in those reservoirs, which mainly caused by asphaltene precipitation, sand production, and ineffective stimulation method. The majority of mature carbonate reservoirs in Iran have low permeability and high skin values. Therefore, such reservoirs are capable of producing at commercial rates only if they are hydraulically fractured. Acid fracturing is usually reported as a standard method for fracturing in carbonate reservoirs. Hydraulic Fracturing (HF) technology, which was originally applied to overcome near wellbore damage, is a proper replacement stimulation method. It is evident that to adopt this technology, considerable efforts have to be strenuous in candidate-well selection. As asserted in the literature, even though a common practice, candidate-well selection is not a straightforward process and up to now, there has not been a well-defined approach to address this process. The techniques applied in HF candidate-well selection could be divided into two methods; conventional and advanced approaches. Conventional methods are not easy to use for nonlinear processes, such as candidate-well selection that goes through a group of parameters having different attributes and features such as geological aspect, reservoir and fluid characteristics, production details, etc. and that's because it is difficult to describe properly all their nonlinearities. However, it is believed that advanced methods such as Fuzzy Logic (FL) could be better decrease the uncertainty existed in candidate-well selection. This paper presents a Mamdani fuzzy model where rules for HF candidate-well selection were derived from multiple knowledge sources such as existing literature, intuition of expert opinion to verify the gathered information. The needs for adapting HF as replacement stimulation in Iranina carbonate reservoirs are discussed and advanced methods for HF candidate selection will be reviewed in this paper. Also, the main reasons which show why propped HF is the choice in carbonate reservoirs will be discussed. Finally, the proposed Fuzzy system model is applied along with a case study in a carbonate reservoir.