

A Water Coning Correlation for an Omani Fractured Carbonate Reservoir-A Case Study

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Abstract

This work aims to develop a reservoir management tool (water coning correlation) for intensely fractured carbonate reservoir in North Oman. The production mechanism is Gas Oil Gravity Drainage (GOGD) with crestal gas injection and dedicated aquifer pump-off wells (water producers). As the field is produced from fracture oil rim through horizontal wells, it is crucial to keep the oil rim fixed and at such depth and thickness so that coning and cusping of water and gas into the oil producing wells is minimal. The key challenge is to control the oil rim and keep it at the desired position and at constant thickness. The aquifer pump-off wells are used to control the fracture oil water contact (FOWC). The oil offtake from the oil rim producers should be balanced with the gas oil gravity drainage rate of the system to avoid gas coning. Currently, the oil rim thickness and position in the fractures network is monitored by running gradiomanometer surveys and locate the fluid contacts (gas-oil contact and oil-water contact) in dedicated observation wells spread-out though the field. These surveys are carried out once a year and they cost a lot. Moreover, the limited numbers of the observation wells make it difficult to know the depths of the fluid contacts in some areas where there is no observation well. An analytical approach using the FOWC from the observation wells and the production data from the oil producers was used to develop a correlation between the produced water rate and the distance from the perforations (open hole) to the measured FOWC. In addition, a conceptual simulation model was built to develop the same correlation for one of the field's sectors. In the analytical approach, water rate/water cut versus distance of well perforations/drainage point to the fracture OWC were plotted for most of the field's oil producers and no realistic correlation could be

obtained. Insufficient data points for some wells and improper fractures connectivity between the observation wells and the oil producers-were found to be the main constraints. On the other hand, the simulation model results showed that the water cut exponentially increased as the FOWC get closer to the well perforations. The obtained exponential correlation from the simulation model could be divided into two linear correlations; below and above critical coning rate. Therefore, producing the well above the critical coning rate (as the current status for most of the field oil producers) yields a linear correlation between the water cut and distance between the perforations (open hole) and the FOWC. However due to lack of fractures details in the model, this correlation needs further improvement so that it can be used for reservoir management in the real field.