The Effect of the Stress Regime and Pre-Existing Natural Fracture Densities, Orientations and Hydraulic Parameters on Fracturing Stimulation and Fluid Flow Dimension in the Cooper Basin

By

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Abstract

Fracture stimulation has played a key role in making oil and gas unconventional resources economically viable and has contributed towards domestic energy production. This has (to some extent) been a very similar situation in the Moomba field of the Cooper Basin. In order to further increase the gas fluid flow for commercial production, it is important to understand the stress state and pre-existing natural fracture densities, orientations and hydraulic parameters which are the critical parameters influencing the shale gas production from unconventional reservoirs.

Pressure transient tests analysis (to test the reservoir deliverability and stimulation treatment evaluation) conducted on discrete fracture networks (DFN) (generated from image log data) showed that change in diffusivity, storativity, mobility and transmissivity of the reservoir fluid due to the changes in the hydraulic parameters will determine the relative lag time of the fracture radial and linear flow regimes on the pressure derivative plot and the well test speed. This also affected the radius of investigation growth with respect to the fracture boundary.

Fracture stimulation was conducted focusing on the effects of geomechanic properties (elastic modulus, fracture size, and shear stress) of unconventional reservoir rocks and controllable fracture stimulation operation parameters (flow rate, pump pressure, and slurry density) on stimulated reservoir volume (SRV) and total percolation area. High elastic modulus (HEM) rock property was found to be the critical parameter affecting this reservoir performance. Further fracture stimulation studies were conducted focusing on the relationship between the controllable fracture stimulation operation parameters and HEM rock property. High flow rate (HQ) or low pump pressure (LPP) was found to be the controllable parameter that would further enhance the gas production from an unconventional reservoir with HEM.

This study, therefore, suggests that fracture densities and orientations (fracture distributions) played a major role in the enhancement of SRV and total percolation area. Fracture density improved the connectivity of the stimulated fractures (and hydraulic fractures) for fluid flow and hence the total percolation area. The scenarios that resulted in low SRV and total percolation area were predominantly caused by low fracture density and increased pump pressure and this situation caused a "tip screen-out" effects around the wellbore.

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