Horizontal Wells Hydraulic Fracturing from Tight HPHT to Multilayer Differential Depleted Gas Accumulations in Oman

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ABSTRACT

The development of Oman gas accumulations requires the use of hydraulic fractures as part of the sand face completion, multi fractured horizontal wells were identified as potential well architecture that allow effective hydrocarbon recovery while reducing the number of well. The unique geological properties of the reservoirs require different fracture strategies and technology deployment to make them commercially viable.

Fracturing High Pressure High Temperature (HPHT) as well as Multilayer Differential Depleted (MDD) formations takes the implementation of this technology to its limits; the challenges are further increased by stress regime variations due to tectonics and rock properties heterogeneities encounter across the horizontal section, challenging the effective placement of transverse fractures, fracture conductivity and final hydrocarbon gas deliverability.

It is well agreed the multivariable nature of this challenges, however these are not well understood. A holistic approach was used starting with the fractured vertical wells in both challenging environments (HPHT & MDD) this providing the stepping stone for the definition of the fracture implementation strategies in horizontal wells. It was possible to identify three key areas influencing the fracture implementation, these covering design, monitoring and diagnostics; from this three areas, fracture diagnostics was a vital stage on fracturing optimization, on this stage the use of pressure and rate data, radioactive tracers, microsismic monitoring were used to provide information about fracture propagation behavior, geometry and containment; on the other hand, production logging and well test data were used to assess fracture conductivity and inflow performance.

The combination of calibrated fracture and inflow simulation platforms were essential for the analysis of the considerable amount of data generated as part of the diagnostic stage. However, commercial available analytical and numerical inflow tools provide limited options to incorporate details variations of fracture conductivity, effective fracture length and inertial affects across the fracture plane.

This paper will describe the developed methodology used for fracturing horizontal wells that combines extensive data acquisition and evaluation in combination with the development of in-house software platforms with commercially available tools and how it was incorporated the detail results from calibrated fracture simulation and characterization with inflow analytical and numerical models, this to estimate the inflow performance across the fractured interval and the subsequent generation of inflow profiles (Synthetic Production Logs). It will be also discussed the comparison of the estimated inflow profiles with measured inflow from production logging (PLT). Finally it will be presented how through the use of the developed methodology was possible to optimize completion, perforation, fracturing and production strategies critical aspects for field development.