TG16

Stimulation Optimization in Multi-stacked Tight Sands

N. Choi* (ExxonMobil), T. Juranek (ExxonMobil) & W. El-Rabaa (ExxonMobil)

SUMMARY

Abstract:

ExxonMobil has been actively developing tight gas reservoirs for over 10 years in Piceance Basin in Northwest Colorado. The Mesaverde formation consists of numerous vertically stacked lenticular sands, varying in thickness from 1 ft to over 100 ft. The overall gross thickness is approximately 5,000 ft, with deposits varying between fluvial, estuarine, and marine. Typical reservoir properties are 3-7% porosity, 60% water saturation, and 1 microDarcy matrix absolute permeability.

To target productive zones while avoiding potentially wet intervals, ExxonMobil developed “Multi-Zone Stimulation Technologies” (MZST) to substantially improve stimulation effectiveness and placement in thick reservoirs. The two MZST methods, “Just-in-Time Perforating” (JITP) and “Annular Coiled Tubing Fracturing” (ACT-Frac), enable the delivery of a large number (40+) of stimulation treatments in a single well, provide diversion among zones, and allow for high injection rates to ensure effective stimulation.

The stimulation strategy has evolved to improve gas production and/or to reduce completion cost. Initially, stimulation designs were conventional and relatively conservative, using cross-linked gel and 20/40 ceramic proppants. Linear gels with 40/70 and 30/50 mesh proppant were then applied. Finally slickwater was utilized, significantly reducing cost and allowing for recycling of produced water and frac fluids from flowback. Historical data analysis showed that geographic region was the most important factor for well productivity and that completion variables were a secondary factor. When fracturing fluid systems were compared, wells completed using slickwater outperformed linear gel stimulations (with 89% confidence). In addition, a steady increase in well performance was obtained from 2002 to 2007.

To further optimize hydraulic fracturing, a systematic approach known as design of experiments was undertaken. In this method, series of structured tests are conducted in which the input variables (treatment design) are changed and the output (90 day cumulative gas production) is measured. We conducted multiple field tests changing proppant size, total proppant amount, water volume, and surfactant concentration. The results showed that while proppant size and proppant concentration had little or no effect on gas production, a significant increase in productivity was observed by increasing total amount of proppant. For the surfactant, best results were obtained when no surfactant was added to the fluid. In this case, the lowest cost option provided the best production performance. Therefore, continual experimentation has allowed for stimulation optimization in this multi-stacked reservoir.