Presentation #1

Impact of Brines on Proppant Transport Capability of High Viscosity Friction Reducers

Barry Hlidek: Engineering Advisor Stim-Lab Inc.

The presence of salts significantly and negatively impacts rheological and proppant transport properties for most High Viscosity Friction Reducers (HVFR). Mix water composition is a dominant variable and must be considered when selecting HVFR products. Viscosity at higher shear rates (40-511/sec) in the power law region do not necessarily reflect HVFR performance at lower shear rates. Performance between different products available for use in fracturing exhibit a wide variation in properties, likely reflecting the potentially wide variation in chemical composition. Proppant transport testing in a slot flow device validates the rheology measurements. The slot flow evaluations show not only a significant loss of transport capability in brines, but also exhibit a wide range of behavior between products. Clearly, HVFR materials are not equivalent and require laboratory performance evaluations.

HVFR properties in various waters are measured using a rheometer. The measurements include low shear rate (<0.01 sec-1) viscosity, higher shear rate measurements in the power law region, and oscillatory measurements used to determine elastic properties. Mix waters include distilled and fresh water, various salt solutions including a 100,000 (total dissolved solids) brine, and simulated field brines. Proppant transport in fresh and simulated field brine is evaluated in a 1 x 8 foot slot flow device.

Recommendations regarding the appropriate application of these products will be included in the presentation.

Presentation #2

Unconventional Field Development

Raj Malpani: NAM Technical Manager – Reservoir Stimulation, Schlumberger

Effectively exploiting unconventional reservoirs require an integrated approach that combines reservoir characterization, hydraulic fracturing and reservoir modeling, data analytics, production diagnostics, surface logistics, production management, scenario analysis, and economic evaluation. The key to maximize the acreage valuation is to determine the potential locations and optimize their productivity which involves getting the number of targets (stacking) and number of wells per target (spacing) right, to avoid overlap and interreference among wells. Time lapse development adds further challenge, as the depletion over time changes the well spacing and stacking. Additionally, the completion designs and employed technologies would also need to be changed to compensate for the change in stresses. Thus, crafting the optimum development plan must take multiple factors in account and can be solved using a range of digital solutions – analytical, hybrid, or full physics approaches. This talk will go over a newly launched tool that allows comparison of various development scenarios using business decision framework. This tool efficiently links to various digital solution approaches to allow for the flexibility and integrates with other pieces required for development planning. An example will be presented where an operator has existing producers and trying to determine a plan to develop the rest of acreage.

Presentation #3

Leveraging Bubble-Point-Death as a Time-Independent Alternative to Reservoir Simulation to Enable Pre-Determination of Optimal Well Spacing

Scott Lapierre: Founder / Science & Engineering Innovation and Implementation Director, Shale Specialists LLC

An optimal well spacing is one that maximizes recoveries per-well, per-acre, and per-dollar while minimizing destructive well interference. As investors switch focus from production growth to stable, long-term return on capital employed; longer-lived production streams capable of sustaining regular dividend payments while funding production growth are now desirable. Trial and error experimentations to determine optimal well spacing have proven highly capital destructive in several infamous instances. It is clear that alternative modeling approaches are needed to improve the generation and achievement of investor expectations.

With the increasing availability of sufficiently-aged production from standalone parent and tightly-spaced child wells, published predictions from the 2017 theory known as 'Bubble-Point-Death' (BPD) are proving accurate across multi-basin, multi-operator, and multi-spaced production data. With its focus on a first principles derivation of recovery factor available from primary reservoir drives - rather than time-dependent flow-through-porous-media simulation, BPD theory and its underpinning isolation and quantification of primary reservoir drive energy enables pre-determination of primary recovery factor independent of estimates of ultimate recoveries or oil-in-place. Once the predetermined recovery factors are combined with heavily constrained oil-in-place (OIP) maps, Recoverable Oil-in-Place (ROIP) maps are generated and used to constrain the maximum oil volume recoverable from a drilling unit via primary production. With the introduction of a simple 'stimulation efficiency' parameter, an optimal well spacing per drilling unit is determined.

The example of an infamous 'cube-' style development from south central Midland County is presented and demonstrates the new model's ability to explain actual production for a 14-well development after 1,414 days to within 1.2%. Economic analysis of the 14-well development 'as-is' reveals only a marginal IRR over an 8-year well life will be generated. The model is used to determine an optimal well spacing and stimulation intensity that will yield a >20% IRR and a >20-year well life. An economic comparison of the two scenarios is provided.

Presentation #4

Depletion Effect Quantification and Mitigation of the Offset Wells

Baosheng Liang: Senior Reservoir Engineer Advisor, Chevron

Ghazal Dashti: Senior Reservoir Engineer

Depletion effects occurs in unconventional reservoirs when the hydraulic fractured wells are completed within the drainage volume of existing producers. Field production and monitoring data show that the existing (parent) wells negatively affect the new (child) wells' productivity, making the new wells produce less than if all the wells are drilled and produced at the same time. This talk presents a systematic study on quantifying the offset well depletion effect in the Permian basin through advanced reservoir modeling and data analytics from field pilots.

The workflow starts with building an Earth model for parent wells in the area of interest, generating a hydraulic fracture network, and performing reservoir simulation for production forecast. The depletion effect is properly updated in the Earth model and further captured through fracture geometry distortion and production decrease in the depleted environment. The results from the simulation models are further validated with actual field data.

The ability to quantify depletion effect has significant business impacts on development sequence, facility design, completion design, and overall project economics. Net present value (NPV) economic analysis of different simulation results indicates that time duration of production in the parent well ahead of child well has more impact on depletion effect than the distances between parent and child wells.