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USA, DESCRIBE THE DEVELOPMENT
OF A NEW PROPPANT TECHNOLOGY TO
ENHANCE THE TRANSPORT CAPABILITIES OF
SLICKWATER FRACTURE FLUID SYSTEMS
IN HYDRAULIC FRACTURING
APPLICATIONS.

A SLICK DESIGN FOR SLICKWATER SYSTEMS

Workover and/or recompletion costs in terms of capital and man-hours can be excessive in multi-stage fractured horizontal wells. Therefore, it is imperative that the best possible completion is designed at the outset of the project to reduce, or at least delay, the need for a recompletion.

Fluid systems and proppant selection are major components of the hydraulic fracturing process and go a long way to determining the success of the fracture stimulation operations, as well as the economic performance. Fracturing with guar and cellulosed-based gel (linear or crosslinked) systems was the standard practice 20 years ago. In recent years however, these 'conventional' systems in hydraulic fracture design have given way to the use of slickwater fracture fluid systems. Two major benefits for the utilisation of slickwater fluids over conventional systems are the reduced chemical requirement in slickwater (compared with conventional fluids), as well as the minimisation in gel damage when using thin fluids. The cost savings in this regard are two-fold: upfront savings (due to reduced fracturing fluid costs) and backend savings (due to incremental production from a reservoir with less permeability impairment from gel). Increased fracture complexity from thin fluids use can also be a major justification for using slickwater in shale reservoirs.

In addition to increased fracture complexity and pressure to reduce environmental footprint, one of the primary drivers for this change is, of course, cost. However, the reduced capability of low-viscosity slickwater systems to efficiently suspend and transport proppant in a fracture (and the wellbore) is well recognised. Proppant has a higher tendency to settle rapidly in slickwater, which limits the typical proppant concentration to 0.25 – 2.0 PPA and mandates turbulent fluid flow for transport. These conditions can only be achieved via a high slurry rate design.

Substantial volumes of water are therefore needed to successfully place proppant stages without near wellbore events (screenouts). For this reason, slickwater completion designs have necessitated the use of small mesh size proppant (100 mesh and 40/70) into the pump schedules to afford placement in these thin fluid systems, which have impacted proppant pack conductivity.

The efficiency of a fracturing fluid in transporting and placing proppant through the wellbore to the hydraulic fracture face is an essential consideration in fracturing fluid design. To meet the new challenges of these emerging conditions in unconventional acreages, CARBO has developed a new proppant technology to enhance the transport capabilities of slickwater fluids, leading to increased reservoir contact area while enhancing proppant pack conductivity.

Proppant designed for slickwater systems

CARBOAIR is a high-transport, ultra low-density ceramic proppant technology with chemically engineered internal porosity, designed to increase production and estimated ultimate recovery (EUR) from slickwater fracturing operations. The proppant has an apparent specific gravity of 2.0, which is approximately 25% lower than conventional sand. The higher conductivity of CARBOAIR technology along with exceptional proppant transport, means that this technology delivers increased propped fracture height and length to maximise effective fracture contact and fracture conductivity.

Reducing costs; improving efficiency

The proppant features a greatly increased volume per pound when compared to sand, RCS or ceramic proppant. In an equal volume frac

design, this technology requires less proppant mass to achieve the same propped fracture volume as conventional proppant, significantly reducing stimulation costs for the operator. Water consumption is reduced, along with flowback treatment. Consequently, there are potential associated cost reductions due to reduced horsepower requirements, and recycle processing costs.

Available in 30/50 and 40/70 mesh sizes, CARBOAIR has been specially engineered to sustain consistent proppant transport and physical characteristics, performing reliably to specifications during the pumping process and throughout the frac.

The technology's low settling rate (30 - 40% slower than sand or RCS) means that fracturing gel concentrations can be reduced or eliminated altogether, to avoid gel damage and improve clean-up. By avoiding the introduction of gel into their fracs, operators are also able to further reduce stimulation treatment costs and proppant pack damage.

Overall, the higher fracture contact and conductivity enabled by this technology generally leads to higher production and EUR for the operator. Improved contact means it is possible to deploy more efficient completion designs that could lead to fewer stages or smaller fracture designs to deliver the same or increased production, with minimal increase in cost. Additional investment is typically followed by quick returns, and results in a lower finding and development cost per barrel of oil equivalent.

Applications

CARBOAIR was designed to provide several deployment options to operators and by doing so, create wide-ranging opportunities with different fracture geometry design goals.

Lead-in/tail-in

As a lead-in, CARBOAIR technology can provide increased propped half length, which increases the drainage area of the fracture. As a tail-in, CARBOAIR technology can contact more of the productive pay zone height and lead to increased production compared to conventional proppant.

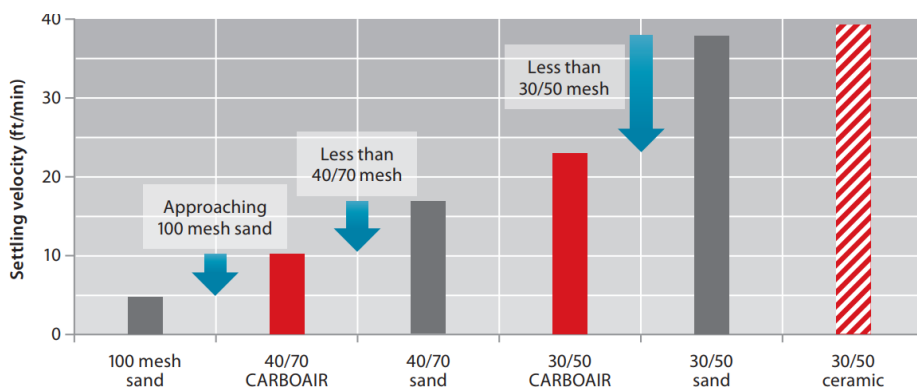


Figure 1. CARBOAIR has a significantly lower settling velocity than comparable products.

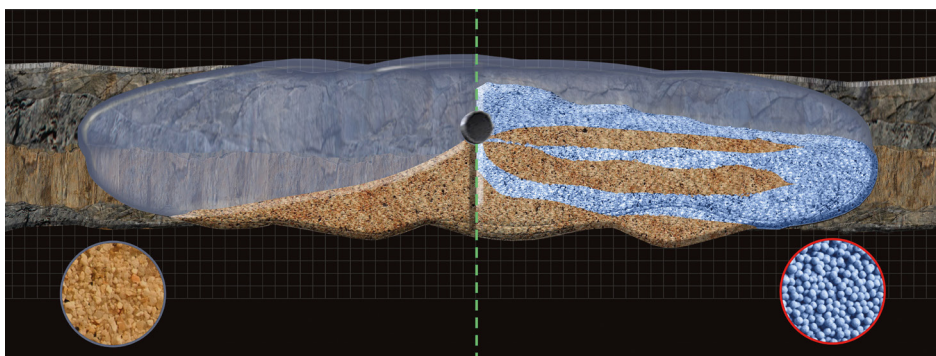


Figure 2. Diagram showing CARBOAIR being used on alternate stages.

The net effect of either design will yield incremental production for the operator.

Alternating stages with conventional proppant

By alternating the technology with standard proppant within a frac stage using slickwater fluids, it can provide increased effective propped length and full productive zone coverage, while increasing the effective conductivity of the fracture, leading to additional production and ultimate recovery. This design can also provide channels of permeability (and conductivity) streaks that can yield an increase in net (preferential) production through the channels.

Replace all sand

Due to the significantly lower density, 30% less mass of CARBOAIR technology can be used to replace the same volume of sand proppant, thereby reducing the amount of water and chemicals used for the treatment. This technology also provides more coverage across the pay zone, leading to increased production.

Permian Basin case study

An operator in the Permian Basin pumped 40/70 CARBOAIR with positive results. While rock properties from well logs indicated the presence of hydrocarbons in the targeted zone, the thinness of the zone presented a challenge to effective stimulation and an economic rate of return. As a result, the fracture stimulation was designed for increased propped length, using a FRACPRO (3D fracture model). The fracture model results prior to the completions predicted a significant uplift in fracture length and height with CARBOAIR over conventional proppant, and the production results to date have borne out the fracture model prediction. Previous well completions in thicker gross intervals were achieved with 100 mesh and 40/70 sand. In this case, the well was completed with a similar design but a tail-in portion of the 40/70 sand was substituted with 40/70 CARBOAIR. Production results from the well have exceeded

the operators' expectations for such a thin payzone and continue to show a shallower decline in average monthly production rate in the most recent 130 days compared to other wells in the area. This enhanced well performance results from improved propped fracture geometry due to the application of CARBOAIR. Similar results have also been seen in a South Texas Eagle Ford completion.

Conclusion

Slickwater fracture fluid systems have been developed to accommodate changing industry designs and cost structures. However, proppant transport and placement in these treatments present challenges for stimulation design optimisation and effectiveness due to their low viscosity that negatively impacts proppant carrying capacity and can lead to lower conductivity or even unpropped fractures. CARBOAIR has been shown to increase production in multiple basins by delivering improved proppant transport, propped fracture geometry (length and height), fracture conductivity and reservoir contact, in comparison with conventional sand. ■