

ENGINEERING PRODUCTION ASSURANCE

JOSHUA LEASURE, CARBO, USA, DESCRIBES THE FEATURES OF A NEW PROPPANT-DELIVERED TECHNOLOGY PLATFORM, DESIGNED TO PREVENT RESERVOIR DAMAGE AND MAXIMISE PRODUCTION.

After completion, operators must work to ensure the consistent, economical flow of hydrocarbons to the point of sale. A variety of issues can potentially interfere with this production process, including paraffin, scale, bacteria damage or well blockages due to solid deposits. These issues have the potential to cause catastrophic, permanent damage to the asset and can also result in significant financial loss for the operator.

In order to improve production assurance, CARBO developed the GUARD proppant-delivered technology platform, engineered with the aim of preventing potential damage to the reservoir or blockage of production tubing, leading to increased estimated ultimate recovery for the operator and lower lease operating expenses. The technologies allow for deferred implementation of traditional remediation strategies while extending the most productive time of the well's life.

Production assurance technologies utilise an engineered controlled release technology, which means that the product only releases chemicals when in contact with the production fluid that the inhibitor that it is intended to treat (Figure 1). This leads to a significant reduction in initial washout and improved frac fluid compatibility.

The technology replaces < 5% of proppant volume and treats for multiple years with no additional cost towards authority for expenditures. In comparison to liquid and solid inhibitors, which lose 90% and 60% of the chemical after placement respectively, GUARD technology retains

95% of the active chemical after application. The technology is designed to maximise porosity and strength, and an interconnected design allows uniform chemical infusion throughout the pellet, enabling advanced chemical delivery. Larger volumes of effective chemical can, therefore, be placed in comparison to other treatment options.

A ceramic proppant with engineered porosity

A high strength ceramic proppant with engineered porosity that is infused with scale inhibitors and the grain coated with a semi-permeable membrane is SCALEGUARD. These proppant grains are then substituted for a designed amount of standard proppant and pumped into the fracture during normal fracturing operations. Placed directly throughout the fracture network, the grains attack scale at a point of origin, utilising a unique controlled release technology that inhibits scale at a designed rate.

The technology, which can be engineered to last for the effective life of the well based on anticipated production profiles, is designed to protect the operator's entire asset. In turn, this safeguards the whole production network without compromising fracture conductivity.

Case study one: Lower Tertiary in the Gulf of Mexico

Due to the high pressure environment in an operator's Lower Tertiary Gulf of Mexico wells, SCALEGUARD technology was deployed into KRYPTOSPHERE grains. Up to 20% of the standard proppant could,

therefore, be replaced with SCALEGUARD-based KRYPTOSPHERE, without compromising fracture conductivity.

The operator had two objectives: maintaining high conductivity while preventing scale formation, and removing the need for costly remedial treatments. Scale residual results show that the scale inhibitor helped to achieve these aims.

Case study two: Permian Basin

In a single treatment, SCALEGUARD shut down habitual scale deposition despite produced water volumes that reached a cumulative 170 000 bbls over a nine month period. This excessive degree of scaling had previously restricted maximum production from the operator's unconventional Permian Basin wells, and the use of conventional liquid scale inhibitors had failed in this application.

The operator incorporated the water-activated SCALEGUARD proppant-delivered scale inhibiting technology in a 24 stage Wolfcamp well to be stimulated with 100 mesh, 30/50 white and 30/50 resin. Following a water chemistry analysis, a blend of SCALEGUARD and 30/50 resin-coated sand proppant with a well-specific minimum inhibitor concentration and placement release rate was blended with the aim of extending the treatment duration. The operator encountered no further

instances of scale deposition and plans to incorporate SCALEGUARD in all future wells targeting the water prone Wolfcamp reservoir.

Case study three: Manitoba, Canada

An operator targeting the Bakken/Spearfish formation was producing from a 22 stage horizontal well, comprising an aggregate 130 000 lb of natural sand proppant. After a year, the operator observed a steep decline in production due to severe scale deposition. The only alternative was to pull the pumps and drill out the well to remove the scale deposits, which dramatically reduced the overall value of the producing asset.

To treat the produced water before it has reached the wellbore, and to thereby prevent scale from forming, the client pumped the SCALEGUARD proppant-delivered scale inhibiting technology. By preventing the near-wellbore build-up of scale and keeping downhole equipment free of deposits, this proppant-delivered technology helped in maintaining productivity and avoided unnecessary costly remediation.

Proppant-delivered production assurance

The GUARD family of proppant-delivered production assurance continues to gain acceptance in every type of reservoir by preventing the buildup of undesirable deposits that inhibit production. The products can minimise or eliminate the substantial cost and time required to regularly shut wells down for workovers and traditional cleaning treatments. Alongside the growing domestic and international use of proppant-delivered technologies, field trials began for SALTGUARD, PARAGUARD and H2SGUARD.

A chemically-infused porous proppant that is constructed with a polymeric/pseudo polymer blend, SALTGUARD requires a low minimum dosage compared to other inhibitors. It inhibits salt formation in the frac and wellbore, preventing production decreases, lowering lease operating expenses and eliminating the need for costly fresh water injection and the associated disposal of the resulting saltwater.

In development, PARAGUARD is a long-term proppant-delivered paraffin inhibitor and dispersant which is blended into base proppant. It encompasses three classes of inhibitors covering wide range of waxes found in various types of crude and is highly efficient at prevention of damage in the reservoir.

As a proppant-delivered H₂S scavenger, H2SGUARD is also blended into the base proppant, which increases the efficiency of the inhibitor. Scavengers become more efficient as exposure time is increased: typical Triazine scavengers demonstrate 30% efficiency, whereas this H₂S scavenger operates at 90% efficiency. The high pH values of other scavengers increase scaling in comparison to H2SGUARD.

The GUARD technologies can be added to sand as well as ceramic proppant, opening up large markets. Additional production assurance chemistries in the development stages include asphaltene and microbial control.

Conclusion

Since its introduction in 2013, SCALEGUARD has been used on hundreds of wells successfully, since a single scale inhibition treatment prevents production losses during the life of the well and significantly reduces lease operating expenses. The inhibition of scale formation by the novel delivery system can reduce costs for the operator greatly. The use of these porous ceramic proppant-based chemical delivery systems with infused scale inhibitor can provide a long-term chemical treatment without the additional lease operating expenses. GUARD technology helps expand the range of scales that can be treated and opens the door for applications for addressing other types of production assurance issues. ■

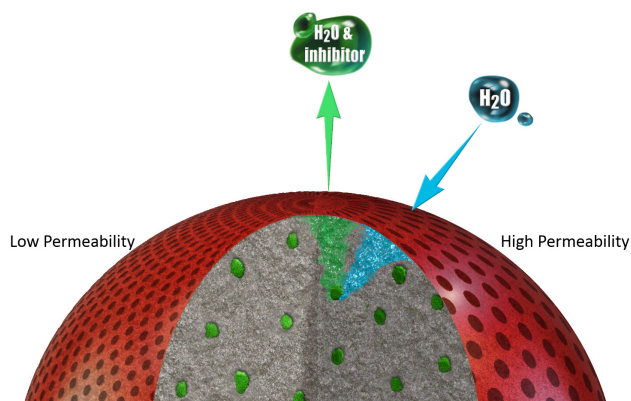


Figure 1. Fully-controlled release technology.



Figure 2. The CARBO production services team ensures that each production assurance treatment is executed as designed.