

NEUTRALWET

Neutral wettability relative permeability modification technology

Features

- Surface modification that alters the wettability of treated proppant to neutral with a contact angle $\sim 90^\circ$
- Coating stable up to 400°F (205°C) so suitable for most wells
- Treated proppant compatible with fracturing fluids
- Available as a flow enhancement to any CARBO ceramic proppant

Benefits

- Increases oil and gas production
- Improves water-based fracture fluid clean-up after stimulation
- Prevents water-based fluids from becoming trapped in pack pore throats
- Increases effective fracture length, conductivity and permeability
- Reduces pressure drop due to multiphase flow effects
- Virtually eliminates capillary forces in the proppant pack
- Increases condensate production to help combat condensate banking



Free water-based fluids. Free more production and recovery

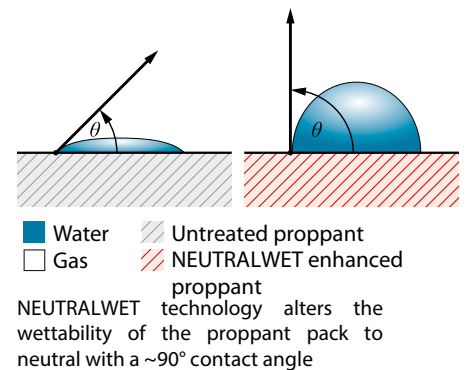
NEUTRALWET relative permeability modification technology is engineered to alter the wettability of proppant to neutral, preventing the retention of water-based fluid in the proppant pack. NEUTRALWET technology increases the effective fracture length, conductivity and permeability of the pack to hydrocarbons, leading to higher production and increased ultimate recovery.

Remove capillary effects

Most conventional proppant is strongly water wet, exhibiting a contact angle $< 90^\circ$. This allows for easy wetting and dispersion of the water-based fracturing fluids in the fracture, causing them to become trapped in the pore throats of the proppant pack.

NEUTRALWET technology alters the wettability of the proppant surface to neutral. This leads to a contact angle of $\sim 90^\circ$, which virtually eliminates capillary forces that prevent water and water-based fracture fluids from becoming trapped after fracturing and during production. This leads to an increased hydrocarbon permeability.

NEUTRALWET is a flow enhancement technology available with any CARBO ceramic proppant



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Increase fracture fluid clean-up, fracture length and conductivity

Proppant enhanced with NEUTRALWET technology improves fracture fluid clean-up by reducing the retention of water-based fracture fluid, which increases conductivity. The improved fracture clean-up and the reduction in conductivity impairment due to gel damage lead to an increased effective fracture length.

Reduce multiphase flow pressure drop

Multiphase pressure drop effects in the fracture can reduce production and ultimate recovery by favoring one hydrocarbon or fluid phase over another. When two phases are present in the proppant pack, they compete for the same space to flow. By reducing capillary pressures through neutral wettability proppant, we can significantly reduce the amount of water competing for this space, ultimately allowing more oil production.

Enhance the performance of any CARBO ceramic proppant

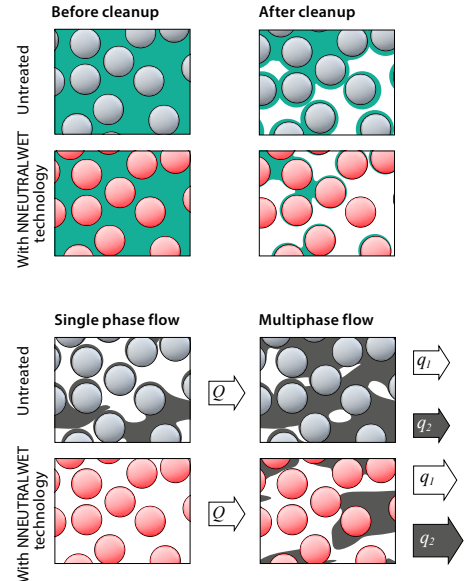
NEUTRALWET technology is a surface modification coating applied during the manufacturing process and is available with any CARBO ceramic proppant. Treated proppant is frac-fluid compatible and the coating is stable up to 400°F (205°C) so they can be used in most stimulated wells.

Field-proven to significantly increase production

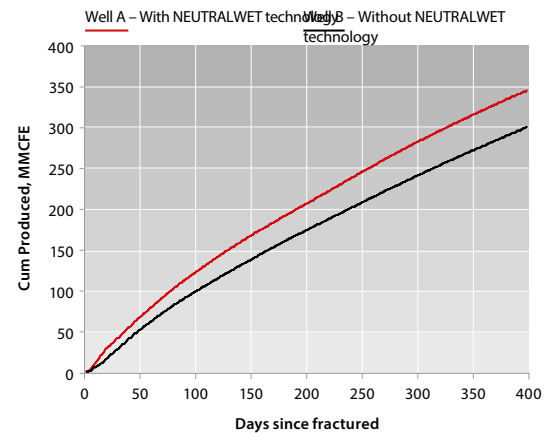
Fractures built with proppant enhanced with NEUTRALWET technology have been proven in field trials to deliver a significant increase in both oil and gas production, with a rapid payback on the investment in NEUTRALWET technology.

An East Texas well enhanced with RPM technology:

- Delivered a 15% increase in overall production
- First gas production nearly twice as fast as the untreated well
- Experienced an 80% increase in condensate production, indicating the potential effectiveness of NEUTRALWET technology for combating condensate banking



Cumulative production comparison



Talk to CARBO to find out how we can help you enhance your production.

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CARBO

Production. Enhanced.