

ClearFRAC CO₂ Surfactant

Schlumberger

ClearFRAC* CO₂ polymer-free fracturing fluid was developed specifically for wells requiring the added flowback energy and hydrostatic benefits of hydraulic fracturing with liquid carbon dioxide.

The fluid was designed to be CO₂-compatible, specifically addressing the technical aspects of creating a stable foam with supercritical CO₂. Possessing all of the attributes normally associated with Schlumberger viscoelastic surfactant systems, ClearFRAC CO₂ fluid exhibits low friction pressure and excellent proppant-carrying capacity, leaves no damage in the proppant pack, improves location logistics, and creates greater effective fracture half-lengths.

Because ClearFRAC CO₂ fluids are formulated to avoid damage in the proppant pack, the fracture's production is unimpeded. Even at low viscosity, the elastic property of the ClearFRAC CO₂ surfactant makes it highly efficient at transporting proppant. The result is the ability to alter viscosity for better control of fracture geometry without compromising transportability.

The low friction pressure generated by the ClearFRAC CO₂ system can vastly improve stimulation through tubing by allowing higher pump rates at maximum treating pressure or lower treating pressures at a given pump rate.

ClearFRAC CO₂ surfactant will experience viscosity reduction following the fracturing treatment through any of the following methods: CO₂ liberation, dilution with formation brines, contact with the prepad, contact and mixing with hydrocarbons, and the addition of chemical breakers.

The ClearFRAC CO₂ system is prepared with 2% potassium chloride (KCl). An encapsulated nonoxidizer breaker is added to the slurry stages. The breaker is designed for the proppant-laden stages and is easily metered through dry-additive feeders.

Viscosity is reduced immediately upon release (closure). This is caused by the disruption of the micelle structure and the elimination of foam stability.

Applications

- CO₂ foam fracturing treatments at up to 200°F [93°C]
- Depleted and/or underpressured reservoirs
- Stimulation through coiled tubing
- Fracture height containment

Benefits

- Improved flowback and cleanup
- Better stimulation with increased effective fracture half-length
- Reduced hydraulic horsepower requirements or greater pump rate potential at maximum surface pressure because of reduced system friction pressure
- Unimpaired production because the proppant pack is not damaged by the surfactant

Features

- Simple one-additive system
- Effective proppant transport characteristics
- Polymer-free
- Excellent drag reduction properties resulting in low friction pressure

ClearFRAC CO₂ fluid, as a single-additive system, simplifies CO₂ fracturing treatments.



Successful stimulation of depleted tight sandstone improves production by 164%

An operator wanted to improve production from an aging field in the Texas Panhandle. The reservoir depth and pressure depletion made CO₂-base fracturing fluids the system of choice for the field. The problem was achieving an effective fracture half-length with CO₂ that would maximize the financial returns.

Normal treatments were polymer-base CO₂ systems pumped down 4½-in. casing. High friction pressure would not allow pumping this system down smaller-diameter tubing. Flowing the well back up tubing increases the flow-back velocity, which aids cleanup by increasing the liquid-carrying capacity.

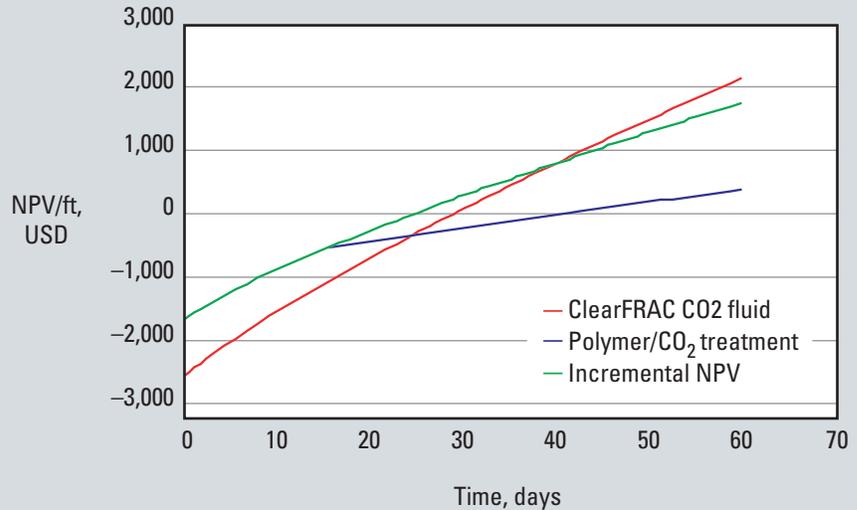
To improve cleanup by stimulating down tubing and not introducing polymers that could damage the proppant pack, the operator used robust ClearFRAC CO₂ fracturing fluid. Low-friction ClearFRAC CO₂ treatment was successfully performed down 2¾-in. tubing, which both reduced rig time and improved cleanup. Operations were further simplified because the ClearFRAC CO₂ system used only one liquid additive and an encapsulated breaker mixed on the fly whereas the polymer fluid required seven additives.

ClearFRAC CO₂ treatment increased fracture half-length by 41% and conductivity by 197%. As a result, production was increased by 29% in comparison with polymer treatment of the same formation in a nearby well. Normalized by net foot of pay, the production increase was 164%.

Significant reductions in the cost of operations were realized by using the ClearFRAC CO₂ system over conventional polymer treatments. The treatment fluid volume was 18% less and the flush volume was 25% less. Tubing installation costs were reduced because snubbing operations, packer lubrication, and killing the fractured zone were no longer necessary.

The operator is planning more ClearFRAC CO₂ treatments in the field to improve production in additional wells.

A ClearFRAC CO₂ treatment produced a 10-day improvement in net present value (NPV) and significant incremental return on investment.



The ClearFRAC CO₂ treatment increased fracture half-lengths and conductivity to maximize production.

