CHEMISTRY: CASE STUDY

NEXTIER

Rethinking Emulsion Prevention: Targeting the Root Cause

CHALLENGE

Operators across the Permian and Haynesville basins increasingly face **severe emulsion formation during load recovery**, creating operational bottlenecks and added costs

SOLUTION

NexTier implemented a **holistic fluid-system redesign** focused on **preventing emulsion formation rather than treating it after the fact.**

RESULT

The redesigned fluid system delivered **immediate and measurable field benefits.**

Stable oil-water emulsions are common in shale formations during the load recovery of hydraulic fracturing fluids. These emulsions can cause significant operational challenges including:

- Overwhelming separation equipment
- Requiring excessive de-emulsifier usage
- Increasing truck-off, handling, and disposal costs
- Extended cleanup and time-to-sales

Field observations showed the problem was **most severe at surface conditions,** particularly after fluids passed through **high-turbulence choke valves,** where shear energy stabilized emulsions. The issue persisted even in **High Resins/Paraffin oils and condensates,** making traditional non-emulsifier approaches unreliable.

In several Delaware Basin wells, operators using **invert emulsion-based friction reducers (EPAMs)** experienced persistent emulsion problems tied to the **surfactants and inverters required in EPAM formulations.** Conventional mitigation relied heavily on **post-frac de-emulsifiers,** adding cost without addressing the root cause.

The approach combined laboratory screening with field deployment and evaluated:

- Friction reducer chemistry and delivery form (EPAM vs. Slurry vs. Dry)
- Surfactant and non-emulsifier selection
- Interfacial tension behavior between completion fluids and crude oil
- Viscosity and viscoelastic properties influencing emulsion stability

NexTier's Chemistry Innovation Center found that commonly used EPAM inverters with **high hydrophilic-lipophilic balance (HLB >12)** were found to **stabilize oil emulsions,** particularly at surface conditions. **They also found that oil-based slurry friction reducers** not including surfactants with High HLB while maintaining hydraulic performance and higher interfacial tension between frac fluid and oil correlated with **faster and more complete emulsion separation.** Slurry-based systems showed **significantly improved separation,** even without added non-emulsifiers.

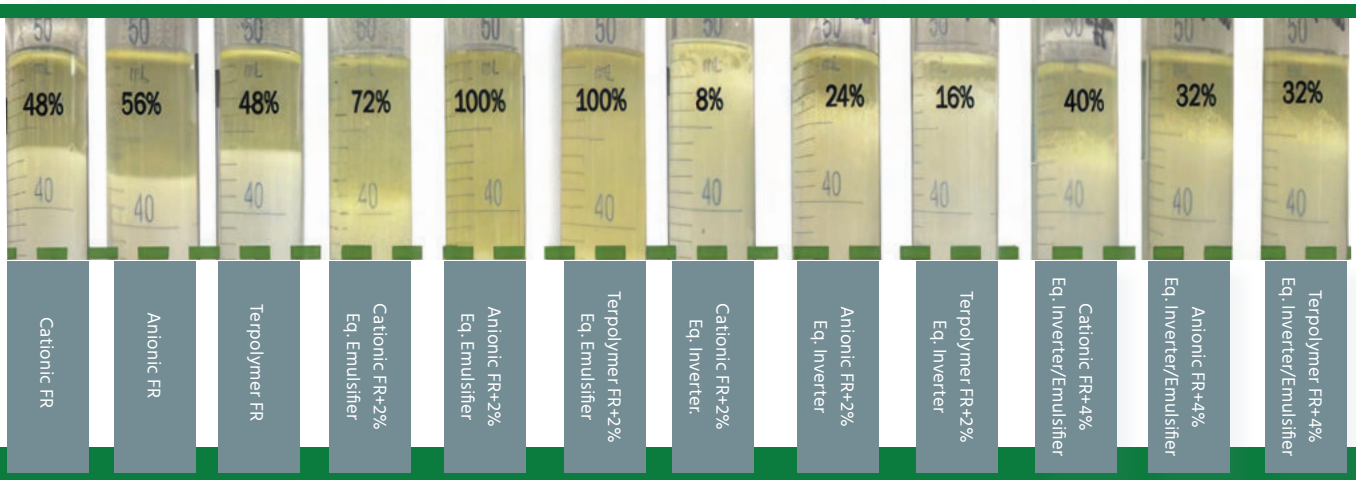

Fig. 1 shows the effect of EPAM emulsifier (HLB=3.9) and inverter (HLB = 12.9) on the emulsion separation

Based on these results, NexTier deployed **oil-based slurry friction reducers** as part of a redesigned completion fluid package shifting emulsion control upstream into fluid selection rather than surface chemical treatment.

Across **22 wells in the Delaware Basin,** operators reported:

- **Zero stable emulsions** observed during separator retention time
- Improved separator efficiency and throughput
- Reduced chemical cost

Laboratory testing confirmed the field results:

- Slurry-based friction reducers achieved **>90% emulsion separation** under surface conditions where EPAM systems struggled
- Improved performance was consistent across **Permian Delaware in Bone Springs and Wolfcamp A** and **B formations in Ward, Reeves, Pecos Counties and Haynesville condensates**
- Emulsion prevention proved more effective than post-formation chemical treatment

By addressing **emulsion formation at the source,** NexTier enabled operators to streamline flowback operations, protect downstream equipment, and accelerate production readiness without sacrificing stimulation performance.

For additional details refer to Paper SPE-227856-MS - New Holistic Approach to Prevent Emulsion Formation from Fracturing Fluids – (Kakadjian et al., 2025)