



DEEPCLEAN

**A powerful spacer that cleans your well to water-wet
in less time, even under extreme conditions**

DEEPCLEAN: The powerful single-product spacer pill for multi-stage displacements



Historically, displacing synthetic or oil-base drilling fluid with clear brine prior to completion required the application of several different products at the rigsite. DEEPCLEAN[†] is a powerful single-stage spacer that satisfies all the technical requirements of a multiple-stage displacement wash train but with only one product. What's more, it converts the wellbore to a water-wet state much faster than conventional multi-additive wash trains.

Unlike other solvent- and surfactant-based displacement chemicals that require separate spacers, the DEEPCLEAN single-stage wash spacer maintains its efficient performance when the wellbore pressure differential requires weighting up the spacer in heavy brine.

A fast-acting solution that delivers water-wet wells under the toughest conditions

Features

- Double-emulsion formulation
- Surfactant/solvent combination
- Can be used at lower concentrations
- Compatible with high density/divalent brines
- Improved oil/synthetic-base film removal
- Reduced contact times
- Disperses oil droplets for smaller interface
- Emulsion prevention
- HPHT stability

Benefits

- Produces water-wet casing and pipe surfaces ready for completion brine
- Enhances wellbore cleanliness
- Requires smaller spacer sizes
- Lowers displacement costs
- Improves waste separation at the surface
- Minimal environmental footprint
- Reduces displacement time
- Requires less chemicals
- Generates lower waste volume
- Simplifies storage and logistics

The typical approach to removing invert-emulsion drilling fluids and converting the wellbore to a water-wet state was a wash train comprising several clean-up pills. While managing a multi-product wash train was difficult enough, the inherent chemistry of most spacer pills did not yield temperature stability, making them ill-suited for high-pressure, high-temperature (HPHT) conditions. In addition, no single product was available that could function effectively in water, seawater and high-density brines.

The DEEPCLEAN technology from M-I SWACO, a Schlumberger company, provides a single pill solution for faster and more efficient wellbore cleaning. Equally effective in water, seawater and high-density brines, the double emulsion of the DEEPCLEAN additive thins, dissolves and disperses oil and synthetic-base fluid residue, leaving downhole tubular and metal surfaces in a water-wet state.

The efficient combination of powerful solvents, surfactants and water wetting agents provides highly effective surface cleaning over a wide range of temperatures up to 300°F (149°C). The DEEPCLEAN single-additive spacer routinely exceeds expected nephelometric turbidity unit (NTU) and total suspended solids (TSS) cleaning targets.

The superb cleaning efficiency of the DEEPCLEAN additive delivers results at low volumes and concentrations; translating into an effective displacement that costs considerably less than conventional approaches, while also reducing the time required to complete the displacement. The chemical make-up of the DEEPCLEAN spacer means that it is acceptable for use in the most tightly regulated ecosystems. An excellent health, safety and environment (HSE) profile makes it ideal for deepwater applications.



Leveraging the cleaning power of double-emulsion technology

The DEEPCLEAN single-stage spacer pill capitalizes on step-change advancements in surface chemistry in a uniquely engineered formulation of surfactants and solvents.

The surfactant package has exhibited exceptional solubility in all completion brines, from 8.3 lb/gal (1.0 sg) up to 19.0 lb/gal (2.28 sg), and with documented contact times considerably faster than conventional wash train chemistry.

During the displacement process, DEEPCLEAN creates a perfect interfacial film between the solvent and aqueous phases. When mixed in an aqueous or brine fluid, the additive creates a complex water-in-oil-in-water structure in which the dispersed solvent droplets contain smaller

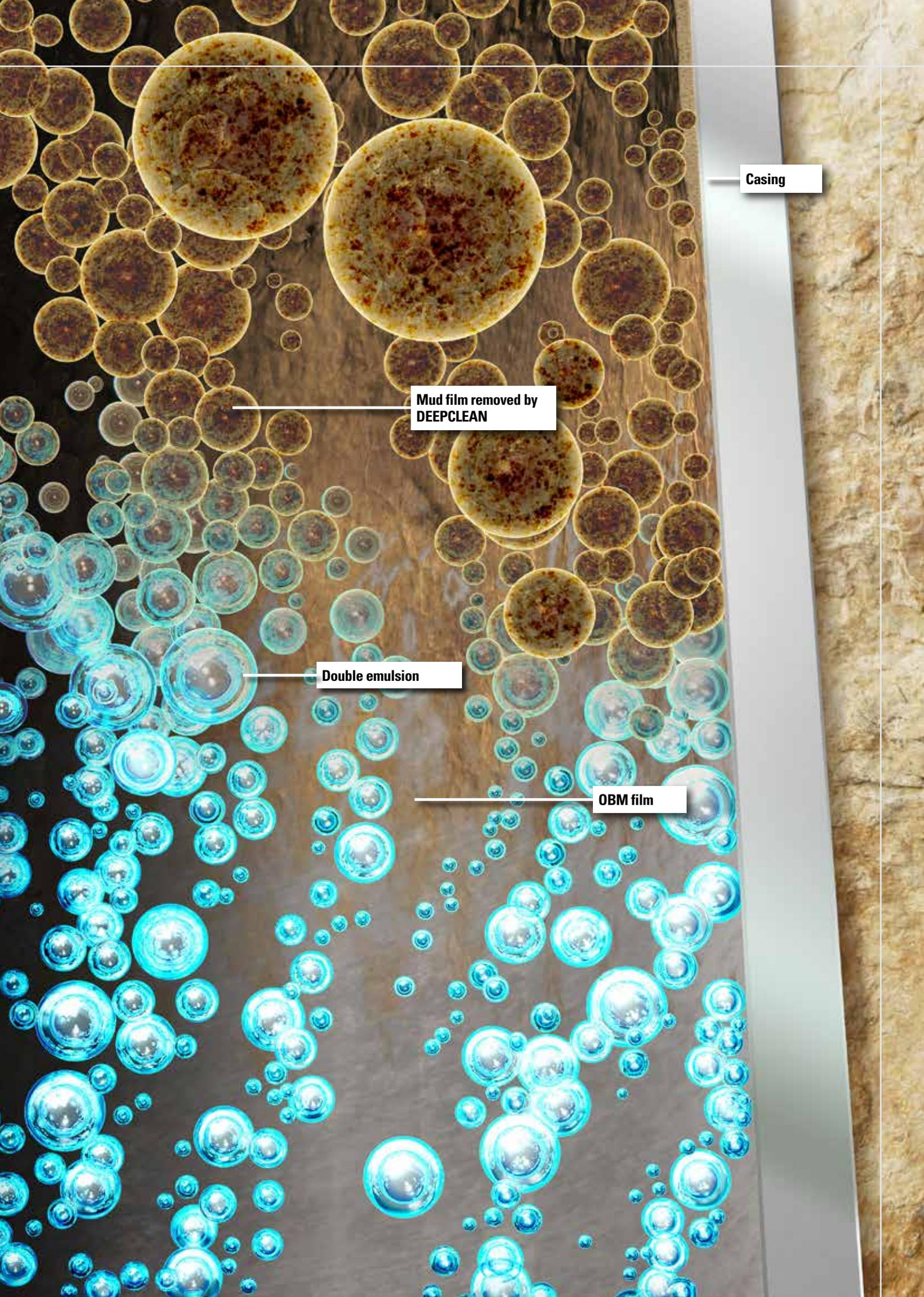
droplets of an aqueous phase containing surfactants. As such, both water-in-oil (W/O) and oil-in-water (O/W) emulsions exist simultaneously.

This novel structure enhances the mass transfer between the cleaning spacer and the oil or synthetic-base film. The oil phase in the invert emulsion film is effectively dispersed in the solvent droplets. Meanwhile, the smaller aqueous droplets containing the surfactants are delivered to the invert emulsion film where it water-wets the solids and tubular surfaces. At this point, all remnants of the drilling fluid have been removed from the wellbore, clearing a clean path for installation of the completion hardware.

DEEPCLEAN additive forms a double emulsion in brine under shear, so that both water-in-oil and oil-in-water emulsions exist simultaneously. The unique structure enhances the mass transfer between the OBM film and the DEEPCLEAN spacer, so that oil film is removed rapidly, solids are dispersed and the surface is water-wetted effectively.



Clean pipe surface



Casing

Mud film removed by
DEEPCLEAN

Double emulsion

OBM film

Offshore Nigeria: DEEPCLEAN wash train reduces cleaning time five-fold

The Situation

The well was drilled to 17,586 ft (5,362 m) TD in 4,465 ft (1,361 m) of water using a 11.25 lb/gal (1.35 SG) NOVAPRO⁺ synthetic-base drilling fluid. The riser, 14-in. casing, and 10¾-in. liner, containing 3,050 bbl (485 m³) of the synthetic-base mud, were to be displaced with seawater using a displacement train. Once the cleanliness specification had been met, the wash train would be displaced with kill-weight completion brine. This type of displacement had previously been performed using competitive wash trains. Typically, once the cleanup pills were back at surface, the seawater flush would require pumping five times bottoms-up volume before the well could be judged clean.

The Solution

M-I SWACO designed the displacement with its VIRTUAL COMPLETION SOLUTIONS⁺ proprietary software with DEEPCLEAN recommended as the sole cleaning agent in the transition and wash spacers.

The Results

The choke, kill and boost lines were displaced and cleaned using 44 bbl (6.9 m³) of transition pill, after which the well displacement was executed. Once the pills were back on surface, samples of the seawater returns were captured and analyzed for properties including density, pH, solids content and NTU. Upon first seawater returns, the NTU readings had dropped below 50 and remained steady. The displacement time was on a little more than one circulation of bottoms up – five times faster than previously displaced offset wells.



Gulf of Mexico: DEEPCLEAN Additive Effectively Cleans Deepwater Well Shut-in for 10 Years

The Situation

A Gulf of Mexico operator planned to re-enter a well that had been shut in for at least 10 years with 10.5 lb/gal (1.2 sg) synthetic based mud. The operation would require drilling a sidetrack before attempting to complete the well. Owing to the unknown condition of both the mud and casing, the operator required an additive that offered the best possible efficiency for cleaning and water wetting the casing.

The Solution

The operator selected a wash spacer formulation incorporating the new dual purpose DEEPCLEAN product, which also was specified as an additive in the transition spacer. The DEEPCLEAN product is engineered for thorough and efficient cleaning of technically demanding well cleanups. DEEPCLEAN product was specially designed and tested to outperform other cleaning products even in laminar flow. In addition, the displacement was designed using M-I SWACO best practice design techniques.

The Results

After circulating only 200 bbl of seawater, the NTU reading was less than 100, indicating a successful casing cleanup and displacement. Further evidence of a successful cleanup was observed when the well was displaced with the clear brine and the final NTU reading was reduced to 25 with only a trace of solids.



DEEPCLEAN spacer disperses invert emulsion fluids readily and quickly



ONLINE RESOURCES

Completion Fluids

www.miswaco.com/completion

Spacers & Displacements

www.miswaco.com/spacers

DEEPCLEAN

www.miswaco.com/deepclean

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