

New-age approach to an age-old problem

A novel surfactant/oxidant system provides a single-step treatment for oil-based filter-cake removal.

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The adage “time is money” is never more true than in production of a commodity such as oil. Reducing the time between well development and oil production while enhancing production efficiency has recently become an area of opportunity with respect to a key step in the well completion process—removal of residual filter-cake buildup.

Conventional oil-based filter-cake cleanup methods consist of multiple chemical injection steps including enzymes, chelating agents, reactive mineral acids, oxidizers or a combination of these chemicals. These methods are also typically preceded by various pretreatments to alter surface wettability from oil-wet to water-wet. Given the current crude oil market dynamics, the timing seems right to utilize a single-step, lower cost approach for well-bore cleanup.

EthicalChem saw the industry need for an easier, affordable, single-step process to remove filter cake. “The MudOut single-step approach not only reduces cost spent on injection equipment, labor hours and overall chemical volume but also allows the well to become a production well faster,” said Dr. Betty Felber, chemist formerly with Amoco, Core Labs and the U.S. Department of Energy as well as one of five

2014 Society of Petroleum Engineers IOR Pioneer Award recipients.

Drawing on years of experience with surfactant-oxidant chemistry, EthicalChem formulated a product that would address both the organic and inorganic components of filter cake while eliminating the need for pretreatment steps to alter surface wettability.

Following extensive R&D in collaboration with the Harold Vance Department of Petroleum Engineering at Texas A&M University, EthicalChem

announced the release of its new patented product, MudOut, in mid-2015.

MudOut disperses oil-based filter cake and removes internal damage without causing significant corrosion impacts on steel and without a series of pretreatment stages. In laboratory testing at Texas A&M under a variety of temperature and brine conditions, MudOut consistently removed 98% of filter cake.

In a head-to-head comparison with formic acid (9% solution by weight) MudOut removed 95% of filter cake after 4 hours, whereas formic acid removed only 78%. After 20 hours, MudOut had removed 98%, while formic acid removed 92%.

Figure 1a shows the effect of 8 hours of MudOut treatment on filter cake. No filter cake or residue is observed, and experimentally 97% of the filter cake was removed. Figure 1b shows the effect of 8 hours of formic acid treatment on filter cake. A substantial amount of filter-cake residue remains visual after the



FIGURE 1. Filter cake (1a, top) is shown before (left) and after (right) MudOut treatment. The filter cake (1b, bottom) can be seen before (left) and after (right) formic acid treatment. (Source: EthicalChem)

Filter cake removal by MudOut and formic acid		
Hours	MudOut	Formic Acid
4	95%	78%
8	97%	85%
20	98%	92%
Final Permeability Ratio	2.1	1.2

TABLE 1. Removal efficiency and permeability ratios show the comparison between MudOut and formic acid. (Source: EthicalChem)

formic acid treatment, and experimentally only 85% had been removed.

In addition to the clear performance advantage in terms of filter cake removal, the retained permeability shows that there is some stimulation effect from the MudOut, with a permeability ratio (k_f/k_i) of 2.1. In comparison after treatment with formic acid, the permeability ratio was 1.2 under the same test conditions.

Table 1 shows the removal efficiencies of MudOut and formic acid after 4 hours, 8 hours and 20 hours of treatment along with the final permeability ratios. Results show that MudOut outperformed formic acid at each time interval and resulted in a higher permeability ratio, indicating improved permeability.

Dr. Hisham Nasr-El-Din, Texas A&M University professor and holder of the John Edgar Holt Chair, who oversaw product testing at Texas A&M, said, “We were pleased to test the MudOut product. It truly represents a significant advancement in filter-cake removal technology in terms of both filter-cake removal performance and elimination of costly steps required by conventional treatment approaches.”

How it works

The key to the MudOut price/performance advantage is the innovative patented surfactant and oxidant system, which works to address both the organic and inorganic components of filter cake. The plant-based surfactant, which was selected in part for its ability to provide stability to the oxidant, solubilizes and emulsifies the hydrocarbons while the oxidant addresses the polymers.

Additionally, decomposition products drive the pH to below one, creating temporary acidic conditions at

the tail end of the process, which dissolve inorganic components of the filter cake such as calcium carbonates. The MudOut oxidant includes multiple coated oxidants that can be varied to create well-specific formulations, which ensure controlled, uniform reactions, thereby preventing partial filter-cake removal or wormholes.

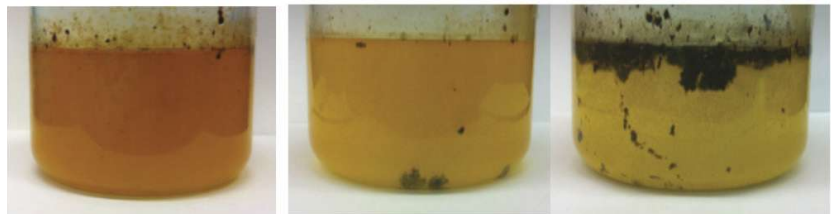
Figure 2a illustrates how MudOut surfactants and oxidants dissolve and solubilize filter cake, which enables easy removal through pumping. Acid treatments, which primarily only address inorganic components, result in incomplete breakdown into large masses and incomplete removal as shown in Figure 2b (formic acid treatment).

The MudOut blend can be formulated for well-specific conditions with, for example, a longer lasting, more durable blend used under harsh conditions (high temperatures and high brine) and a faster acting blend used for lower temperatures and lower brine.

“Now is the right time for oil services companies and producers to embrace new technologies such as MudOut, which can significantly lower costs while bringing wells into production faster,” Felber said. **ESP**



2a



2b

FIGURE 2. MudOut surfactants and oxidants dissolve and solubilize filter cake, which enables easy removal by pumping. After 4 hours, 8 hours and 20 hours of treatment, the top row (2a) shows MudOut filtrate with the filter cake ready for pumping, while the bottom row (2b) shows results with formic acid (9% by wt). (Source: EthicalChem)