Concentrated emulsifier can provide better stability

Jeff Miller, Alan Clark, and Lane Bates, Halliburton Baroid

HOW MUCH EMULSIFIER does a typical invert emulsion fluid require? Some wells require truckloads to maintain oil- or synthetic-base fluids to reach the target depth. Others may need a few 55-gallon drums each day to keep drilling.

A new concentrated emulsifier recently introduced by Baroid has demonstrated that just five gallons of emulsifier a day can provide equivalent or better electrical stability (ES) than conventional emulsifiers.

An innovative development in surfactant technology makes this possible and changes almost everything we have come to expect from conventional oil mud emulsifiers.

The new emulsifier not only gets results with lower treatment levels, but also helps provide filtration control.

Fluids service representatives carefully monitor properties such as the electrical stability to gauge the health of the emulsion. As a rule, emulsifier products are added to provide stronger emulsions or accommodate influxes of water or formation solids.

The invert emulsifier products offered by drilling fluids service companies have long been considered effective in terms of performance and economical in terms of the cost to the customer. While some operators are satisfied with commonly used products, the fact is the majority of today's popular chemistries are hamstrung since they require inert-oil carriers (also known as solvents) to have a suitable pour point. Standard oilfield emulsifiers generally contain around one-third solvent, and low-cost offerings can contain more solvent than active product.

Another crucial issue for fluids providers is proper control of filtration. Plenty of filtration control additives for invert systems are available, ranging from untreated black powders to modified leonardite, and more recently include various polymers.

Like emulsifiers, these materials have only one specific function: to reduce migration of base oil from the fluid to the formation.

Taking care of these two essential fluid functions normally requires an inventory on location of one or more drummed products, as well as several pallets of sacked additives.

Since routine maintenance is needed to keep the fluid in shape, the on-site warehouse is re-stocked by periodic truck or boat deliveries.

Rig crews can have a tough job making chemical treatments to the mud system. When emulsifiers and fluid loss additives are packaged as separate materials, rig personnel have to manipulate onsite inventory to get the right product to the hopper. Forklifting pallets is relatively simple, but handling 55-gallon drums that weigh between 400 and 500 lbs can be difficult.

After the treatment is completed, all empty sacks and drums have to be picked up for disposal at an additional expense to the customer.

Today's service companies handle a large portion of this effort, since deliveries to location leave empty trucks ready to remove packaging waste.

While empty sacks are relatively easy to dispose of, emulsifier drums can only be used once. When picked up from the rig site, they are taken to a central location where they are cleaned and shredded for disposal.

CONCENTRATED EMULSIFIER

These circumstances set the concentrated FACTANT™ emulsifier and filtrate reducer at a distinct advantage. Developed in the year 2000 and introduced in 2001, the product is a blend of surfactants that provides robust invert emulsions and filtration control.

It relies on a concentrated emulsifier package (CEP) to form and stabilize the emulsion and to provide solids wetting.

With less than 5% solvent by weight, the CEP blend offers more active surfactant for any given container volume. While this gives customers more real product in each package, the most significant difference is that on an active basis half as much of the new surfactant blend can

Table 2: SBF Comparison

SBF Properties after Mix	Conventional	CEP Blend
Density, lb per gallon	9.0	9.2
Oil-to-Water Ratio	73/27	72/28
Plastic viscosity at 80ºF, cP	23	27
Yield point at 80ºF, lb/100 ft^2	6	19
6-/3-rpm readings at 80ºF	3/3	9/8
Electrical Stability, volts at 80ºF	225	487
Plastic viscosity at 120ºF, cP	16	19
Yield point at 120ºF, lb/100 ft^2	5	14
6-/3-rpm readings at 120ºF	3/2	9/8
Electrical Stability, volts at 120ºF	264	519
HTHP filtrate at 200ºF, mL	1.8	1.2

Table 1: SBF Comparison

SBF Components	Conventional		CEP Blend	
	Units	lb/bbl	Units	lb/bbl
11.8 lb/gallon Conventional SBF	87 bbl	—-	87 bbl	—-
Base Oil	138 bbl	—-	138 bbl	—-
Freshwater	27 bb	—-	27 bbl	—-
Emulsifier	11672 lb	5.57	660 lb	2.20
Emulsifier	2400 lb	1.33	0 lb	—-
Lime	800 lb	2.67	1300 lb	4.33
Filtration Control Additive	800 lb	2.67	0 lb	—-
Organophilic clay viscosofier	1050 lb	3.50	1050 lb	3.50
Calcium chloride brine	36 bbl	—-	36 bbl	—-
Sized calcium carbonate	4500 lb	15.00	4500 lb	15.00
Suspension agent	500 lb	1.67	500 lb	1.67

provide equivalent or better performance than conventional emulsifiers.

Compatibility and compliance should also be considered. Synthetic-, mineral oil-, and diesel-base mud systems use three different versions of conventional emulsifier that contain carriers to match the base oil.

The CEP blend is a more versatile product that may be used in any invert emulsion mud, regardless of the type of base oil.

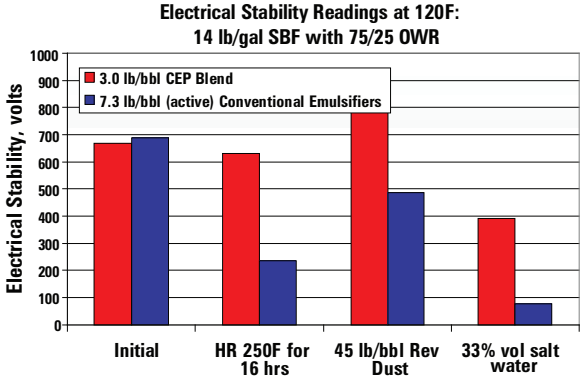

Figure 2 - Comparative ES Readings

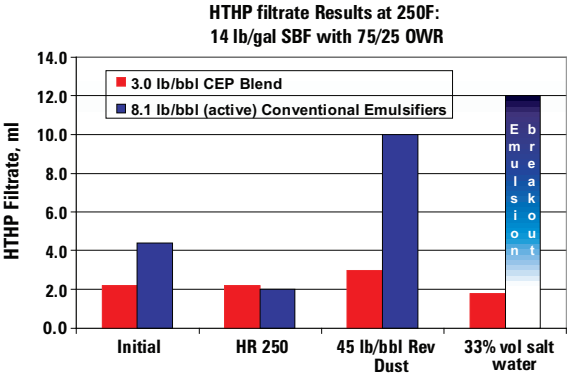

Figure 3 - Comparative HTHP Filtrate Volumes

In terms of the impact to the environment, this product allows a significant reduction in shipping freight going out to the rig and the waste stream of used packaging materials (Figure 1).

Offshore, the concentrated emulsifier is usually delivered in re-useable tote tanks that completely eliminate packaging wastes.

FACTANT emulsifier is also sold in five- and 15 gallon containers. These can allow for more precise system treatments and help reduce the risks associated with spills.

Smaller packaging can provide yet another advantage over large drums since base oil can be used to wash every drop of product into the mud system. The clean pails also find several uses around the rig.

EMULSIFIER TESTING

Extensive formulation work took place in Baroid's Research and Development Laboratory in Houston. Synthetic-base fluids testing revealed that relatively low concentrations of the new emulsifier were capable of providing more stable emulsions than hearty treatments of conventional emulsifiers.

Numerous fluids were tested for thermal stability at 250ºF.

After evaluating the properties, the fluids were contaminated with solids or salt water and stressed again at 250ºF (Figures 2-3).

The conclusions were clear: far less concentrated emulsifier was needed for better properties.

The lab performance trends were verified in Baroid's liquid mud plant in Galveston.

A standard synthetic-base fluid (SBF) was diluted 70% by volume to a final volume of 300 barrels.

With a small addition of lime, the CEP blend produced a better ship-out fluid and drastically reduced the amount of chemicals and effort required (Tables 1-2).

Only 83 gallons of the new emulsifier were added, with no need for filtration control additives.

Using the CEP blend allowed the mud plant to build volume quickly and eliminated the addition of more than one ton of additives.

An unexpected bonus was that the CEP blend also gave enhanced suspension characteristics, a difficult feat for any batch of fresh synthetic-base fluid.

CASE STUDY

Over thirty wells have been drilled in the Williston Basin of North Dakota using the new emulsifier. A typical well for this area takes an 8 3/4-in. hole to 12,000 ft, though some operators choose larger diameters (9 7/8-in.). Normally, 50 drums of conventional emulsifier and 100 sacks of filtration control additive are required.

One operator made the switch to the concentrated blend and reduced the amount of emulsifiers needed to the equivalent of 11.3 drums. They also eliminated over two tons per well of sacked filtration control additives.

Many wells reaching maximum temperatures of 280ºF have not required any filtration control additives when the new product was used.

The operator realized an immediate savings in this case by minimizing shipping expenses and eliminating empty drums.

Drum disposal alone could have incurred costs of around $1000. The rig crew was able to carry out routine treatments more easily due to the smaller containers.

Customers who have experienced the benefits of using the concentrated emulsifier, and much less of it, have adopted it as a standard practice in many locations. The benefits include:

- For many wells, a 5-gallon pail of concentrated emulsifier can replace a treatment requiring a 55-gallon drum of conventional product.
- Fluids formulated with this robust emulsifier can be much easier to treat and run, with greater tolerance to water influxes.
- Filtration control can be provided along with emulsification
- Water in the filtrate can be eliminated.
- Smaller containers can be much safer.
- The on-site inventory is smaller, and sacked filtration control additives may not be needed at all.
- Container disposal costs are nearly eliminated, and the operation can have less impact on the environment.