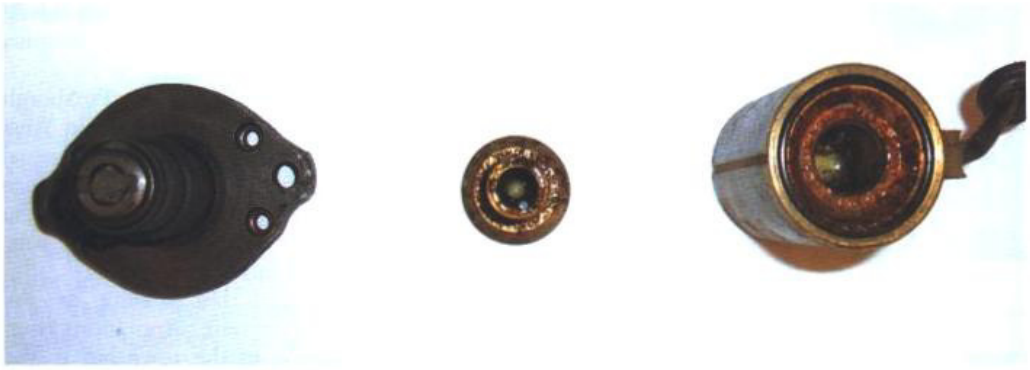
The science of longwall emulsions

MACROEMULSIONS and microemulsions – the terms may sound similar but small differences between the two can have a great impact on longwall performance and cost. Knowing the definition of both and having the ability to identify them are imperative to safety and profits.

According to Quaker Chemical consultant Kevin Dickey, of the two primary types of emulsions used in longwall fluids today, microemulsions have inherent advantages over macroemulsions. An emulsion by definition is the mixture of two unblendable liquids that have a wetting agent stabilizer, or emulsifier, which serves to lower a liquid's surface tension.



Before Quintolubric: A solenoid after 90 days use with previous fluid.

After Quintolubric: The improvement in solenoids with macroemulsions, in this case using Quintolubric 814-02.

Benefits of microemulsions

While macroemulsion fluids have an oil content greater than 20%, they have thermodynamically unstable properties and are milky white with a particle size between 50 nanometers and 500 micrometers. Microemulsion fluids have an oil content less than 20% and are thermodynamically stable, clear to translucent in color and between 5nm and 50um in particle size.

Among the benefits of microemulsions are particle sizes as they relate to performance and stability. When the emulsion's particle sizes are smaller the fluid is more naturally stable. Microemulsion particle sizes are about 10-100 times smaller than a macroemulsion.

Because longwall systems' fluids are mostly water – or approximately 95-98% water to 2-5% emulsifier – water quality can make a significant impact on an emulsion's performance and stability of an emulsion, according to Dickey. When water quality is poor, the importance of microemulsions increases.

"The small size of particles in a microemulsion – less than 100 nanometers – allows them to be more stable in different water types," development chemist Anthony Malloy said.

"Hard water emulsions usually have increased electrolytes that can cause coagulation. A macroemulsion, with larger particles, will start to coagulate faster than a microemulsion as the electrolyte levels increase."

He also pointed out that in the case of macroemulsions, larger particle sizes equate to a larger surface area that therefore comes into contact with water contaminants, and leads to bacteria and fungi issues as well as other deposits. All are problems that microemulsion can help to eliminate.

After performing tests on both emulsion types in hard water applications in purpose-designed rigs at the British Hydrodynamics Research Group, Quaker Chemical Corporation looked to its incoming data to demonstrate that microemulsions are superior, the company said.

"These tests conclusively proved that more conventional macroemulsions formed high-volume, stable foams, like shaving foam, in high-flow areas such as valves," Quaker global technical mining manager Nick Fowler said.

The company's full synthetic emulsions, specifically the Quintolubric 818 and 816 series, were tested against extreme water conditions and were found to withstand them and perform while remaining clear and stable.

"Quintolubric 818 evaluated in mine water having a hardness of 700 parts per million $CaCO_3$ and conductivity of 900 micromhos remains clear and stable," Dickey noted.

Case study

Dickey said that Quaker and one of the largest US operators, Massey Energy, came together recently on a conversion to microemulsions to increase profitability and safety.

"When Massey switched to Quaker Chemical's semi-synthetic microemulsion, Quintolubric 814-02 longwall fluid, it not only improved the performance and safety of their operations, it lowered overall production costs," he said. "Massey has seen a reduction in fluid maintenance, an increase in productivity in longwall operations, and an increase in the mine's profitability."

One of the key advantages was the elimination of bacteria, an area the producer was having problems with – at times, bacteria levels were as high as 109. After incorporating Quintolubric 814-02, all deposits have been eliminated.

"This lowered their filter consumption and improved the protection of worker health and safety," Quaker said of the end result.

Additionally, solenoid consumption using the fluid has dropped. After Quintolubric, the operator saw a decrease in solenoid changes during shifts and was able to reduce overall solenoid consumption by more than 80%. The life of the solenoids was also extended, and with downtime decreased, savings have gone up. CU