New drilling fluid saves cost, environment

A new water-based mud is helping Haynesville operators save drilling time and spread cost while adding environmental advantages to their operations.

Del Leggett, Newpark Drilling Fluids LLC

Driven by substantial reductions in overall rig days as well as savings in fluids and associated handling costs, an application-specific Haynesville shale drilling fluid introduced by Newpark Drilling Fluids LLC in 2010 confirms the system's cost and operational effectiveness. Through overall efficiency improvement, the system saved operators an average of seven days' operating time and associated spread cost while providing the added benefit of distinct environmental advantages. This water-based drilling fluid system provides the safety advantages of improved well control and influx recognition over non-aqueous fluids due to lack of compressibility.

An eco-appropriate system

The Evolution drilling fluid system was developed as an eco-appropriate solution to the extreme thermal demands and field-specific formation contaminants of the Haynesville while providing lubricity and penetration rates similar to those of oil-based muds (OBMs) in long lateral production intervals of North America's most active unconventional shale gas play.

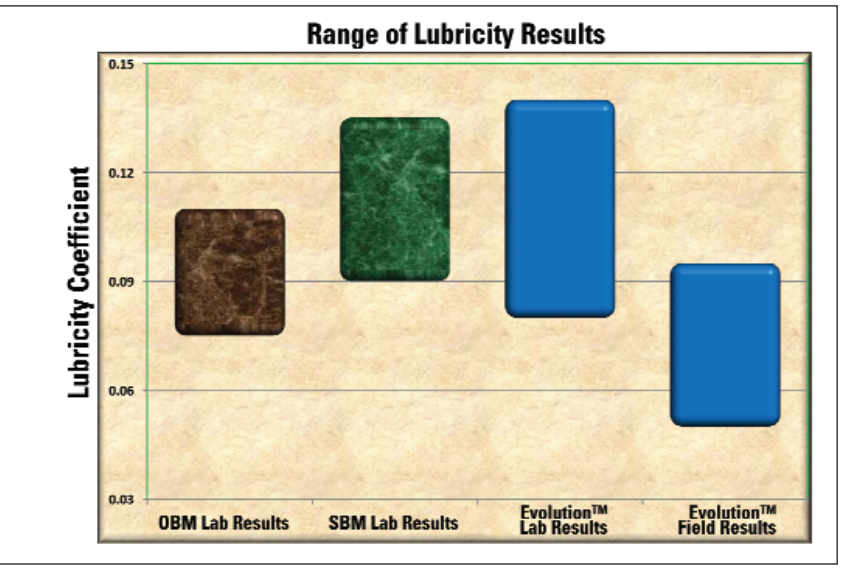
The unique clay-free water-based polymer drilling fluid system has been implemented in more than 40 applications in the year since its introduction. The density can be adjusted as is typical of any water-based mud (WBM), and its compatibility with PDC bits has been repeatedly field-proven.

For each new application, the system's formulation is customized to best address the unique geologies and drilling environment of each drilling basin. Lower-temperature and low-density versions of the system also are scheduled for deployment in other shale plays across North America.

Three new primary components resulting from an intense R&D initiative form the heart of the rugged water-based system:

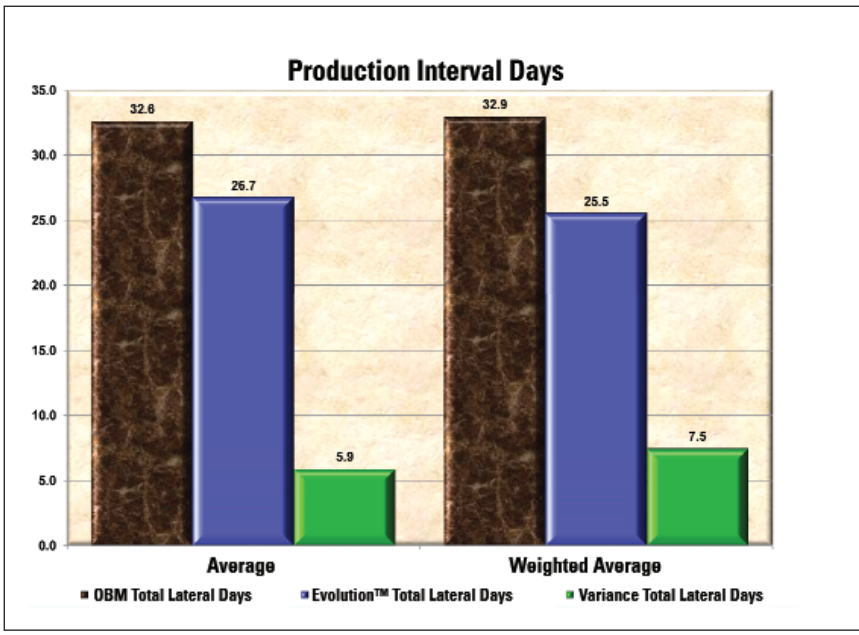
- ***EvoVis*** advanced polymeric viscosifier exhibits conspicuous thermal stability (laboratory proven to 425°F, or 218°C) and resistance to common field contaminants including CO_2 and H_2S. This rugged polymer originally was introduced for drilling fluid applications as the heart of the system. EvoVis polymer also contributes to synergism in lowering coefficient of friction when used in conjunction with EvoLube;
- ***EvoLube*** drilling lubricant provides OBM-like coefficient of friction values (0.04 to 0.09) to enhance penetration rates and enable efficient tripping of the drillstring and casing or liner running operations. The economical lubricant is effective in low concentrations and, like EvoVis, is laboratory-proven to 425°F; and
- ***EvoMod*** rheology modifier adjusts low-end rheology to optimize drilling hydraulics and hole cleaning capabilities in extremely low concentrations.

Several system characteristics and capabilities enhance its applicability to unconventional shale gas use. Primary among these are extreme thermal stability, resistance to



The water-based system is specially designed to lubricate the drilling process with OBM-like coefficient of friction values (0.04 to 0.09) to enhance penetration rates and enable efficient tripping of the drillstring. (Images courtesy of Newpark Drilling Fluids LLC)

A reduction in total interval drilling days – about 7.5 – provided operators a cost savings of about $450,000 per well.



common contaminants (CO_2 and H_2S), HP/HT lubricating capabilities, and the synergistic qualities of Evo-Vis and EvoLube to enhance penetration rates in long horizontal sections through transmission of weight to the bit. The clay-free formulation and low-end rheology modifier also enhance drilling efficiency. The system's recyclability enhances its cost-effectiveness. A relatively simple system with few components, wellsite housekeeping is simplified by virtue of fewer products required at the rig.

Field developed, proven

The system was developed in response to operators' focus on environmentally appropriate drilling practices and drilling fluid design to protect drilling locations, subsurface water sources, and the surrounding ecology, as well as eliminating the cost and potential liabilities associated with OBM usage, handling, transportation, and disposal. But economic considerations also were vital, particularly in prevailing market conditions of depressed natural gas prices that made management of developmental cost a paramount issue.

The 24-well evaluation conducted by Newpark compared operational results of the company's Evolution water-based drilling fluid system versus 11 offset OBM applications using data provided by area operators. Haynesville wells used for the analysis encompassed three Louisiana parishes – DeSoto, Red River, and Sabine – where use of the new system was most common in its first year.

Developed as an OBM alternative for drilling demanding horizontal production intervals in the Haynesville shale, the water-based system typically is displaced into the well before drilling the intermediate casing shoe and employed throughout the build, turn, and horizontal production interval to total depth, as is the case with OBM employed in offset wells used for comparison. This allowed for a straightforward comparison of cost and operational data in the review. Though all wells used in the evaluation were virtually identical in terms of total depth, kickoff point, production interval length, and lateral length, those factors were normalized for analysis. The average total depth of all wells used in the analysis was 16,330 ft (4,977 m) measured depth; the lateral production interval length averaged 5,350 ft (1,631 m). These averages were weighted according to the number of wells drilled by each operator in the analysis.

The traditional use of OBM presents key ancillary cost issues to Haynesville operators. Operator-provided spreadsheet costs regarding OBM logistics and disposal averaged approximately US $170,000 per well in the 11 OBM offset wells studied, compared to $14,700 per well for the 24 wells employing the new water-based fluid – a savings of more than $155,300 per well on fluids handling alone.

The actual fluid cost of the WBM system also compared favorably to OBM systems. In terms of cost/ft, the WBM system was more cost-effective at $25.41/ft versus $27.66/ft for the OBM system. Calculated OBM-system cost included diesel used on location for system dilution as drilling progressed. The WBM system's favorable cost was aided by its ability to be recycled from well to well after standard reconditioning, including adjustment of low-gravity solids. Recycling the fluid from well to well resulted in progressively lower mud cost over repeated use in a series of wells.

The most significant cost savings, however, resulted from reduced total interval drilling days – about 7.5 interval days saved per well – in the evaluation group comparison. From an operator-provided average of $60,000 total spread cost per day, the days saved resulted in cost savings for operators of about $450,000 per well.

Average interval drilling footage for wells employing the water-based system was about 332 ft/d (101 m/d) compared to about 242 ft/d (74 m/d) for the OBM offsets. This significant daily footage improvement resulted from consistently improved penetration rates and elimination of nonproductive time (NPT) associated with preparing the rig and location for use of oil-based fluid.

Time spent reaming and running casing was virtually the same regardless of the system in use. In both OBM and WBM wells, these totals were consistent with generally accepted field averages. The method by which total well cost and drilling days were calculated also inherently includes total NPT on all wells analyzed and is therefore included in comparative results.

Savings realized from the elimination of OBM ancillary cost, lower overall drilling fluid cost, days saved per well, improved penetration rates, and daily footage totaled approximately $700,000 per well. More abstractly, the dramatically lessened environmental impact derived from use of an OBM alternative, while real, is impossible to quantify for active Haynesville operators that value ecological stewardship as responsible corporate citizens. E&P