"magic" drilling fluid

PERFORMANCE MAKES THE CASE FOR ENVIRONMENTALLY FRIENDLY DRILLING MUD BY ELSIE ROSS

BP PETROCHEMICALS ALWAYS knew its patented Amodrill olefin drilling fluids had a lot going for them from an environmental and health and safety perspective. Originally designed to address concerns about water degradation in offshore operations, the products had low toxicity and rapid land reclamation potential compared to diesel-based muds. But what has really been attracting attention is its performance for land-based drilling, especially in deeper, harder rock formations, says Joe Palm, BP manager for linear alpha olefins (LAO). "Health and safety improvements do not mean as much unless people are drilling the wells," he says.

Two years of trials of the synthetic olefin fluid in the Noel and Wapiti areas of northeastern British Columbia and northwestern Alberta showed the synthetic oil-based mud drilled more than 50% faster in shales (greater than 15,000 psi compressive strength) than conventional diesel muds with similar properties. The trials used the same mud properties, drilling parameters and bits.

"The benefits are seen most in deep wells and when they go into hard rock," says Palm. "The harder the rock, the better the rate improves." Below 2 000 metres (6,561 feet), the rate of penetration (ROP) increased by an average of 84% and below 2 500 metres (8,202 feet) ROP surged 117%. The total drilling time for one well was reduced to 17 days from 26 days, he says. "That amounts to real money when you're paying $40,000 to $50,000 a day for equipment."

At Wapiti, of the seven wells drilled between 2000 and 2004, wells using an olefin mud took an average of 165 hours to drill to below 2 500 metres compared to 280 hours using a diesel-based mud. At Noel, the average drilling time to 2 500 metres was cut to 245 hours for the olefin mud compared to 425 hours for its competitor.

"When you are working with diesel, at about 2 000 metres there is an inflection point and all of a sudden it starts to drill a lot slower," says Palm.

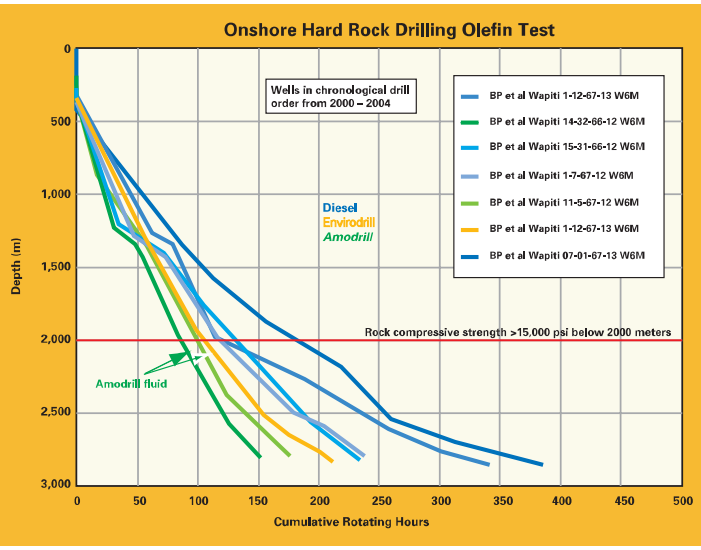
Amodrill fluids — clear, odourless products with an aromatic content of less than 0.001% — are made from ethylene compared to the diesel and mineral oil fluids that are refined from crude oil. As such it offers a "much nicer environment" for rig workers as they are not exposed to volatile organic compounds such as diesel and benzene. "One of the drillers turned to me and asked me 'What is this magic stuff?'" Palm recalls. But that quality can create its own problems. "It is so clean and so nice people forget it is a hydrocarbon and you have to use the same care and handling."

The olefin muds have a higher flash point of 116 C compared to between 66 C and 76 C for diesel-based muds, making it a safer choice. While BP manufactures two olefin products, the Amodrill 1400 fluid (isomerized tetracedene C-14) is more suitable for Canadian winters because it has a lower pour point (the lowest temperature at which it will pour) of -35 C to -40 C.

However, the synthetic oil-based muds also come with a higher price tag — double that of the cheaper diesel products. That premium, though, can be more than offset by shorter drilling times and lower remediation costs down the road, Palm suggests.

The C-14 olefin "is a lot easier to deal with than diesel cuttings, which are much more problematical to deal with and have major effects on plants," says Suzanne Visser, a research associate and adjunct professor in microbiology at the University of Calgary. Diesel-based muds and drilling cuttings typically are characterized by extreme toxicity in the environment that can persist following bioremediation. "Diesel needs to be incubated for a long time before it

NEED FOR SPEED
In hard rock drilling tests against two of its competitors, Amodrill fluid consistently led to faster drilling times.



completely detoxifies," she says.

In laboratory and field studies of the drilling fluid Visser found LAOs degrade extremely rapidly and any residue, usually very small, is non-toxic to organisms. Because there are little or no volatiles associated with the olefins, they offer a reduced health and safety risk compared to the diesel-based muds, she says.

In her bioremediation research, Visser evaluated the biodegradability of diesel and synthetic-based fluids and their toxicities to flora and fauna. These included three types of plants along with earthworms and springtails, small soil-dwelling insects that are extremely susceptible to LAO. The application of linear alpha olefin along with isomerized olefin and isomerized tetradecene stimulated the most microbial activity, demonstrating they were the most degradable, she said in a paper presented to a Society of Petroleum Engineers conference on health, safety and the environment in Kuala Lumpur, Malaysia.

In the laboratory, the very rapid rise in respiration rates of olefin cuttings in soil is strong evidence these fluids are available to be used by the microbial biomass for growth and reproduction, according to the paper. The linear structure of the relatively short carbon chain length of the isomerized olefin made them readily available for microbial degradation, Visser suggested.

The study found that in the laboratory, there was almost complete degradation (96% to 97%) of the C-14 LAO olefin cutting in the soil after three months, says Visser. At 0.25% LAO, the earthworm reproduction was higher than the control sample due to the increased mass generated from the olefins degradation.

Based on the barley, lettuce and root elongation assays, only the alpha olefin, isomerized olefin and isomerized tetradecene would exhibit little or no toxicity following bioremediation, the study concluded. It noted that toxicity of diesel to lettuce germination and root growth increased following bioremediation, suggesting the toxicity may be caused by metabolic products produced as a result of the degradation. Further study is needed in that area, says Visser.

A field study showed a slower rate of degradation than in the lab. When C-14 LAO cuttings were tilled into the soil and fertilizer added, there was 96% degradation after 28 months. Landfarming results showed 99% degradation over 36 months, meeting regulatory release levels. However, for the best results, cuttings must be properly incorporated in the soil and fertilizer added, she said.

Field data at the land farm site also supported lab results that showed no impact on barley growth after degradation to one per cent LAO. While earthworms survived at all concentrations their growth and reproduction was affected at that level.

Studies of co-compost piles in northeastern B.C. by Newpark Environmental Services found that the Amodrill olefin-based drill cuttings reached regulatory release rates faster than conventional oil-based cuttings. Co-composting involves mixing drill cuttings with wood fibre, fertilizer and some soil to facilitate the natural biodegradation of contaminants.

Researchers found olefin cuttings reached release levels of less than 0.1 extractable petroleum hydrocarbon within 32 months, less than half the time it takes for wells drilled with conventional oil-based muds. At that point, regulators would no longer consider the piles waste but simply wood chip piles.

The piles were ready to spread in the fall of 2003 at hydrocarbon levels of around 0.5%, but BP decided to continue the study. The piles remained about 20 C above ambient temperature, indicating continuing degradation to even lower levels, which was confirmed this past summer when a reading below 0.1% was recorded in one of the treatments.

Commercial interest in Amodrill products has picked up over the past year and a half as operators have begun to hear about its drilling performance, according to Palm. BP Canada has decided this drilling season that when it has to use an oil-based mud it will use the synthetic olefins obtained through a service company. This year three different service companies are using the Amodrill 1400, he says. ntm

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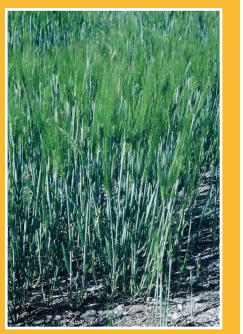

GREEN SOLUTION
**Top: Bioremediation field studies indicated rapid degradation of Amodrill drilling fluids when fertilizer is added.
Bottom: Barley growth was unaffected after degradation to one per cent linear alpha olefins.**