

New fluids, new systems lower environmental risk

NEW PRODUCTS AND NEW techniques have dramatically reduced the environmental impact of drilling operations. A key focus of these advances is drilling fluid and cuttings handling systems.

A session at the 2002 IADC/SPE Drilling Conference, "HSE: Environmental Improvements in Drilling Operations," highlights important HSE challenges and solutions. The session is to be chaired by **P D Scott, Marathon Oil Company** and **Gary Hoggatt, True Drilling Company**.

CASING CLEANING

The removal of drilling fluids from the cased well prior to installation of completion equipment often involves the use of special fluids to ensure complete removal of both the drilling fluid itself and particles attached to the casing wall.

IADC/SPE paper 74475 describes a well cleaning fluid system designed to meet technical objectives with special focus on reducing environmental impact. The paper, "Emulsion Based Fluid Used to Optimise Casing Cleaning Operations," was prepared by **E Berg and F N Shoghi, BJ Services Company**; **A Saasen, Statoil**; and **S Sedberg, BJ Services Company**.

Casing cleaning is a critical operation where failure can lead to excessive complications in the subsequent completion operation. Furthermore, these operations have the highest attention of the environmental authorities because casing cleaning is considered a highly polluting operation.

Modern drilling fluids used in the North Sea are relatively difficult to remove from the casing surface.

The casing cleaning fluid system described by the authors is designed using a partly unstable emulsion, where the surfactants are partly dissolved in the water phase and partly used as emulsifiers. Since the emulsion is unstable, the individual components can be separated after the operation.

This allows for re-use and recovery of the fluid components at the same time as the fluid has optimized the well clean-

ing efficiency. The removed base oil can be used to formulate new drilling fluid or reused in casing cleaning systems. The improvement of the new fluid has been verified by laboratory tests and North Sea field experience.

Field experience from 30 operations shows that average operation time has been reduced by more than 1 hour and chemical consumption reduced by almost 50%.

PROPPANT RECOVERY

The development and successful application of a system that allows excess proppant to be collected, treated and recycled on location is the subject of IADC/SPE paper 74473, "Unique Offshore Recovery System Dramatically Reduced Environmental Impact by Recycling Stimulation Proppants."

The paper was prepared for the Drilling Conference by **M Slater, BP plc**; **D Perez, Schlumberger**; **C Teesdale, BP plcs**; and **N Hilbig, Swaco Norge A/S**.

Over the past 4 years, the use of multiple-zone proppant fractures has significantly improved production and the ultimate productive life of horizontal wells in the Valhall chalk field, the authors report.

A typical well is designed with up to 10 proppant-fractured zones. The stimulation technique involves pumping as much as 300,000 lb of proppant into each zone. During this process, up to 70,000 lb of excess proppant may remain in the wellbore that is cleaned out using coiled tubing.

The material contains a resin coating to facilitate adhesion in the reservoir that restricts disposal.

Previously, this waste had to be collected offshore, placed in big bags, containerized and shipped to shore for incineration, a practice that was costly, wasteful and environmentally suspect, according to the authors.



Vacuum hopper is part of system to collect, treat and recycle proppant on location, reducing transport and storage costs.

In 1997, engineering studies revealed that the properties of the waste material made it suitable to be re-cycled in future operations with minimal impact on fracture performance. While re-using proppant has become an accepted practice with no noticeable effect on well productivity, logistically it had some limitations.

The material still had to be collected offshore and transported onshore where it was stored for several months before being reloaded into the stimulation vessel for reuse in the next fracture treatment. This represents storage problems and environmental exposure of these materials.

Furthermore, with no unforeseen delays, this was a 24-hour two-way trip.

Some 150,000 lb of proppant was successfully recovered and recycled on the first well with the system, the authors report. The technique is still evolving and is likely to become a standard operation on Valhall wells.

The offshore collection and recycling technique has eliminated the logistical problems associated with the previous method and will in time reduce the total proppant costs, along with minimizing the associated HSE impact.

INVERT EMULSIONS

Invert emulsion drilling fluids can be designed not only to minimize potential negative environmental impact of discharged drilled cuttings, but also to create a product from the cuttings that enhances soil quality.

Each of the major components—base fluid, internal polar phase, emulsion stabilizer, wetting agent, fluid-loss reducing agent and weighting material—can be chosen to generate a fluid which is essentially non-toxic, biodegrades rapidly and provides nutrients that are necessary for the healthy development of plants and animals in the area.

That is the conclusion of the authors of IADC/SPE paper 74474, “Designing Invert Drilling Fluids to Yield Environmentally Friendly Drilled Cuttings.” The paper was prepared by **F B Growcock, G W Curtis, J E Candler, S Brooks, M-I Drilling Fluids Co LLC; B Rogers, Swaco; and J Ewanek, M-I Canada.**

Where governmental regulations and

environmental conditions permit, the drilling fluid can be designed to be land-farmed directly. If there are severe limitations on electrical conductivity, the fluid can be designed with a non-conductive internal phase.

Finally, for areas where any kind of non-aqueous fluid on cuttings is prohibited, a drilling fluid can be designed to take advantage of rapid bioremediation or other pretreatment.

PNEUMATIC TRANSFER

A bulk transfer and containment method based on the use of positive air pressure conveying has been under development since 1998. Initial onshore trials proved the capability to convey drill cuttings samples using technology developed for other industries.

The technology is outlined in IADC/SPE alternate paper 74476, “Bulk Containment and Transfer of Oil Contaminated Drill Cuttings: Field Experience Using Pneumatic Systems.” The paper was prepared by **N Martin, M-I Internation-**

al; B Chambers, BP plc; G Logan, Clydeblowers; and F Krukowski, M-I International.

In the North Sea, where cuttings injection is not used, it is necessary to transfer the cuttings to shore for processing. This transfer has largely been by the use of specially constructed skips. The lifting of many skips during the course of a well created a requirement for new techniques for the safe containment and transport of drill cuttings.

The authors report that in autumn 2000, on-rig containment and rig-to-boat transfer trials were carried out on rigs drilling in UK waters. This demonstrated the successful application of positive air pressure conveying for drill cuttings and resulted in further improvements to the technology.

In 2001, the full bulk containment and transfer system was successfully deployed, demonstrating the inherent safety of the system, improved occupational hygiene and its operational efficiency. ■