Innovative filtration process for well clean-up fluids reduces amount of water-based waste

By Thomas Blyth, Anna Johnston, CETCO Oilfield Services Company

AS ENVIRONMENTAL legislation becomes more stringent around the world, oil companies need to continually re-evaluate how waste fluids produced offshore can be processed and disposed. Areas of focus include reducing onshore disposal of waste and discharge of harmful materials to sea.

Drilling rigs, while completing well tests and performing well completions, are a source of water-based waste, and there are several options for handling well return fluids from these types of operations. This article discusses the options for handling this water and proposes an innovative filtration process to reduce the overall waste. Possible sources of water-based waste streams, options for handling water-based waste streams, and a waste classification and filtration process will be presented, as well as a field case history.

WASTE FLUID SOURCES

There are several steps in the drilling and completion process where a rig may produce water-based fluids as a waste stream. During the first step of a completion, drilling mud may be replaced with completion fluids. The displacement of drilling mud helps remove light well debris. The completion fluid circulated in the process may contain significant solids and components of the drilling mud, which creates waste.

During well clean-up, fluids are flowed back at a rate higher than normal operational parameters to remove any remaining larger debris. Fluids are usually flowed back until several barrels of crude are produced. Fluids from these completion activities can generate water-based waste containing solids, mud, additives in the mud, and oil. This results in additional waste.

WASTE-HANDLING OPTIONS

There are several means of handling water-based wastes. The field options have been compiled into the following three comprehensive areas:

• On-site subsurface injection well.
• Inland commercial disposal.

Samples of water-based fluids are seen before the CETCO process (left) and treated fluid for subsequent discharge (right).

• On-site processing with or without additional treatment.

On-site well injection is often preferable if a disposal well is available and if the fluids meet the injection well criteria. These criteria can include fluid specifications that limit or specify pH, solids (size and quantity), oil content and chemical composition. These specifications have been developed based on the well formation characteristics and designed to prolong well life and efficiency. Also, the rate and pressure of the well may limit the discharge. The well must also be set up to accept a fluid with the appropriate equipment, i.e., pumps and connections. This can become costly in terms of rig time and equipment.

Inland disposal involves the collection, segregation and transportation of fluids to an onshore commercial processing facility. There are several concerns in accomplishing this.

First, the collection and segregation of waste requires cutting boxes, tanks or barges. Cutting boxes and tanks can require multiple lifts, which increases the rig’s task load. Most drilling rigs have weight restrictions and are space-limited, which may make it difficult to spot containers or tanks. The risks associated with having a vessel such as a barge along the rig are always a concern. Weather can cause transport delays, which increases costs. Other costs and liabilities are associated with the transport and commercial treatment of waste fluids. There are also increased concerns for personnel safety due to additional tasks and possible exposure to the fluids.

On rigs, unlike production platforms, there are no produced water streams to combine the water-based fluids with overboard discharge. After removing solids, some fluids can be discharged, but, in many cases, the wastewater fluids do...
not meet overboard discharge requirements without additional treatment. One option is an on-site temporary treatment facility.

**WASTE CLASSIFICATION AND FILTRATION PROCESS**

Fluids that are treated offshore using a temporary treatment plant can be categorised as:

- Waste.
- Discharged.
- Recycled/recovered.

Fluids Processed = Waste + Discharged + Recycled/Recovered

The primary objective in using a classification system with a filtration process is to minimise the amount of waste by recovering any valuable products (oil, expensive brines, etc.) for re-use, re-sale, or to safely discharge regulatory-compliant fluids. Filtering for product re-use or for discharge may result in varied treatment criteria.

The water-based fluids that are targeted for filtration treatment can vary in volume, return rate and composition. There are, however, several common attributes in the filtration process. Firstly, solids and other debris must be removed and isolated. Secondly, the removal of free oil is required. Lastly, a final polishing step to further remove any emulsified oil, water-soluble organics (WSO), such as BTEX, and other potentially toxic materials, concludes the treatment process. These steps can be summarized as:

- Solids removal.
- Bulk oil removal.
- Final polishing.

Solids and bulk oil removal is achieved by physical and gravity separation, enhanced in some cases with chemicals and/or gas sparging in a 120-bbl 4 compartment Weir tank. Free oil is recovered and returned to the operator. Downstream of the Weir tank, CETCO Offshore’s proprietary CrudeSorb adsorption media canisters achieve further oil removal by using a RFV (radial flow vessel) skid. Additional polishing is accomplished by using granular-activated carbon.

CETCO’s CrudeSorb and GAC technologies are proprietary medias based on resin, polymer and clay technology, which have proven to be extremely efficient at removing oil, grease and soluble organics from water.

Although the specifics of each case history vary by application and geographical region, these basic technologies described above are the basis of the filtration process.

**CASE HISTORY**

CETCO mobilised equipment and manpower for BP to treat waste generated on the Rather drilling rig in the Gulf of Mexico. Initially, CETCO’s equipment was situated on a nearby platform due to space constraints, and waste fluids were transported from the rig via cuttings boxes. Fluids comprising of CaCl and CaBr and including contaminants such as Petrofree LC, Frac Gels, HCL, K-Max, Cellie, DE and waste oil were treated through an equipment package.

The fluids were treated from the cutting boxes, wastes were segregated and valuable products were recycled and returned to the rig for re-use. All tests for overboard discharge resulted in compliant fluids less than 29 ppm oil and grease, all static sheen tests passed, and pH was adjusted when necessary. Table 1 summarizes the fluids treated.

After the technology was proven to reduce waste, the application was moved to the rig generating the waste. The process was the same as above, with a reduction of one weir box for a smaller footprint. The system treated contaminated brine from the pits and returned the fluid for re-use. Later, the CETCO system was put on-line down stream of pressure vessels to receive fluids directly from the well for the final well clean-up and pressure test. The CaBr fluid weight ranged from 13.1 lb to 13.3 lb. Table 2 summarizes the fluids treated.

Again, all fluids discharged overboard contained less than 29 ppm oil and grease, all static sheen tests passed and pH was adjusted when necessary.

CETCO was contracted later on the same drilling rig to treat contaminated 15.6-lb ZnBr completion fluid was treated. A total of 25 bbl of oil and barite solid waste was packaged for shipment to shore. The average treatment rate was 1,500 bbl/day. Oil in water inlet concentrations to the process were in the percent levels whilst the effluent oil in water averaged 8 ppm.

**CONCLUSIONS**

Oil companies searching for new ways to mitigate offshore waste and maintain oil in water discharge requirements have created a need for re-engineering the drilling rig waste handling of well test, workover and completion fluids. The following conclusions can be drawn:

- The CETCO system is an effective method for treating drilling and completion fluids for discharge, re-use and waste minimisation.
- The process combines different technologies to treat various fluid conditions.
- The treatment process can handle a variety of fluids, even heavy brines.
- The adsorption media is reliable and can be transported to a variety of on-site treatment locations (onshore, ship or rig locations).
- Systems can be engineered to meet specific site requirements (i.e., space, rates, volumes, discharge requirements, pressure).

Thomas Blyth is a marine chemistry honours graduate from Liverpool University with a MSc in environmental science. Bjørn-Tore Anfinsen holds a masters degree in petroleum engineering from the Norwegian University of Science and Technology. Anne Sofie Flatbo holds a masters degree in chemical engineering from the Norwegian University of Technology and Science.

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