

Dope-Free Connections: A North Sea Case Study

After an initial development period, a final dope-free product was ready for testing. A waxy compound is applied directly on selected premium threads, serving as both storage and running dope, eliminating requirements for cleaning and redoping at the wellsite. The decision was made to perform a field test.

Introduction

Mærsk Oil operates offshore wells in the Danish sector of the North Sea, which are characterized by being long horizontal wells (5,000 to 20,000 ft) drilled in chalk reservoirs. The wells commonly are completed with 4½- or 5½-in. completions inside a 7-in. liner hung off in a 9⅝-in. production casing set just above the reservoir. In some cases, the liners are cemented in place to provide zonal isolation.

Field Trial

For the field test, 230 joints of 7-in., 29-lbm/ft liner with premium dope-free tubular connections (DTCs) were acquired. All joints were equipped with standard open-ended driftable protectors. The 7-in. liner was selected for the test because it would have the least effect on final well performance if it turned out the DTCs did not perform as expected. The decision was made

This article, written by Assistant Technology Editor Karen Bybee, contains highlights of paper SPE 105851, "Dope-Free Tubular Connections, Through Research and Development to Field Trial and Implementation: A North Sea Case History," by H.B. Andersen, M.P. Hummer, SPE, and R.C. Engell, SPE, Mærsk Oil, and Lionel Verdillon and Arnaud Pardé, Vallourec & Mannesmann Tubes, prepared for the 2007 SPE/IADC Drilling Conference, Amsterdam, 20–22 February.

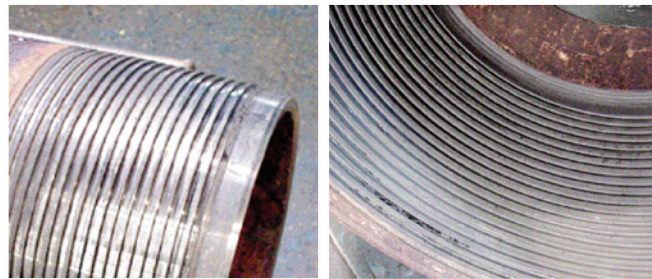


Fig. 1—Coupling pin- and box-thread condition after 3 years in stock (after cleaning).

to use two wells, one of which had a cemented liner so the pressure integrity of the connections could be tested.

Manufacturing Trial Order

The 230 joints for the test were produced in February 2002. In the plant, the dope-free layer was applied on connections manually before mill makeup. As expected, no major difference was found at the coupling makeup stage when compared with standard American Petroleum Inst. (API) modified mill makeup. The 230 joints were shipped to the offloading facilities in Esbjerg, Denmark, where pipes were stored until shipped to the North Sea offshore rig in March 2002.

Rig Deck

The pipes were received at the rigsite bundled in slings. On the deck, they were laid out in one layer at a time. For the field trial, the protector design did not allow the pipe to be tallied with protectors installed; consequently, these were removed and the pipe was tallied. The pipe was drifted with the protectors reinstalled. Drifting the pipe with the protectors installed ensures that no pipe scale or other debris pollutes the box-end threads during drifting. Drifting pipe without DTCs normally is done before cleaning the thread so drift debris in the thread is not an issue.

Running

The tests were conducted in two different wells where 66 joints (2,942 ft) and 137 joints (6,102 ft) were run, respectively. The pipe was run in March and April 2002. There was little to no rain and a 40 to 50°F ambient temperature.

The tubular installation started with the pipe being transported to the V-door. In the V-door, the box-end thread was inspected before the joint was transported to the drill floor with a tugger and a single-joint elevator. The pin end on the joint was inspected before stabbing and making up the joint. The joint was run and the string hung off in spider slips. A 7⅝-in. power tong fitted with standard grip jaws was used for joint makeup with a speed-control unit. Rotary speeds were normal, with high gear for the initial turns, and low gear for last turn. All joint makeup curves were shown on a graphical display and digitally registered.

Both runs were successful. One of the key parameters while making up premium connections is the shoulder torque. Shoulder torques for all joints run in both wells were within the acceptance criterion of less than 13,900 ft-lbf.

The 11.3-lbm/gal water-based bentonite mud was splashed over the box-end thread several times during running. This had no effect on makeup

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quality, and twice the box end was purposely covered by mud before makeup to test the makeup sensitivity to mud. No effect was seen on the makeup charts.

Of the 203 joints run in the two tests, three had to be backed out and made up a second time. All three incidents were related to the tong makeup and not the DTC. If DTCs need cleaning after the protector is taken off, this can be done easily by use of low-pressure water or compressed air.

Both strings were run as liners in the tests, and therefore the last joint run is made up to a liner hanger. Because the liner hanger was not prepared with dope-free material, normal API modified dope was used between the DTC joint and the liner hanger. This is possible because the DTC specification is such that DTCs are compatible with API modified dope.

Finally, one string was successfully pressure tested. The second string was run as a slotted liner.

Backload and Storage

Surplus joints were returned to shore. Bundling and backload preparation is quick because no protector refitting is needed. All remaining joints were put back in outdoor storage. For the purpose of the test, the protectors were removed and the threads inspected. No damage was observed.

With DTCs, much work is saved in the yard because the returned unused pipes can be put directly on the shelf. This contrasts with use of standard storage and running dope, where it is necessary to remove the protectors, clean the threads, and apply storage dope before refitting protectors.

The remaining 27 joints have been left outdoors since the test for a prolonged storage test, but without any regular yard return cleaning/inspection procedure as normally is performed on joints designed to be used again.

Mærsk Oil Commercial Orders

Mærsk switched all current oil-country tubular-goods (OCTGs) orders to dope-free products in early 2005. Dope-free products selected were 3¹/₂-, 4¹/₂-, 5-, 5¹/₂-, 7-, and 9⁵/₈-in. sizes.

Industrial equipment at the mill was designed together with the dope-free lubricant to fulfill the latest and most stringent requirements for the health, safety, and environmental standards of

the European Union. Implementation occurred in summer 2004, and all lines were operational by the end of 2004. Specific protectors with a design that allowed accurate tallying were ordered and qualified for dope-free thread. The first Mærsk orders were manufactured in March 2005 and stored in the Mærsk yard the same month.

Field Implementation

Mærsk does not use standard torque-turn equipment for liners. However, to validate the behavior of field makeup, all first runs, including liners, were monitored with such equipment. All runs are performed on a jackup rig, stabbing pipes with the stabbing arm mounted in the derrick. Makeup is performed by a remotely operated iron-roughneck casing tong rolling on rails. Torque turn is recorded for production casing (9⁵/₈ in.) and completion tubing (5¹/₂ and 4¹/₂ in.), but not for liners (7 and 5 in.). The topdrive fill-up and circulation tool is used for filling and circulation as required.

Before the dope-free pipes were delivered, Mærsk organized extensive training sessions by the supplier for rig supervisor, drilling engineers, completion specialists, casing crews, and yard personal. This was of utmost importance because the key issue for success was to ensure that everyone involved in storing, identifying, preparing, shipping, inspecting, and handling dope-free tubulars was informed about what to do and what not to do in using these new threaded products. Backup solutions if needed were included in this training.

Actual Field Learning

The initial run to be monitored in May 2005 was a 4¹/₂-in. tubing that performed as expected. Other sizes that were run and monitored closely were 5-in., 15-lbm/ft L-80; 7-in., 29-lbm/ft L-80; and 5¹/₂-in., 20-lbm/ft L-80 13Cr. All performed as expected, with regular torque used and no extrusion of dope-free material.

The 9⁵/₈-in. L-80 (carbon-steel material) did not run as expected. The initial run, July 2005, was not successful. Acceptable shoulder torque could not be reached on many joints, leading to application of thread compound to the dope-free surface. This enforces the opinion that dope-free products need to have the option of being run with

thread compound applied on top of the dope-free layer.

Storage Performance

Joints from the 2002 trial run were inspected in 2005 to determine the condition of the threads under the couplings after 3 years in stock. The condition of the pin ends was questionable because protectors were not manufactured to specific dope-free standards and no special care was taken at the time of storage after return from the rig. The couplings backed out as normal, and the thread condition was excellent (**Fig. 1**).

Rig Returns

Unused tubulars can be shipped back to stock following the standard procedure. Joints that have been made up and broken out before back loading will have some surface oxidation on the thread areas that experienced significant friction. To solve this problem, a dope-free additional product derived from the regular dope-free material has been developed that pipe inspectors can apply before sending pipe back to stock.

Benefits

More than 10,000 joints of carbon-steel and 13Cr DTC have been installed successfully in the Danish sector of the North Sea. Experience from the offshore test and field implementation has documented the benefits of DTC tubulars. The benefits on the rigsite include the following.

- Easy pipe handling including no cleaning, no doping, easy inspection, and less work in preparing, running, and returning pipe.
 - Improved safety because the deck is cleaner because there is no washed off storage dope.
 - Pipe can be drifted with protectors on.
 - Having no dope in the well improves future wireline and coiled-tubing interventions.
 - If dirt gets in the threads, a light water spray or application of compressed air can remove it easily.
- Benefits in the yard include the following.
- Improved safety because less manual handling is required.
 - Visual inspection is easy because there is no storage dope and the dope-free layer is transparent.
 - No cleaning or redoping of unused joints returned from the rigsite. **JPT**