

NEW HYDRAULIC FRACTURING SYSTEM CUTS TIME BY 40%



By Hans-Henrik Kogsboll

Maersk Oil's standard approach to hydraulic fracturing has many advantages but also a key weakness – the pipe has to be pulled completely out of the well for each fracture, and that costs time and money. Could we find a way to fracture a series of zones in a single operation? Meet the Pipe Conveyed Frac Sleeve system, capable of achieving significant time savings.

When Maersk Oil recovers hydrocarbons from low permeability rock, we have to create many large fractures in the rock to allow the oil or gas to flow out. We do this by drilling long horizontal wells and inducing multiple fracture filled with proppant. The fractures are induced using fluid containing proppant. When the treatment stops the proppant will keep the fractures open for flow. This is known as massive propped hydraulic fracture treatment.

To achieve the treatment, Maersk Oil has since the late 1980s used the 'perforate, stimulate and isolate' (PSI) system to access each zone along the horizontal drilled hole, induce the propped hydraulic fractures, and then seal the zone off from other zones. This is an extremely flexible system, but for every zone that we work on, the pipe has to be pulled out of the hole, and that's time consuming.

MULTIPLE FRACTURES IN A SINGLE OPERATION

When our development team for the Adda field, in the Danish North Sea, investigated the economics of developing the field, they realised that if the completion was going to be economically attractive, a different system would be needed. Their initial investigations pointed towards the NCS Mongoose tool – a way of achieving multiple fractures within a single operation. But the system had an issue – it wouldn't be able to operate beyond the maximum reach of its coiled tubing of some 17,000 ft. The Adda field would require wells in excess of 21,000 feet to be economical.

Would it be somehow possible to combine the benefits of the PSI system with the Mongoose tool? Our completion engineer in the Adda team was tasked with answering this question, and his solution was the Pipe Conveyed Frac Sleeve system.

HOW THE FRAC SLEEVE SYSTEM WORKS

The PSI system uses jointed pipe, though with the downside of having to pull and run the pipe in and out of the hole for each zone to be hydraulically propped fracture treated. For the Frac Sleeve system, sleeves are installed in the horizontally drilled hole. The sleeves are operated through a jointed pipe workstring, which opens a zone, allows for a hydraulically induced propped fracture treatment of the zones and closes the sleeve afterwards. A well is then fracture treated from the bottom up. To treat each new zone, the pipe just has to be moved to the next zone.

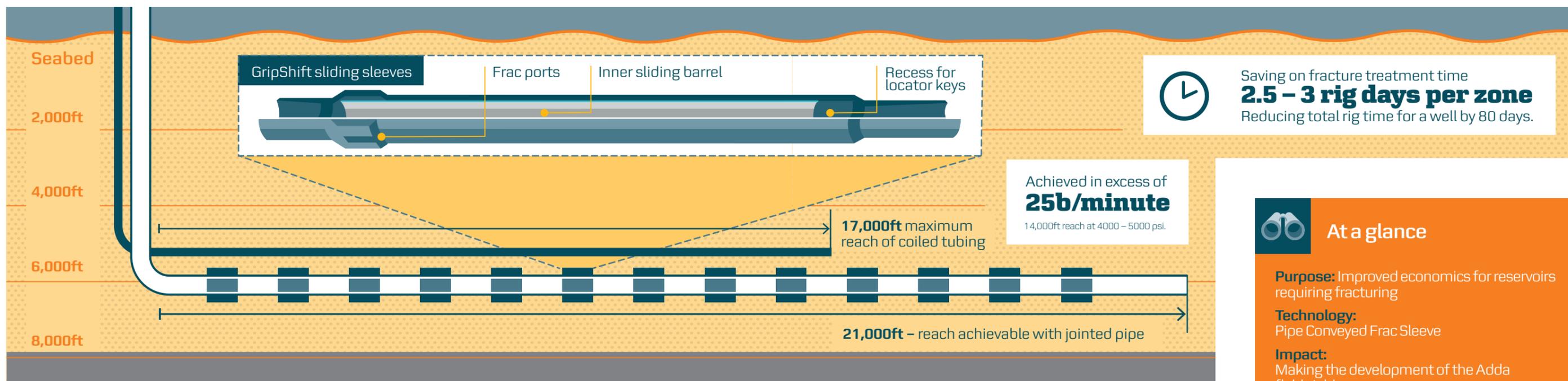
During February 2017 a full test of the Frac Sleeve system was carried out in an Apache Corporation well in Midland, Texas. We asked Apache Corporation to run 10 sleeves in the outer part of one of their 14,000-foot long well, testing two different types of sleeve. The '2 position sleeve' is well proven in the industry, with more than 115,000 having been run on coiled tubing worldwide, and has two positions: open and closed. A prototype '3 position sleeve' was also tested successfully: it has open and closed positions, plus a production mode which is intended to restrict the flow of proppant back into the well.

TEST AIMS AND RESULTS

The main aims of the test were to:

- Run a specially designed 3½ inch workstring to a total reach of around 14,000 feet with a fracture treatment rate in excess of 25bpm.
- Be able to achieve an accurate location of each sleeve using jointed pipe.
- Open, fracture treat and close 10 sleeves, with a final operating time of less than 12 hours per zone.
- Open and close zones using a wireline operated tooltractor and expansion tool.

All these aims were successfully achieved. The new approach will mean an estimated saving on a fracture treatment of some two and a half to three rig days per zone – reducing total rig time for a well from 180 days to some 100 days. ■



At a glance

Purpose: Improved economics for reservoirs requiring fracturing

Technology: Pipe Conveyed Frac Sleeve

Impact: Making the development of the Adda field viable

Completion date: 2017