COLLAR CEMENTING TECHNOLOGY

No Mill-Out Is Required

CURRENTLY, ONE OF THE CHALLENGES IN COMPLETING WELLS FOR MULTI-STAGE HYDRAULIC FRACTURING (MSF) OR WELLS WITH SCREEN COMPLETIONS, WHERE COLLAR CEMENTING WAS PERFORMED, IS THE NECESSITY TO MILL OUT THE PUMP-DOWN PLUGS, THE COMPONENTS INSIDE THE CEMENTING COLLAR, AND THE JUNK CATCHER. WHAT SOLUTIONS ARE RUSSIAN DESIGNERS OFFERING TO REDUCE THE MILLOUT TIME?

UDC 622.245

Keywords: multi-stage hydraulic fracturing, well workover, cementing, well completion, soluble internal assemblies.

Azat K. Gatiyatullin
Head of Production Support and Supply Service

Denis S. Shovkoplyas
Deputy General Director for Technology

Evgeny G. Bychkov
Head of the Well Completion Projects

Anton V. Vydrin
Deputy Head, Well Completion Projects
TatProm-Holding Group

Millout of pump-down plugs, cementing collar components, and the junk catcher is normally performed by well workover crews from a slimhole rig, with a milling tool and a low-power downhole motor. Due to these limitations, milling operations generally take between 40 and 72 hours.

To address this problem, Naberezhnye Chelny Pipe Plant (NChTZ LLC) is actively implementing a technology for running well completion equipment with dissolvable internal components (cementing collars, junk catchers, and hydraulic frac sleeves with dissolvable catching baffles and balls) (Figure 1).

Dissolvable assemblies are made of a magnesium alloy, the precise formulation of which is tailored to the well conditions (reservoir temperature, completion fluid) and the customer's requirements for dissolution rate. The internal design of the dissolvable elements ensures integrity during operations and the required dissolution rate downhole.

The first stage of implementation of this equipment involved factory bench tests. Naberezhnye Chelny Pipe Plant LLC manufactured a 178 mm Stage Cementing Collar, a junk catcher for this collar with dissolvable components and a set of pump-down plugs in its shops. Downhole conditions and the cementing operation were simulated (the stage cementing collar was activated, cementing was performed, and the cementing ports were closed), and the collar was left for a 24-hour waiting on cement time heated in a tank with a 10% KCl brine solution.

FIG. 1. Soluble cementing collar (d 178) with dissolvable components

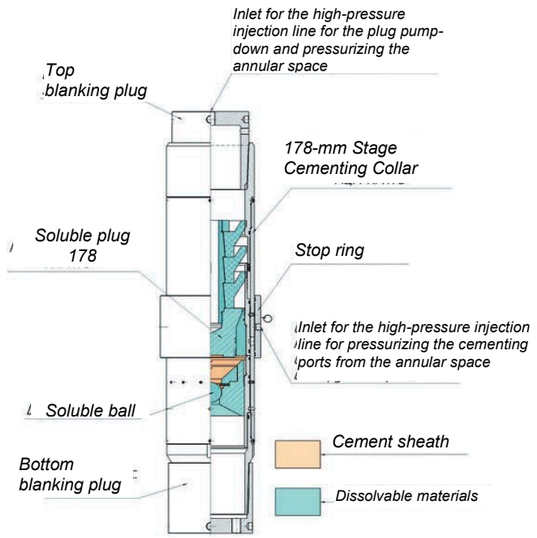

TABLE 1. Factory test parameters

No.	Test parameter per Test Program	Specified value	Actual value
1	Cementing port opening pressure, MPa	19.3	18.4
2	Cementing port test pressure, MPa	35	35
3	Test pressure of the plug sitting in dissolvable components, MPa	25	25
4	Total dissolution time in 10% KCl brine at 95°C until loss of integrity, hrs	–	480
5	Total dissolution time of components after loss of integrity until 90% mass loss, hrs	–	110

A subsequent pressure test confirmed the product's integrity. The next testing phase involved periodic pressure tests via a threaded test plug to monitor the dissolution of the components. After 480 hours, a leak occurred at 21.8 MPa during a scheduled pressure test. A detailed examination revealed that the leak occurred along the contour of the dissolvable components. The components were pushed out using a drift mandrel for inspection. After pushing out the leaked components, it was confirmed that the collar was full-bore. Complete test parameters are given in Table 1.

For the purposes of field trial, a candidate well was selected in collaboration with the client. A 140/178 mm combined casing string designed for multi-stage hydraulic fracturing with collar cementing was run in hole according to the RIH and activation program. The RIH and activation operations were completed successfully.

> The reaming of the interval, in which the dissolvable components were installed, took only 30 minutes.

After 20 days, a workover crew arrived at the well for milling-out to subsequently run the frac plug (stinger) and conduct the hydraulic fracturing operation. The string was run to the planned depth successfully, without any tight spots. The reaming of the interval, in which the dissolvable components were to be installed, took only 30 minutes.

The operations conducted and data obtained upon pilot tests run in the well completed with dissolvable tools as part of the combined casing (178/140) manufactured by NChTZ LLC lead us to the following conclusions:

Firstly, the double casing system (178/140), equipped with dissolvable components (the stage cementing collar and the junk catcher), fully proved its operational reliability in field conditions. The average dissolution time of the stage cementing collar and the junk catcher elements was 18–20 days, according to the technical requirements and the results of earlier conducted bench tests. The waiting time before flow initiation was 35 days.

Secondly, the well equipment mill-out operations were completed normally, as per the standard operation procedure: reaming the target interval to install the dissolvable components was performed as designed; no successfully, without any tight spots. The fragments left after the dissolution reaction, component parts, or elastomers were detected; the BHA moved freely during the milling-out operation; no tight spots or overpulls were recorded.

Thirdly, the hydraulic fracturing operations were carried out as designed, without any issues.

Proceeding from the above, it can be concluded that the field tests of the combined casing (178/140) completion with dissolvable components manufactured by NChTZ LLC were completed successfully. No equipment malfunctions were recorded.

Conclusions

The use of completion tools with dissolvable components, along with proper planning of flow initiation jobs, can help save time and resources required for milling-out as well as minimize the probability of wellbore issues.

Keywords: multistage hydraulic fracturing, well overhaul, cementing, well completion, soluble internal nodes.