Integrating Production Logging with Coiled Tubing Intervention in Saudi Arabia

Openhole water injection well achieves first-ever real-time stimulation and production logging operation

**Challenge**
Successfully stimulate water injection well using coiled tubing (CT), and run a production log to confirm uniform injection profile after the stimulation. Efficiently perform both operations in real time with a single CT unit.

**Solution**
Use ACTive PS* integrated production logging with CT intervention. Make faster, more-informed decisions with real-time production logging operations.

**Results**
Deployed world-record fiber-optic–enabled CT string length of 32,175 ft. Efficiently stimulated and logged well using one CT string, saving time and resources.

**Formation damage removal needed in water injection well**
A water injection well in a horizontal openhole section in a Saudi Arabian field experienced formation damage during the drilling process. To remove this damage and enhance permeability for better water injection results, the operator required a CT-supported acid stimulation job.

Traditional methods for this type of operation include a post-treatment production logging run to record an injection profile for calibrating the injection model. A logging cable–equipped CT string and a standard logging unit are necessary to convey the production logging data. Among other complications in this process, the cable restricts the flow rate through the CT, a critical component in optimizing injection. This problem suggests the use of two CT strings to perform the job. When this conventional strategy was applied to the field’s water injection well, though, a uniform injection profile was not achieved.

The operator then explored the use of memory production logging for this well, hoping to avoid the extra time and cost of using two CT strings. This choice, however, risked low data quality and a potential additional run.

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**Case Study**
Coiled tubing integrating production logging with coiled tubing intervention in Saudi Arabia.

First-ever production log acquired using CT fiber-optic telemetry.

ACTive PS BHA.
CASE STUDY: Openhole water injection well achieves first-ever real-time stimulation and production log

Real-time production logging service successfully acquired
Schlumberger suggested ACTive PS integrated production logging with CT intervention to enable production logging jobs in real time—using the same string for both stimulation and logging interventions. The system uses a fiber-optic-enabled CT string for telemetry and a 1 1/8-in BHA, which powers and communicates with the conventional production logging system. Data is sent wirelessly from the working reel to the acquisition software on surface, so no surface logging unit is needed on location.

The well was stimulated using ACTive Matrix and Profiling services first, after which the first-ever real-time production logging job was performed in the field using the ACTive PS service. During the injection of 1,725 bbl of preflush, acid, and VDA* viscoelastic diverting acid fluids, a distributed temperature survey (DTS) facilitated the understanding of the injection profiles. Consistent acid placement was based on acid reactions in observed high-injection zones.

To measure the well’s injection profile following the acid stimulation treatment, water was injected on surface at 7 bbl/min while the up and down logging passes were executed. The ACTive PS BHA and PS Platform new-generation production services platform were conveyed to 12,560-ft TD. Measurements included pressure, temperature, casing collar locator (CCL), gamma ray, X-Y caliper, and inline spinner. The objective was to measure the well’s injection flow profile following the acid stimulation treatment.

Record set for longest fiber-optic-enabled coiled tubing string
Not only is this well the first to undergo real-time production logging in the field, it is the first well in the industry to use fiber-optic-enabled CT for production logging telemetry. This operation also achieved a world-record fiber-optic-enabled CT string length of 32,175 ft.

The data quality ensured by the ACTive PS service minimized logging misruns, which will prove especially important for future wells in the field. Stimulation was performed with one CT string, allowing the operator to mobilize a reduced amount of equipment just once, logistically saving time and resources while improving the safety of operations.

Because of this success, the operator planned remedial action to eliminate water production using the ACTive PS service. This system can also be used to optimize offshore barge use, with the multipurpose CT performing both conventional and real-time horizontal logging operations.