

Casing Integrity restoration through unconventional approach of temperature log yielding revival of Decade-Long Sick Well – A Success Story from Lanwa Heavy Oil Field of ONGC Mehsana

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Theme: Others

Abstract:

One of the most useful log in cased hole logging is Temperature log. A temperature log is interpreted by looking for anomalies, or departures, from the Reference Gradient. This reference might be the geothermal gradient, or a Log recorded with the well under shut-in condition. Most anomalies are related to the entry of fluids into the borehole or fluid exit into the Formation. Since the temperature is affected by material outside the casing, this log is sensitive to not only the Borehole fluid but also the fluid movement behind casing. Temperature logs have many applications, with the most common being to identify zones producing or taking Fluid, to evaluate a cement or Hydraulic Fracture Treatment, and to locate lost circulation zones and casing leaks. Since temperature takes time to dissipate, a temperature log tends to reflect the behaviour of a well over a longer time period than other measurements.

Present paper will discuss a successful case study on how the Casing Leakage points have been identified using Temperature Logs in an innovative approach and restoring of Casing Integrity of a Well, which was non-flowing due to Casing Leakage for the past 10 years as well as conventional Logging attempts had failed to detect Casing Leakage as these leaks are of very small/micro level or through the casing collars.

Introduction and Background:

LWXX was drilled to a depth of 1100m to explore the prospects of KX Pay in Lanwa field, a heavy oil field of Mehsana block. It was completed in KX pay sand (with OSC). Subsequently, several workover operations were done to increase the productivity. The well has produced cumulative production of 9739T oil with an average W/C less than 65 %. Free water was observed after 20 years of production. Subsequently, the produced water samples were collected and the salinity of the samples was 2.6-3.5 gpl, which is less than the formation water salinity (7-8 gpl).

Based on these observations, 8 years ago a workover job was carried out, to identify the water source. R3-Packer could not be set even after multiple attempts at different depths below X80m. CAST, CBL-VDL & MIT Logs were also recorded to locate the casing leakage point. However, no significant casing damage anomaly was found on these Logs. The injectivity was observed as >300 lpm at 25ksc. This well was non-flowing for the past 10 years. Recently this well was again taken-up for revival operation.

Strategy:

As the source of casing leakage could not be determined through CAST/MIT log, some other mechanism had to be devised for the purpose. Believing that “**Constraints create Creativity**” and “**conceptualizing problems differently**”, an out-of-the-box strategy was formulated to detect the Casing Leakage with the help of recording temperature log under hot/cold water injection in the well. A deviation from the normal temperature gradient was anticipated after injecting hot/cold water which would indicate or locate the actual leakage point.

Job Execution:

Sand was dumped to cover the open perforated interval. Warm water was injected in the well (*Hot water transported from approx. 30 km which took more than 1 Hr to reach the Well Site. By the time it was injected, Hot Water became just Warm.*). Temperature Log was recorded. Injecting warm water (Due to moderated temperature) could not provide the desired result alone. Hence, normal temperature water was injected and temperature log was again recorded to see the temperature deviation against the leak point.

Log Analysis:

The recorded Temperature Logs under both warm water & normal temperature water have been plotted in Fig-1. The results were quite exciting and encouraging as the Temperature Log responses are as per the expectation.

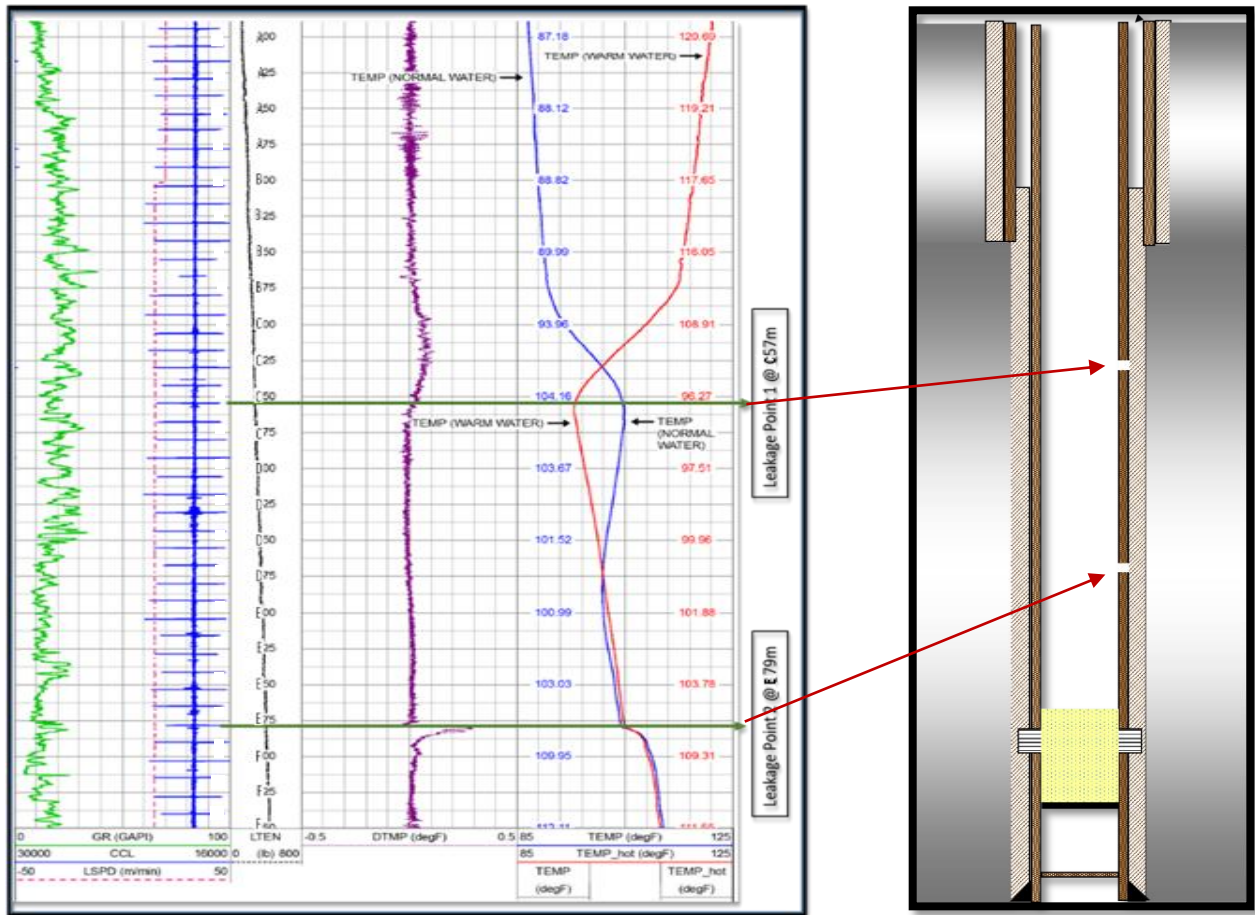


Fig-1: Left: Temperature Log recorded in both Warm Water & Normal water; Right: Well Schematic

In Fig-1, the point of change in slopes of both Temperature Logs coincided at C57 m, representing an area of interest, which was being looked for. Moreover, another anomaly at E79 m suggested the presence of another point of leakage. The flattened portion of the Temperature curves in both passes suggest channelling/communication between these two leakage points behind casing. Which might have developed due to the excessive attempts of injectivity testing & R3 packer testing.

Based on these observations made from the Log, it has been concluded that there were two suspected leakage points in the well at C55 m & E79 m. Both were present against the collar and as a reason, could not be detected in CAST and MIT Logs.

Results – Temp log based CSQ salvaging operation :

Based on the observations made by the Temperature Log, Cement squeeze was planned to restore the casing integrity.

Attempt 1: In the first attempt, Cement Squeeze was done keeping the Tubing shoe at C65 m and squeezed around 2.8 m³ of cement. After the squeeze, while tagging the cement top, no cement was found in the wellbore indicating the Cement loss into the Formation. The injectivity was tested, which was seen as 200 LPM @ 500 PSI against the pre-CSQ injectivity of 500 Lpm @ 500psi.

Attempt 2: CSQ was again attempted to keep the tubing shoe at E65m. This time 700 Ltrs of cement was pumped @ 1200 psi. After the squeeze, while tagging, cement top was found at B62m. Cement was drilled and a Free Fall was observed at C72 m (110 m cement plug). And a Second Cement Plug was observed at a depth of D48m. The Hermeticity of the casing was checked, which was found to be OK at 100 ksc.

As discussed above, Temperature log revealed the presence of communication behind casing between two leakage points which was substantiated physically when the second plug was encountered against E79m with cement top at D48m. The cement during Squeeze attempts must have entered from C57m (first leakage point) and travelled down behind casing till E79m (second leakage point) and then rose up inside of the well casing till D48m. Pictorial representation has been provided in Fig-2.

Subsequently, Cement was drilled and another Free fall was observed beyond E90 m (Total cement plug of 142m). Hermeticity was again tested after clearing the well till X00m which was found OK at 100ksc.

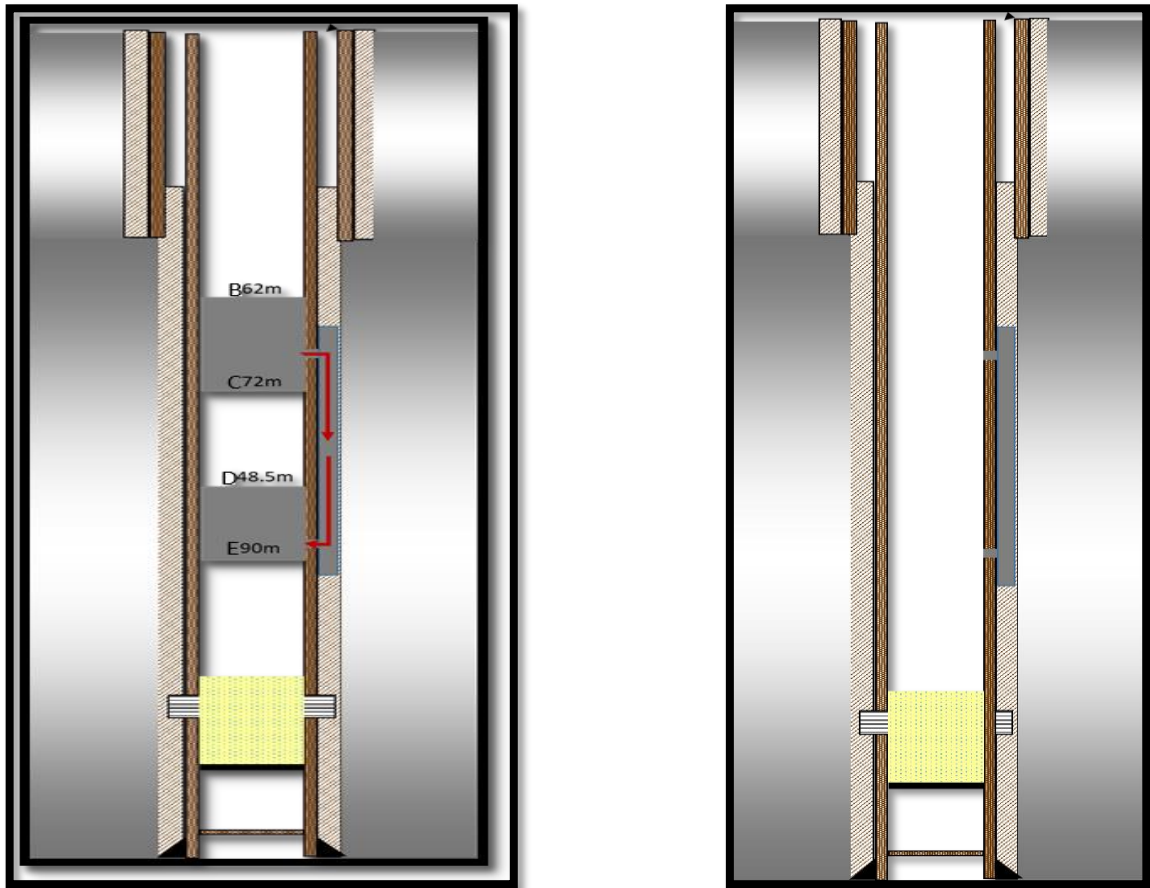


Fig-2: Well Schematic: Left: after Cement Squeeze; Right: After Cement Drilling

Benefit:

By this kind of approach, a ten years old non-flowing well, which once was considered for abandonment, was revived successfully. The casing integrity was restored, and the well was completed on SRP.

Conclusions:

Adding innovation to the available technology can resolve problems as like in presented case. Carrying out a temperature log after injecting warm & normal temperature waters has helped in solving the well integrity problem, which ultimately helped in restoring and reviving a non-flowing well for the past 10 years.