Pegasus Vertex
A LINQX Company

Case Study

# Temperature Simulation–A Comparison with Logger Data

## Challenge

Verify the accuracy of the temperature prediction by CEMPRO⁺.

## Solution

Temperature history data was recorded in real-world operations using temperature sensor loggers installed in the weight-set centralizer near the casing shoe during inner-string cementing. Simulation results from CEMPRO⁺ and a competitor's simulator were then compared against the logged data.

## Results

This study involving two offshore wells demonstrated that CEMPRO⁺ produced results very close to the actual measured temperatures, outperforming the competitor's simulator.

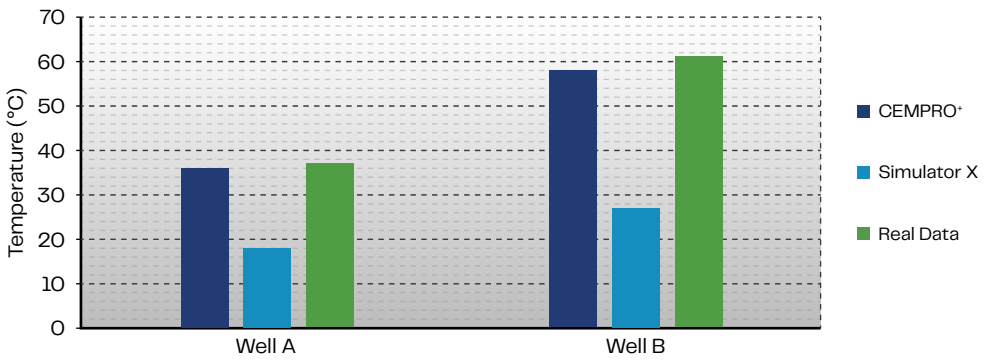
The cementing industry has a recurring concern regarding the accuracy of predicted downhole cement temperatures when relying on simulations for job planning. The complex nature of heat transfer physics, numerical methods, and downhole uncertainties make accurate prediction challenging. Simulators used by the cementing industry are not equally created. Therefore, a side-by-side comparison of simulation results with logged data is crucial for building confidence and gaining valuable insights.

One of the two wells in this study had a water depth of 5,000 ft. The 22-inch surface casing was cemented before a heat sweep (hot seawater) was run through the inner string and into the inside-casing annulus. A pre-installed temperature logger at the bottom measured the bottom hole temperature during the job. The flow rate was 28 bpm. The other well had a shallow water depth of 1,500 ft., and the job involved cementing the 36-inch conductor. Here, a circulation flow rate of 23.5 bpm was used after cement placement.

The logger data showed that the maximum observed bottom hole temperature was 38°C, and 9°C below the inlet temperatures in both cases. The seawater temperature gradient and sea currents evidently influenced the bottom temperature. CEMPRO⁺ accurately accounted for the heat loss from the pumped fluid to the seawater, predicting the bottom temperature with a discrepancy of only ~1°C and ~3°C for the respective wells. The results from the competitor's simulator, Simulator X, showed larger discrepancies (note that the model inputs were not identical).

| Well | | CEMPRO⁺ | Simulator X | Actual Operational Inputs and Results |
|---|---|---|---|---|
| Well A (Gulf of Mexico) Water depth: 1,500m (~5,000') 22" surface casing | Model Inputs | 75°C inlet seawater pumped at 1,200 gpm (28 bpm) | 65°C inlet seawater pumped at 1,200 gpm (28 bpm) | 75°C inlet seawater pumped at 1,200 gpm (28 bpm) |
| | Model Outputs – Max gauge/logger expected reading | 36°C | 18°C | 37.0°C |
| Well B (West of Shetland) Water depth: 400m (~1,500') 36" conductor | Model Inputs | 70°C inlet seawater pumped at 990 gpm (23.5 bpm) | 85°C inlet seawater pumped at 1,050 gpm (25 bpm) | 70°C inlet seawater pumped at 990 gpm (23.5 bpm) |
| | Model Outputs – Max gauge/logger expected reading | ~58°C | ~27°C | 61.1°C |

Table: Comparison of Temperature Simulation Results with Logger Data from Real Operations




Credit: The logger data and the comparison are courtesy of Expro.