Case Study
i-Con™

i-Con logging tool

Providing an understanding of downhole dynamics when installing a 9⅝" cemented liner

Background

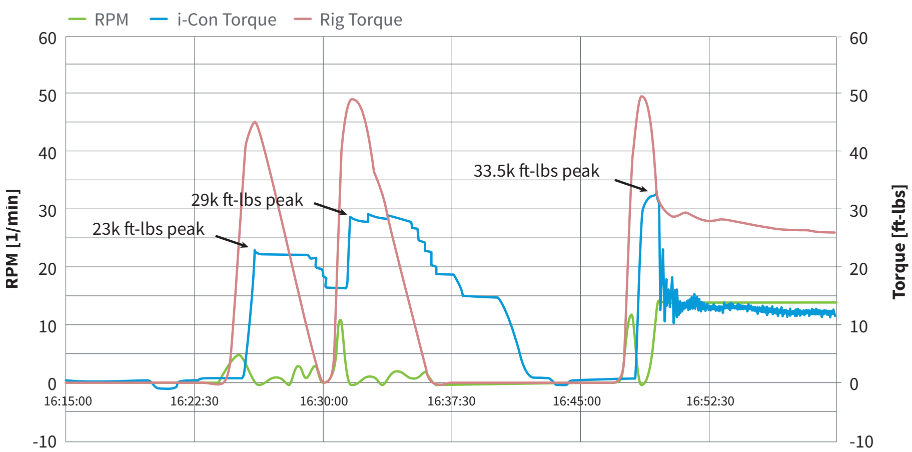
A major offshore operator in Norway logs their 9⅝" cemented liner after installation, as they need to ensure that shallow gas zones are properly isolated. Experience has shown that rotating the liner during cementing is essential to getting a quality cement job, and this requires very high torque - on the limit of the equipment they are running. Better understanding of how surface applied forces transfer to the deep of the well during installation was required in order to optimize equipment and operations.

Solution

The i-Con tool was run directly above the liner top to log the downhole forces and verify the downhole dynamics during the liner installation. To increase the chance of a successful liner installation, the operator selected premium drillpipe connections rated to 50k ft-lbs.

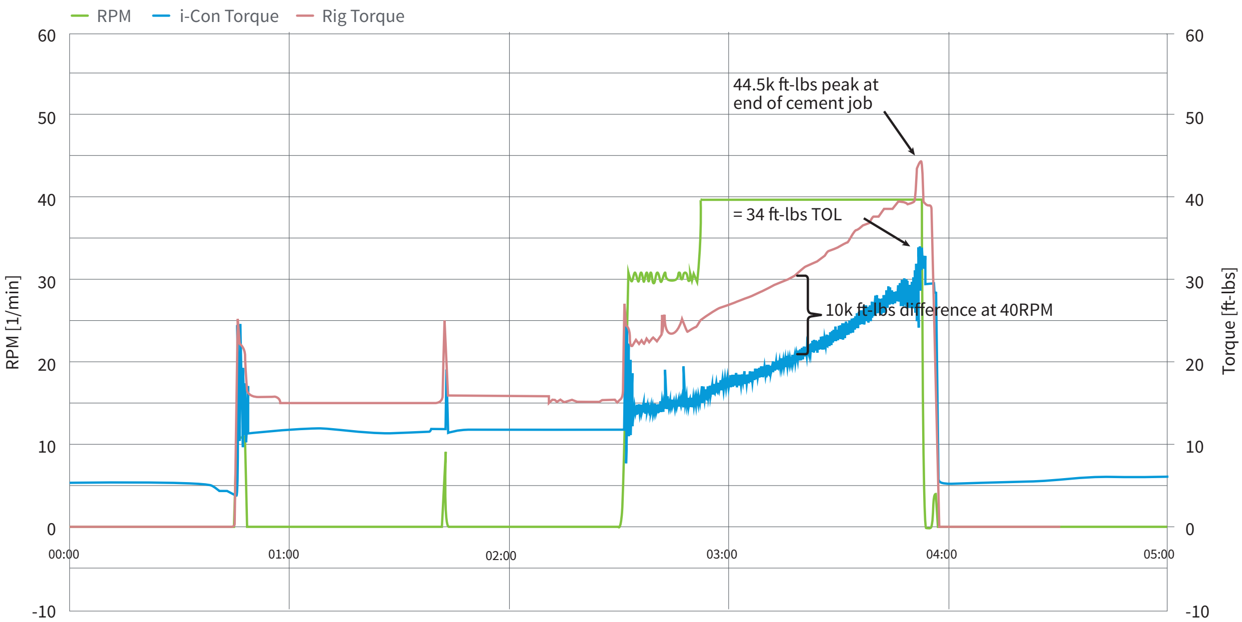
Establish liner rotation

A first attempt to get rotation at final depth with 45k ft-lbs surface torque proved unsuccessful. The i-Con tool showed that 23k ft-lbs were seen at the top of the liner without achieving rotation. At 50k ft-lbs - the make-up torque - only 29k ft-lbs were seen at the liner top, and liner rotation was still not initiated. On the third attempt, again at 50k ft-lbs surface torque, reciprocation of the pipe was attempted. With 33.5k ft-lbs at the top of liner, liner rotation was achieved, settling at a steady 15RPM with 12k ft-lbs of torque downhole, and 25-26k ft-lbs of torque at surface.



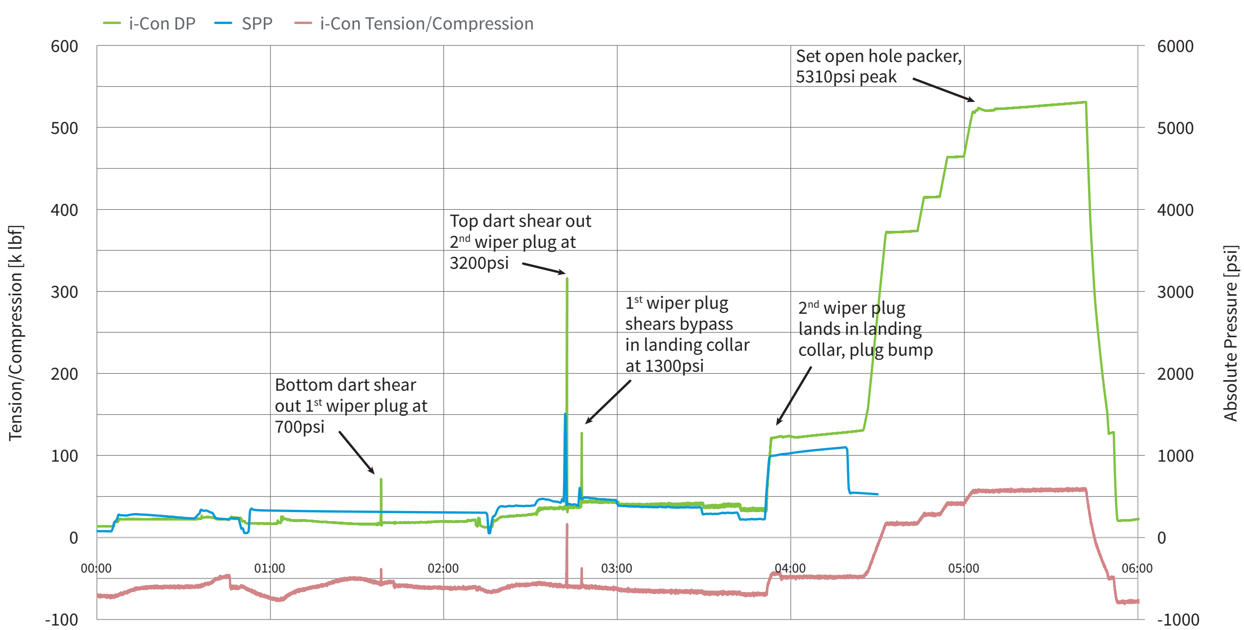
Rotation during cementing

The i-Con tool also recorded the torque response during the cement job. The torque needed to maintain liner rotation increased when cement reached the shoe, due to the increased friction as the oil based mud is displaced with the cement slurry.



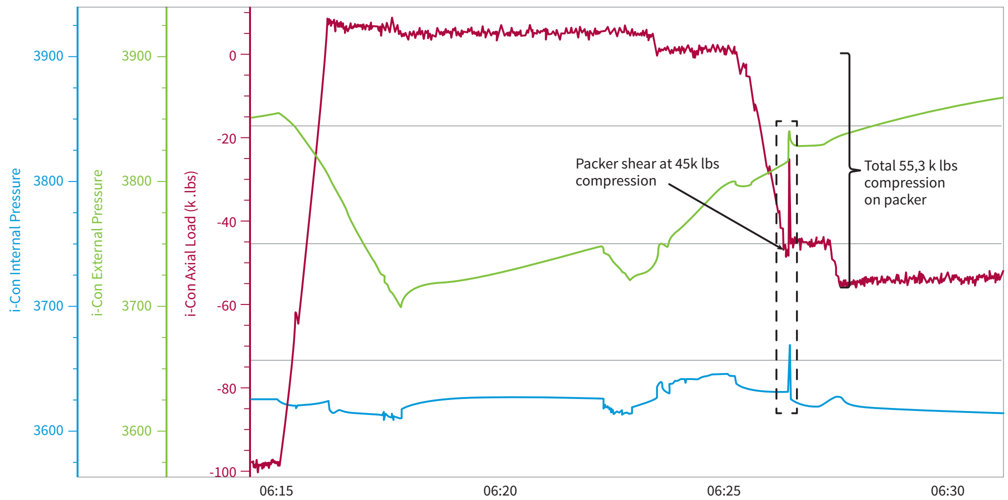
Dart pumping and open hole packer setting

Cementing dart/plug bumps and shear values were easily verified with the i-Con data. With the i-Con pressure sensors very close to the liner top the pressure peaks are very clear and provide extra resolution in the data set compared to the data recorded at surface. There was also an open hole packer included in the string set with applied hydraulic pressure after plug bump.



Setting packer

The i-Con data provided insight into the liner hanger packer activation and verified that the minimum required slack-off weight was applied to properly compress the packer. Data from this operation also allowed verification of the torque and drag modelling done prior to the job. Pressure signatures on the internal and external pressure sensors on the i-Con tool together with a momentarily drop in compression applied to the liner top are seen when the packer shear screws break and the string moves downwards to compress the packer.



Conclusion

i-Con data compared to the surface rig data provided a clear picture on how the liner installation was conducted. This resulted in improved understanding of torque transfer from surface to liner top combined with a deeper insight on how cement displacement impacts downhole torque during cementing operations. Torque and drag simulation modelling can be calibrated based on i-Con data from the installation. Shear pinning, activation and operation of individual tools in the liner could be monitored and verified using the i-Con data. Lessons learned can be implemented into the running procedures for upcoming jobs to facilitate continuous operational improvements.

This job was an operational success – in jobs less successful, the i-Con data provides great value in root cause identification. Accurate and prompt root cause understanding helps in taking the correct operational decisions and learning for future installations to reduce the lost rig time and the costs involved.

Case Study Snapshot

Project Area: North Sea, Norway

Challenges:
- Install and cement a liner hanger to ensure effective zonal isolation

Solution:
- i-Con XL tool, run directly above the liner top
- Measurement of torque required for rotation while cementing
- Verification post installation of hanger setting, ball seat shearing, plug bumps and shear values

Results:
- Successful installation of liner hanger and cement job
- Actual and simulated data comparison to inform future operations

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