

Keep Your Pipe Flowing – Flow Assurance Innovation

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Production interruptions or asset damage from flow assurance issues can lead to extreme financial losses for oil and gas companies. For this reason, flow assurance is widely considered the most critical task during subsea production given the challenging operating environment, including long distances, high pressures, and low temperatures. In the current oil market, smart and efficient solutions are necessary to simultaneously increase production reliability and optimize production costs.

Flow Assurance Challenges

Multiple challenges can affect the reliability of subsea oil production. Risks associated with deposition of waxes, hydrates, asphaltenes, and scales on pipelines and production equipment are increasing as the industry moves towards more challenging production fields. Assessing deposition risks, determining the need for chemical treatment, and developing effective remediation solutions are essential for developing reservoirs in these new fields. The industry also faces other major issues such as erosion from sand production, corrosion, and annular pressure build-up.

Temperature management of produced fluids and adjacent equipment can also affect the reliability of oil production. Industry-standard analysis techniques can at times over-predict the heat transfer of produced fluids to annular cavities filled with fluids that can undergo natural convection, like seawater or brine. This can result in the under-prediction of wellhead temperatures. Overcoming this challenge for applications where produced temperatures may be near hardware limits requires a step beyond standard analysis methods.

Solutions for Reliable Oil Production

Exponent's multi-disciplinary team of Ph.D.-level engineers and scientists are in a unique position to assist the industry with their most challenging and never-before-seen problems. Over decades performing failure analyses, the Exponent team has seen the rare failure modes that have doomed past projects. The cases described below show how Exponent's multi-disciplinary team brings this experience to bear on new projects. In some instances, our multi-disciplinary experience can help identify and translate solutions from one industry into another.

Subsea processing conceptual evaluations

Some flow assurance strategies consider placing processing equipment and chemical storage near the wellhead. Our team at Exponent can help evaluate the viability and practicality of such concepts by answering questions about the availability of technologies from other industries that could be leveraged to better facilitate the unique circumstances of the subsea environment.

Flow-loop testing

Our team recently partnered with a client that indicated waxy oils were expected to cause flow assurance concerns. To address this problem, our team led a project involving

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the design and construction of a large-scale flow loop with a scraped-surface cooling reservoir and implemented a novel ultrasonic-based velocimeter to interrogate waxy oil behaviors under a variety of operating conditions. The client now has a unique facility that can be used to probe the behavior of a variety of model and crude oils under laminar, transitional, turbulent, and transient conditions.

Development of models and evaluation of new technologies

The Exponent team develops bespoke models to evaluate the conditions under which flow assurance issues may arise before they become a reality. These models have addressed asphaltenes, waxes, hydrate deposition, erosion, thermal characterization, and flow acoustics, among other phenomena. We also use bespoke models to assess the viability of new technologies during early-stage development.

Evaluation of novel monitoring solutions

Our team assisted a client in conceptualizing and assessing the technical viability of a real-time, high-fidelity monitoring technology intended to allow operators to evaluate the health of a pipeline and make informed decisions about remediation activities, including chemical injection and pigging frequency as well as fiber optic technologies such as distributed temperature sensing (DTS). Optimizing these activities can help minimize operating costs.

Assessing need for chemical treatments and crude oil rheology

Our team performs state-of-the-art characterizations of crude oils for risk assessment of asphaltene and wax deposition and also for performance evaluation of chemical treatments. Characterization includes rheological assays to capture important non-Newtonian behavior of crude oils and deposition tests to determine fouling tendency due to asphaltene precipitation.

Exponent's Expertise

Exponent's multi-disciplinary team integrates expertise across petroleum, chemical, mechanical, aerospace, and nuclear engineering with polymer science, materials chemistry, corrosion, metallurgy, optics, and signal processing, among other disciplines. We help oil and gas companies solve their most challenging flow assurance problems and assist with cutting-edge research and development efforts.



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