



Accelerating digital transformation in Upstream Oil & Gas

Enhance E&P with rigorous water chemistry insights & intelligence

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Industry trends

The Upstream Oil and Gas (O&G) industry has played an integral role in global development, providing energy resources to fuel industrial and technological advancement. This marketplace has experienced numerous cycles of growth and recession as reserves are discovered and drained, prices rise and fall, and innovation drives new opportunity. Increasing demand, uncertain economic conditions, and the evolving regulatory landscape have caused a growing urgency to locate and extract energy reserves as quickly, safely, and cost-effectively as possible. Digital transformation is empowering companies to capitalize on these trends.

Pursuing digital transformation

Digital transformation is the key to advancing upstream operations, in the way assets and processes are designed, operated, and maintained in the most optimal way. The benefits are undeniable: increased yield, safer operations, cost savings, and greater intelligence. Produced water management is one of the most vital areas of this digital paradigm shift, enabling companies to make real-time and prescriptive changes as water production rates and compositions change. Yet many companies lack the chemistry expertise to fully exploit this data and analytics revolution.

Today's energy producers face a number of produced water issues when attempting to operate productively and sustainably. A crucial challenge is balancing production cost with product yield. Efficiently managing the vast amounts of produced water for reuse, decontamination, or disposal is a key operation challenge. Groundbreaking developments in modeling and chemistry analysis are streamlining drilling and completion operations, mitigating fouling risks, maximizing asset and process performance, and promoting upkeep. State-of-the-art digital transformation empowers Upstream O&G companies to pursue these new technologies.

Leveraging water chemistry insights

The combination of environmental data and chemical analysis is essential to predicting a number of chemical reactions—such as pH control, steam generation, water treatment, gas sweetening, and corrosion. Modeling and simulating chemical processes is foundational to industrial digital transformation, particularly for capital-intensive industries like O&G. Exploiting water chemistry knowledge enables companies to drive performance and innovation. Industry-leading process modeling and simulation software tools are designed to deliver these improvements in both the design and lifecycle optimization of assets and processes.

Enhancing asset design is the first step to establishing a successful operating enviro. Process water simulation is used to predict conditions and guide decision-making prior to production, saving time, money, and resources. For example, the contents of a frac-water holding tanks are managed for ideal mixing as part of a larger field fracking operation. As a result, companies can design water transfer lines to maximize consumption and minimize risks in future completion operations.

Once facilities are up and running, software continues to maximize performance by providing precise modeling insights. By inputting field data into sophisticated models, companies can simulate their exact processes to identify problems, anticipate potential issues, and take remedial/preventive action. Accelerating process design is a critical water chemistry application that not only sustains and advances operations, but it allows companies to make the most economic decisions.

Water chemistry innovations promise to revolutionize industrial processes and assets across their entire lifecycle, from conceptual design to production operations and maintenance. With rigorous models and expertise for a variety of upstream applications, companies have the intelligence to achieve lifecycle optimization:

- **Increasing engineering productivity:** faster and more accurate process design, rapid problem identification and resolution, more time to focus on process design innovation.
- **Lowering operational costs:** efficient and cost-effective design phases, prediction and prevention of costly issues, higher operating margins.
- **Increasing reliability:** real-time diagnosis of damaged equipment, prescriptive insight into at-risk areas, proactive maintenance.
- **Ensuring regulatory compliance:** safer operating environments, enhanced water management and treatment, environmental compliance.

Upstream O&G companies pursuing asset and process lifecycle optimization must employ the latest tools and chemistries to enhance E&P operations. Companies rely on cutting-edge capabilities to calculate chemical stream analysis, electrolyte process flow, scaling and corrosion risk, and much more—all integrated with process modeling software for accurate and immediate results.

Offshore – accelerating operational efficiency

Modeling production from the reservoir through facilities and finally to the refinery is a powerful capability that allows companies to modify operations and remain highly efficient, safe, and profitable. The key is a tool that predicts the composition and properties of all phases: gas, oil, water, and even solids—not just the oil and gas. Without insight into all-phase behavior, key decision-making factors, like mercury partitioning, BTEX contamination in discharge water, and heat-stable salts in regeneration columns would be missed.

Deepwater operations require specialized metals to build pipelines and equipment to resist mineral scaling and corrosion. Some alloys are susceptible to failure while other more highly resistant alloys are costly. Simulation technology aids engineer and material scientists in selecting the right materials. In this process, autoclave experiments are used to test the resilience of various alloys. Software translates the exact field conditions into the autoclave recipe, maximizing the experiments relevance, reducing the number of required experiments, and limiting the use of dangerous chemicals. This insight is crucial to maintaining low design costs, and it helps companies to ensure the safety and consistency of operating environments.

To further assist offshore facilities, digital twins are paving the way to digital transformation. Digital twin is a game-changing innovation that models complex electrolyte water processes, utilizing historical and regularly measured data to diagnose corrosion, fouling, and other flow assurance issues. With real-time updates to these predictions, companies can visualize continuously, where, when, and at what rate problems may occur.

Digital twin simulation is paramount to lifecycle optimization, from designing to production maintenance. Expertly-designed models mitigate risk in all areas of E&P. The incredible benefits of this capability range from honing chemical use and reducing waste, to mitigating equipment failure, to ensuring the safety of workers and the environment. Without digital twins, companies are limited to estimating the conditions of their environment and hoping for the desired outcome, which is highly unreliable.

Fracking – enhancing water management

With the higher costs of offshore drilling, companies are now centering their resources on fracking. Extracting oil from source rock costs roughly half the price of developing the same oil in deep water. Water management is the primary concern in fracking. Producing oil fields requires millions of gallons of water, which can result in scaling, corrosion, and water treatment issues.

Simulation software is essential to creating a comprehensive fracking plan, by predicting the amount of water needed, the composition of process waters, the corrosivity on equipment, and much more. Companies can intelligently plan and adapt their processes in real-time, leveraging water chemistry analysis through a digital twin to create a powerful strategy that drives precision decision-making, increased performance, and peak levels of productivity.

Oil sands – making operations more sustainable

With the discovery of the Athabasca Oil Sands, Canada is now the single largest supplier of imported oil to the U.S, topping all OPEC countries combined. Alberta's marketable oil sands production is projected to surpass 3 million bpd in 2018, with an additional 380,000 bpd expected from 2019 to 2021.

Steam-assisted gravity drainage (SAGD) production now constitutes much of Canada's oil sands production. Because Alberta is environmentally sensitive, it is critical for these production facilities to reuse as much water as possible; removing oils, calcium, hardness ions, carbonate ions, and especially dissolved silica (the cause of steam generator failure). Water-based process simulation is a fast and accurate way to design new and optimize existing water treatment operations. Optimizing operations protects steam boilers against failure while minimizing chemical and waste disposal costs.

Companies are currently exploring digital twin as an extremely effective and interactive schematic for production facilities. The digital twin enables process engineers to monitor their facility, while constantly inputting data into the model to reflect real-time changes in temperature, chemical composition, and other crucial variables. Particularly for SAGD mining, this ability will help to optimize performance, resource consumption, and operating costs on a daily basis, according to the company's optimal design specifications. Physics-based models are unlike any technology on the market. Companies who utilize these trailblazing water chemistry capabilities will have the opportunity to build an ideal operating facility, avoid overdesign, and fuel lifecycle optimization, promoting productivity from stage one.

OLI Systems fueling innovation

[OLI Systems, Inc.](#) offers rigorous thermodynamic models and rich chemistry expertise as well as software platforms, advisory, and implementation services to help Upstream O&G companies design and operate their facilities with the utmost efficiency. OLI Systems' extensive capabilities can also be accessed through leading chemical process modeling and simulation platforms including Aspen, Aveva, Honeywell, KBC, and others. Moving forward, OLI Systems will become a "one stop shop" for water chemistry analysis, from planning phases to optimization throughout the production lifecycle.

OLI Systems is continuously working to expand and automate the scope of modeling and simulation. Building on existing offerings, OLI Systems will not only help companies diagnose scaling and corrosion issues to determine the ideal resolution to achieve desired results. Their mission is to utilize advanced water chemistry analysis to instruct companies how to avoid these reactions. This inhibitor tool will be the cornerstone of providing companies a comprehensive solution to enhance productivity and sustainability.

Another OLI Systems' goal is to develop digital twin technology to create virtual models that can run any number of models and simulations. Digital twin using OLI Systems software will transform modeling and simulation capabilities to transform Upstream O&G. OLI models harness the precision of thermodynamics to eliminate human error. The world has already witnessed the consequences of imprecise measurements and undiagnosed complications—including catastrophic oil spills and the [contaminated water crisis in Flint, Michigan](#). What these disasters have in common is, they were both avoidable.

Process modeling and simulation is on the brink of transformation as digital twin, augmented reality, big data analytics, predictive maintenance, and other innovations push the boundaries of human intelligence. Today's Upstream O&G sector is on a digital transformation journey to maximize ROI and discover new value-producing opportunities, allowing them to rapidly adapt to changes in environment, product demand, regulatory compliance, and competition. Advanced technologies like artificial intelligence (AI) are already being used to assist companies in operationalizing immediate insight—but that is just the beginning. OLI Systems is striving to develop physics-based learning models to replace empirical AI models, providing superior accuracy and immediacy to anything on the market. Physics-based models utilizing electrolyte chemistry analysis combined with the rigor of AI promise to deliver unparalleled intelligence. OLI Systems is leading the charge.

For more information on electrolyte chemistry applications that are transforming Upstream O&G, [contact OLI Systems](#) today. You can also follow [@OLISystems](#) for the latest news and updates.

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