



Expanding electrolyte chemistry modeling applications for Oil & Gas production

Transform end-to-end operations with rigorous water chemistry analysis

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Introduction

The Oil & Gas (O&G) landscape is undergoing a major evolutionary transformation. New advances—such as the Internet of Things (IoT), Digital Twins, and Advanced Analytics are offering enhanced productivity to an industry that continues to push for greater yields, cost-efficiencies, and faster time-to-market. O&G operators that capitalize on these innovations will drive more efficient production, respond more rapidly to market needs and will realize greater ROI.

The promise of Digital Transformation lies in the ability to reduce CAPEX and OPEX costs, optimize the exploration-development-production lifecycle, and harness the full power of their chemistry, physics, mathematics, and economics expertise. As a result, savvy operators are investing in new, effective innovations to enhance process automation and to extract greater value from their data gathering and technology resources.

A key benefit of Digital Transformation will be to significantly advance the understanding of production fluids. Produced water, for example, perhaps the most complex of the fluids produced, can impact flow assurance in a number of ways: scaling, corrosion, hydrate formation, additive compatibility, formation damage, etc. Managing produced water is often hamstrung by inadequate software tools that lack rigor and accuracy, that are unable to provide a clear understanding of production conditions. As a result, bad predictions and incorrect decisions eventually lead to costly remedial actions—but there is a solution being driven by Digital Transformation. Combining rigorous simulation tools with Digital Transformation technologies allows operators to eliminate preventable problems, and capitalize on their full breadth of technical resources as well as historical and real-time data.

The drive to market leadership

Today's companies are seeking advanced production chemistry technology to enhance design and operations. [OLI Systems, Inc.](#) is at the forefront of this technology and is transforming the industry by providing clients with the most accurate representation of their production fluids. OLI's rigorous, first-principles approach lets clients screen vast quantities of data to pinpoint critical issues, equipping energy companies with the right decision at the right time to transform their operations. This exclusive approach helps clients improve decision-making and realize the best course of action for any given environment.

OLI's software contains industry-leading tools—including thermodynamic frameworks, data parameters, and software innovations—that are vital to any production fluid application:

- **A revolutionary thermodynamic framework** – Explore water chemistry properties and phase prediction from pure water to pure salt or hydrocarbon. OLI's new [MSE-SRK framework](#) with its dual theory can model the complete produced fluid chemistry to extreme pressures and temperatures. It is a single tool that can handle all the conditions encountered during drilling and production.
- **An ever-evolving library of chemistries** – OLI's team of thermodynamicists, perhaps the largest in any private company, expertly compiles troves of literature citations and experimental data to develop the parameters that make it possible to model multi-phase systems. Whether the environment includes a dolomite reservoir or a sandstone lens adjacent to a salt dome, this extensive chemistry database captures the components that make up reservoir fluid and the ensuing chemical reactions during production.
- **A link to existing production tools** – OLI's product development team has made it possible to access this transformative technology across many software platforms. From a basic flash calculation to a dynamic production simulation tool, the technology that OLI provides is available to all.

With superior capabilities and convenience, OLI's software drives greater levels of performance and insight to operations, empowering teams of operators to chemical suppliers and corrosion testing lab technicians.

“We are transforming how engineers approach produced water operations,” according to Vineeth Ram, Chief Revenue Officer at OLI Systems. “With advanced software, data, and algorithms, OLI software provides the most precise and comprehensive answers to the O&G industry's most demanding questions.”

Answering the hard questions

OLI solutions are unlike anything on the market. With the capacity to predict the properties of so many systems OLI is answering questions that were otherwise estimated using interpolative or simplified models. “Our thermodynamics team is not afraid to tackle the hardest of technical challenges,” writes Andy Rafal, OLI’s CEO. “Moving forward, OLI’s vision is to apply advanced analytics across the entire periodic table—leveraging chemical data, modeling software tools, and intelligent analytics will take the Energy industry to a new technical and business level.”

Although this is a massive undertaking, OLI is already well-positioned to cross a range of applications, allowing energy companies to operate successfully across remote and extreme environments. The ability to think and compute beyond empirical data is the key differentiator, helping clients achieve business leadership. Whether clients require Digital Twin updates every 10 seconds, 15 minutes, or hour, OLI’s rigorous, near-time chemistry analysis uncovers progressions of change. By automating these processes, Operating companies can benefit from faster, more accurate outcomes to improve energy production with increased efficiencies and profits.

Today, automated processes are rapidly exceeding the performance capabilities of human beings; thus, as chemical data collection and analysis become increasingly streamlined, OLI will leverage transformative methods like IoT analytics, cloud computing, and machine learning to revolutionize chemistry modeling with greater simplicity and accuracy. For example, rather than doing the calculation directly, production engineers could manage an app that notifies them when the scaling tendency of a production tubing reaches saturation. In the future, OLI will utilize machine learning tools to analyze vast quantities of IoT data to deliver predictive and even preventive insights in real-time. The [possibilities for chemistry modeling applications](#) in the O&G sector are endless, and OLI is pioneering the journey.

Virtual research & development

Research and development (R&D) is a lengthy and resource-consuming process for energy companies. Even labs with generous budgets cannot ensure quick or accurate outcomes. The problem is that many companies lack a simple way to target lab experiments or redo the same experiment because of limited knowledge about previous work.

OLI is equipping today’s scientists and engineers with virtual R&D capabilities that will help them simulate experiments. This will work to lower costs and reduce time-to-reporting. In addition, virtual R&D software will enable companies to pinpoint the experiment to be run and guide technicians in choosing the correct configurations. This technology allows technicians with limited training to perform the right experiment, and to derive virtual insights to understand what’s happening in the real world.

OLI consults with clients to virtualize a number of laboratory and pilot tests, including autoclave experiments, water purification, and brine evaporation. By virtualizing experimental efforts OLI will help to increase the productivity of a company’s research and technical support team, and give them a more active part in affecting their company’s bottom line, environmental stewardship, and technology leadership.

[One OLI client](#), a fullstream provider of integrated oilfield products and services, is harnessing OLI technology to optimize corrosion testing. With one of the largest hydrogen sulfide labs, this client must maintain a safe and efficient procedure to perform high pressure corrosion tests. OLI simulation software allows them to evaluate corrosive gases under elevated temperature and pressure conditions, reducing the number of required experiments. By measuring precise phase properties and pressures, the software provides key information to select the right operating materials, which can save time and money.

Other material scientists see the [OLI Studio: Corrosion Analyzer](#) as a vital component to replace costly lab work. Through the use of polarization curves, clients analyze the behavior of different chemistries and their relative contribution to corrosivity. Corrosion Analyzer greatly reduces the number of required experiments, while defining corrosion mitigation ideas, and OLI is at the core of these cutting-edge capabilities.

Process simulation

A major challenge to upstream operators is finding ways to streamline production and increase yield while reducing operating costs. Exorbitant investments in money and manpower are required to design and build facilities, manage materials and equipment, extract resources, and cost-effectively dispose of water. Optimizing resource consumption and reuse is a crucial mission for today’s

companies. As valuable materials grow progressively scarce, the ability to reduce consumption and improve a resource's usability becomes crucial to success.

Fresh water is one essential resource that is quickly reaching scarcity. By 2030, half of the global population will face water shortages. While O&G uses significantly less arable water than sectors like agriculture or power generation, energy companies have a critical role in protecting the quality and safety of water sources.

O&G wells produce large amounts of water. In fact, wells producing 20X more water than oil or gas is common, and this water is often saline and unsuitable for surface disposal. Producing this water can also lead to costly and sometimes catastrophic corrosion, solids buildup (fouling or scaling), emulsion, and reservoir souring problems. Because of the environmentally harmful impact, brines containing excessive salts must be treated—evaporation, reinjection, or chemical treatment are the time-, money-, and resource-depleting options. OLI Flowsheet: ESP, a steady-state process simulator, assists companies in finding the optimal solution to handling brine. Solving these complex questions is the difference between a successful upstream operation and one that loses time and revenue.

A marquee feature of OLI Flowsheet: ESP is its membrane unit. This unit uses first-principles-based permeabilities to deliver highly accurate results for all elements in water. The most popular membrane unit, Reverse Osmosis (RO), allows process engineers to simulate the complete water treatment plant in a single software platform. This disruptive technology is transforming the way companies approach water treatment and is redefining the way we think about water as a resource.

Scaling & corrosion modeling

A continuing challenge is mitigating scaling and corrosion, perhaps the two most common production issues facing any oil or gas well. Mineral scales build up over time in tubing and equipment, restricting flow and reducing production rates. With corrosion, dissolved components in waters are universally aggressive to all forms of steels and alloys, and stresses on a material only leads to greater risk of failure. When these problems occur, companies have little choice but to shut-in production, fix the problem, and then resume operations. This cuts off revenue and increases operating costs.

To combat this dual loss event, OLI is employing classic modeling techniques to predict the propensity of a well to scaling or corrode. OLI's approach to speciation, solubility, and corrosivity helps clients understand the impact of phase composition (oil, gas, water, reservoir minerals) and the impact of temperature and pressure on the risks presented by their fluids.

Water chemistry is not intuitive. With countless variables affecting chemistry behavior, many O&G companies struggle to predict and prevent scaling and corrosion issues. The prescriptive approach is to utilize modeling and simulation to avoid these occurrences altogether. OLI software is the key to unraveling these complex problems, with the capabilities to pinpoint how and why a problem occurs and how and where to treat it. By uncovering these insights, OLI creates a personalized treatment option to help companies prevent issues and achieve optimal production.

Alliance partners

To further these trailblazing advancements, OLI is working with alliance partners like Schneider/AVEVA, Honeywell, Aspen, and others to expound on process design applications. OLI's one-of-a-kind technology is a critical component in today's simulation and modeling software. By adding electrolytes to flowsheet simulators, OLI can deliver the most comprehensive and accurate insights right to your fingertips. OLI technology, after all, is the same in Alliance products as it is in OLI's standalone software.

This process is integral to achieving the desired physical and chemical transformation of highly valuable materials. Whether working as an OLI Engine inside an alliance partner product, or in OLI's standalone software, there is no comparable process simulator on the market.

Summary

The O&G sector relies heavily on transformative technologies to find new assets, harness deep water insights, assess risk, and optimize operations end-to-end. This is one reason why the Hubbert curve, the theory that predicted peak oil production, has continuously been extended since its inception 60 years ago. Transformative technologies are essential to exploring potential

complications and driving efficiencies as well as the most effective way to produce energy resources for maximum profit and minimum risk. **Table 1** in the Appendix shows key OLI's current capabilities for various Upstream Oil & Gas applications. Moving forward, OLI Systems will expand on these capabilities with more predictive and pervasive solutions that address the entire spectrum of process and asset lifecycle challenges in the O&G industry.

OLI Systems, Inc is committed to furthering the science of electrolytes and phase chemistry, everywhere. The company is expanding and enhancing their abilities, making OLI the go-to partner for any water or phase chemistry challenge. With the most accurate, rigorous capabilities and a client-friendly approach, OLI is prepared to address a wide range of industry needs, equip clients for future growth and success, and work vigorously to develop new electrolyte chemistry modeling applications.

[Contact OLI](#) today to learn more about the industry-leading innovations that can drive your operating potential.

Appendix

Table 1: Key OLI Systems, Inc Capabilities for Upstream Oil & Gas Applications

Process/ Application	Electrolyte Chemistry Use Cases	OLI Systems, Inc. Capabilities
Sag-D	Higher steam quality (e.g. >80%) and silicate scaling	<ul style="list-style-type: none"> • Scaling Prediction and Inhibition <ul style="list-style-type: none"> • Scale Treatment • Remediation • Corrosion Prediction and Inhibition / Green Technology <ul style="list-style-type: none"> • Mercury Removal • Autoclave simulation • H2S removal from gas and liquid <ul style="list-style-type: none"> • MEG Recovery • Gas Hydrate Prevention • Gas Well simulation for enhanced oil recovery <ul style="list-style-type: none"> • Scaling and Corrosion in HPHT conditions for Extreme Reservoir Production
	calculate chemical dosing rates / chemical treatment	
	Optimizing silica removal, Surface complexation	
	Optimizing Ion Exchange purification	
	Boiler feed water clean up	
	Steam injection and mineral dissolution	
	water separation from bitumen (skimming)	
	Whole plant simulation for water mass balance	
	Reservoir mixing	
Production: flow assurance	Enable designing experiments for Corrosion testing using autoclaves	
	Creating recipe for the lab tech	
	Enhance Engineering Design for Corrosion Scientist	
	Injection water compatibility, scaling predictions	
Production	Scaling and Corrosion of production assembly	
Exploration and drilling	Drilling fluid chemistry	
Completion	Drilling fluid chemistry	
Abandonment	Drilling fluid chemistry	
Industrial Water Treatment	Water treatment before discharge to the environment	
Regulatory Compliance - (RCRA)	Flue gas removal from water in treatment process	

For more Information

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