

Real-Time Process Analysis Strengthens Crude Distillation Unit Operation Using the Modcon.AI Optimization Suite

Real-time crude quality monitoring and AI optimization improve CDU stability, energy efficiency and performance during feedstock variability.

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EINPresswire.com/ -- As refineries worldwide face increasing variability in crude oil feedstocks, advanced artificial intelligence (AI) combined with real-time analytical measurement is emerging as a critical enabler for more efficient and resilient crude distillation unit (CDU) operations. New developments in deep reinforcement learning (DRL) and online crude quality monitoring are allowing refiners to respond dynamically to feedstock fluctuations, improve energy efficiency and maintain consistent product quality.



Modcon's petroleum process analyzers provide continuous, accurate measurement of crude oil and product streams, enabling real-time optimization, improved yield, and enhanced safety in refining operations.

Crude distillation is the cornerstone of petroleum refining, separating crude oil into valuable fractions based on boiling ranges. However, modern refining operations must contend with a growing mix of conventional and unconventional crudes, frequent crude switching and tighter economic and environmental constraints. These conditions place significant strain on traditional steady-state optimization and model-based control strategies, which often rely on historical data and limited real-time feedback.

Deep reinforcement learning offers a fundamentally different approach. DRL systems learn optimal control strategies through continuous interaction with the process, evaluating actions based on defined performance rewards such as yield maximization, energy reduction or product quality stability. Unlike classical machine-learning methods, DRL does not depend solely on historical datasets and is well suited to dynamic environments where rapid feedback is available.

This is where real-time crude quality analysis becomes essential. Crude oil composition can vary



Accurate AI-driven optimization of crude distillation operations is only possible with real-time feedstock quality analysis, which is essential for deep reinforcement learning optimization.”

*MODCON Systems R&D
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significantly over time, directly affecting distillation behavior, vapor-liquid equilibrium and cut-point stability. During crude switching, these variations become more pronounced, increasing the risk of off-spec products, energy inefficiencies and operational disturbances.

Online analytical technologies, such as near-infrared (NIR) [crude oil analyzers](#), provide continuous measurement of key crude properties including composition, viscosity and other critical parameters. When integrated with AI-driven optimization platforms such as the MODCON.AI [CDU Optimization Suite](#), this real-time data enables continuous validation and adjustment of AI models, ensuring control

decisions reflect actual process conditions rather than predicted averages.

By combining DRL-based optimization with live crude property measurement, refineries can proactively adjust furnace operation, column temperatures and reflux ratios in response to feedstock changes. This integrated approach improves fractionation stability, reduces quality giveaway, lowers energy consumption and enhances overall unit profitability.

Beyond operational efficiency, the solution provides greater flexibility for processing a wider range of crude slates without extensive manual intervention. Continuous learning from real-time data allows the AI model to refine its performance over time, supporting long-term improvements in plant reliability and sustainability.

As refining economics become increasingly sensitive to feedstock variability and energy efficiency, the integration of advanced AI with real-time analytical measurement represents a significant step forward in CDU optimization. This approach offers refiners a practical, scalable pathway to operate closer to optimal conditions while maintaining safety, product quality and environmental performance.

[Modcon Systems](#), headquartered in London, UK, is a global provider of advanced process analyzers, optimization software and AI-driven control solutions for the energy, chemical and refining industries. With more than 50 years of experience, the company specializes in real-time measurement and intelligent optimization technologies that help industrial operators improve efficiency, safety and sustainability.

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