

Monitoring Crude Oil in Produced Water

The oil and gas production industry generates produced water. Produced water is typically a mixture of formation and injection process water that contains oil, salts, chemicals, solids and trace metals. Produced water is the primary waste product resulting from the separation of oil, gas and water at production facilities. The discharge of produced water to the environment is regulated by the Environmental Protection Agency (EPA) in the United States.

The EPA mandates that produced water discharge, as overboard water, must contain an oil and grease concentration less than 29 ppm and 42 ppm, respectively, for a 30 day average and daily maximum. Federal EPA Method 413.1 is mandated for regulatory compliance monitoring of oil and grease concentrations in produced water. Method 413.1 is a gravimetric method that utilizes solvent extraction (Freon 113) of oil and grease hydrocarbons followed by solvent evaporation and subsequent residue weight analysis. Regulatory compliance samples are typically taken at thirty day intervals and analyzed by EPA recognized laboratories. Method 413.1 analytical results are reportable to the Federal EPA.

The Problem

The oil and gas production industry typically monitors oil and grease concentrations in produced water at production facilities on a daily basis to manage oil/water separation processes and discharge compliance. The industry utilizes a modified Method 413.2 which relies on Infra-Red (IR) measurement of the Freon 113 extract for oil and grease concentrations versus residue weight (gravimetric analysis).

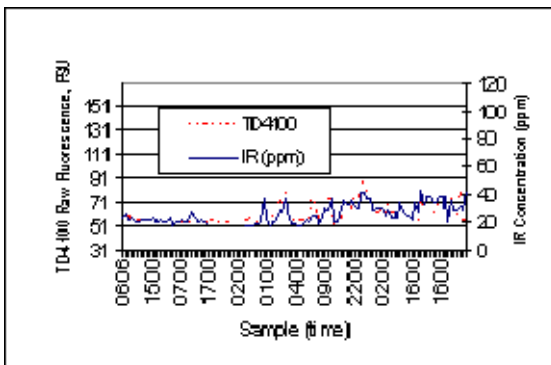


Figure 1: The TD-4100 continuous on-line monitor demonstrates high correlation to Freon/IR grab sample measurements.

IR instrument response is calibrated and allows production chemists to determine oil and grease concentrations in produced water. The modified Method 413.2 is classified as a "non-report" method whose analytical results are not reportable to the EPA.

The oil and gas industry is now challenged with developing an alternative analytical method for use by production chemists to measure oil and grease without using Freon 113. Recent amendments to the Clean Air Act of 1990 and the Montreal Protocol force the phase out of Class I chlorofluorocarbons (CFC's) by January 1, 1996. This presents a dilemma for all analytical

methods using Freon 113 as an extraction solvent for oil and grease measurements. The EPA has issued Method 1664 to replace Method 413.1 with the primary objective to substitute Freon 113 with n-hexane as the extraction solvent. The American Petroleum Institute (API) is currently evaluating alternative methodology to support oil and grease measurements in produced water by oil and gas production facilities. The new EPA solvent, n-hexane, cannot be used as a replacement solvent for Freon 113 in the Freon/IR modified 431.2 method. The flammable solvent, n-hexane, strongly absorbs IR wavelengths and interferes with the oil and grease measurement.

The TD-4100 continuous on-line monitor demonstrates high correlation to Freon/IR grab sample measurements.

The Solution

Yielding to produced water discharge regulations and the phase-out of CFC's, the oil and gas industry is consistently asked to invest in analytical methods that demonstrate the effectiveness of process control for oil/water separation systems. Protecting regulatory compliance for produced water discharge translates directly to effective management of process control systems that treat produced water. Continuous treatment verification for discharge compliance is only achieved by continuous on-line oil in water monitoring. Until recently, viable continuous on-line oil in produced water monitoring systems were absent from the oil and gas industry.

Recent advances in the development of a continuous on-line monitor, the TD-4100, provide the oil and gas industry with a viable complement to grab sample measurement for oil and grease measurements in produced water. The TD-4100 makes a positive impact on the effectiveness and costs associated with managing treatment and discharge compliance for produced water. Continuous oil in produced water monitoring benefits the growth of unmanned production facilities, and need to monitor the purity of re-injection water. Data generated by the Turner Designs TD-4100 compared with the Method 413.2 Freon/IR technique demonstrate strong correlation between continuous monitoring and grab sample measurements for overboard discharge (Figure 1). These data provide strong support for utilizing continuous monitoring for verifying treatment of produced water either for discharge compliance, process control applications or re-injection.