



Application Note AN-PAN-1014

Automated online determination of salt in crude oil according to ASTM D3230

Crude oil is a highly complex mixture of hydrocarbons that contains different organic and inorganic impurities (e.g., water and inorganic salts). Excessive amounts of salt in crude oil lead to higher corrosion rates in refining units and are detrimental to the catalysts used. Therefore, salt must be removed from crude oils before refining in a process known as desalting.

Desalting techniques are well established, but continuously monitoring the salt content in crude oil

is a necessary innovation to facilitate process control and cost reduction.

This Process Application Note discusses monitoring the salt content in crude oil following ASTM D3230 using the **2060 TI Ex Proof Process Analyzer** from Metrohm Process Analytics, equipped with special heavy-duty sampling devices. This online analysis solution ensures a safe working environment for operators, avoids corrosion from excess salt in crude, and increases profitability in the desalting process.

Crude oil is extracted from wells that contain water, gases, and inorganic salts (either dissolved or suspended). These salts facilitate downstream fouling and corrode heat exchangers and distillation overhead systems. Furthermore, salts are detrimental to catalysts in downstream conversion processes.

Salt is removed from crude oil via two major methods: chemical and electrostatic separation. The most common method is **electrical desalting** [1]. Both methods use hot water as the extraction agent.

Excess water must be removed first; consequently, desalting takes place before distillation (Figure 1a).

After preheating to 115–150 °C, the oily feedstock is

mixed with water to dissolve and wash out the salts. The water must then be separated from the oil feedstock in a separating vessel by adding demulsifier chemicals to break up the emulsion. A high-potential electric field must then be applied (via electrostatic grids) across the settling vessel to coalesce the polar saltwater droplets (Figure 1b). The wash water (brine) which contains dissolved hydrocarbons, free oil, dissolved salts, and suspended solids is treated further in an effluent treatment plant. Efforts are made in the industry to reduce the water content of the desalted crude to less than 0.3%.

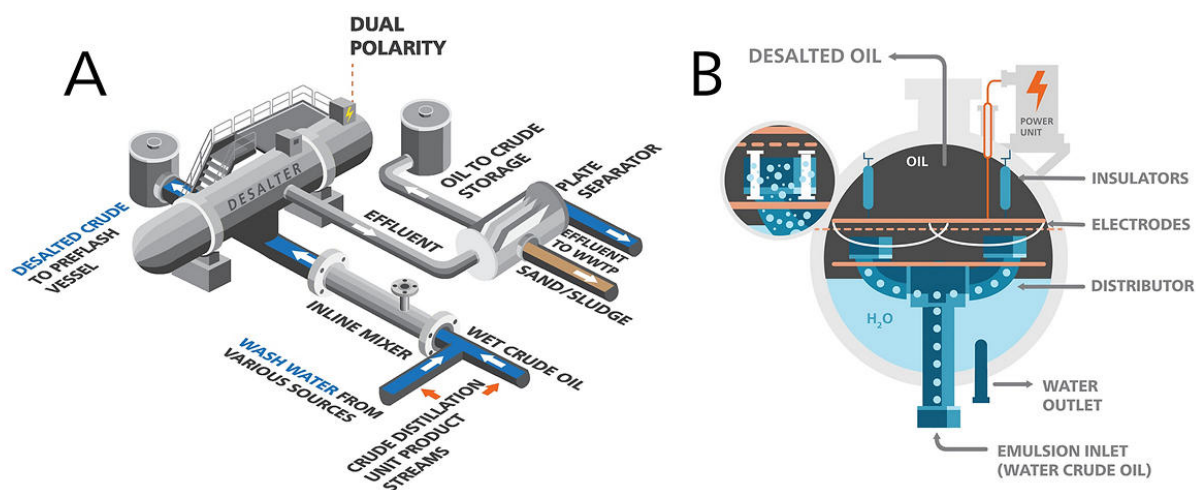


Figure 1. a) Schematic diagram of a typical crude oil desalter process. b) Cross-sectional view of a crude oil desalter.

INTRODUCTION

Traditionally, the desalting process can be monitored by laboratory pH analysis. This method helps to determine the speed of phase separation between the two phases (water-oil). However, this methodology does not provide results quickly and requires human intervention to implement the laboratory analysis results back into the process. Online process analysis allows for constant monitoring of crude oil quality without long wait times in the laboratory. This ensures more accurate and representative results, delivered directly to the control room.

Additionally, testing of crude and refined oil products is demanding and requires precise and reliable analysis to meet regulatory demands. Metrohm Process Analytics is actively involved with international standard bodies to drive method development. The **2060 TI Ex Proof Process Analyzer** (Figure 2) can monitor chloride in crude oil after desalting according to ASTM D3230 testing procedures.



Figure 2. 2060 TI Ex Proof Process Analyzer.

APPLICATION

Chloride (**Table 1**) is analyzed with conductivity detection, as described in ASTM D3230, with the

2060 TI Ex Proof Process Analyzer (Figure 2).

Table 1. Typical chloride concentration range in crude oil according to ASTM guidelines

Components	Range (mg/kg)
Chloride	0–500

The chloride in crude oil must be monitored before and after the desalting process to check the process efficiency and prevent corrosion problems downstream. Since the sample take-off point is typically located in a hazardous environment, the

2060 TI Ex Proof Process Analyzer is designed and equipped to meet Directive 94/9EC (ATEX95). No «hot work permits» are needed for maintenance, and the analyzer can be controlled remotely.

Other measurement techniques can be applied for low economy grade crudes like the Standard Test Method for Salt in Crude Oils (Potentiometric

Method) ASTM D6470. Karl Fischer titration can be applied for moisture/water content determination as an additional parameter in the desalter.

RELATED ASTM METHODS

- ASTM D3230: Standard Test Method for Salts in Crude Oil (Electrometric Method)

AN-PAN-1001 Online analysis of hydrogen sulfide and ammonia in sour water stripper

AN-PAN-1026 Mercaptans and hydrogen sulfide derived from crude oil, according to ASTM D3227 and

- ASTM D6470: Standard Test Method for Salt in Crude Oils (Potentiometric Method)

UOP163

AN-PAN-1047 Monitoring water content in refined products inline with NIR spectroscopy

BENEFITS FOR ONLINE DESALTING ANALYSIS

- No «hot work permits» are needed for maintenance, and the process analyzer can be controlled remotely.
- **Safe production** due to near «real-time» monitoring and no exposure of the operator to chemical reagents.
- Greater and faster **return on investment (ROI)**.
- **More savings** per measurement, making results more cost-effective.
- **Increased product throughput**, reproducibility, production rates, and profitability.

BENEFITS FOR ONLINE DESALTING ANALYSIS



REFERENCE

1. Al-Otaibi, M. B.; Elkamel, A.; Nassehi, V.; et al. A Computational Intelligence Based Approach for the Analysis and Optimization of a Crude Oil Desalting and Dehydration Process. *Energy Fuels* **2005**, *19* (6), 2526–2534.
[DOI:10.1021/ef050132j](https://doi.org/10.1021/ef050132j)

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CONFIGURATION



2060 TI Ex Proof Process Analyzer

The **2060 TI Ex Proof Process Analyzer** is an intrinsically safe wet chemistry process analyzer for process monitoring in gas or dust zoned hazardous environments rated as zone 0, 1 and 2, or 20, 21, and 22. It complies with EU Directives 94/9/EC (ATEX95) and is certified for Zone 1 and Zone 2 areas. Its design combines a purge and pressurization system with intrinsically safe electronic devices. The air purging phase and permanent overpressure prevent potentially explosive atmospheres from entering the analyzer enclosure.

The analyzer's design eliminates the need for purging large analyzer shelters, allowing for direct installation at the production line within hazardous zones. It supports various kinds of techniques, including titration, Karl Fischer titration, photometry, ion-selective electrode measurements, and direct measurements.