



Application Note AN-PAN-1044

Online trace analysis of amines in the alkaline water-steam circuit of power plants

Thermal power plants use the heat generated by combustion or nuclear fission to produce high pressure steam, which is fed into a turbine driving a generator that converts the mechanical energy into electrical energy. Downstream of the turbine, the steam condenses to water, forming a vacuum critical

for the power plant efficiency. This water is returned to a feed tank from where it is pumped back into the steam boiler. Cooling water flows through the condenser in a separate circuit, removing the heat of condensation released by the steam via a heat exchanger.



Figure 1. Diagram of a 2-water circuit power plant.

Unplanned maintenance can lead to costly and critical downtimes and corrosion is often the cause. Exceptionally low pH values increase the corrosion potential, whereas excessively high pH values destroy the protective layer on the metals. Adjustment of the pH value is challenging because the requirement for minimum corrosion and maximum protective layer leaves very little flexibility. To keep corrosion low, the pH value of the watersteam should be in a slightly alkaline range, frequently achieved with All-Volatile Treatment. In this treatment procedure, neutralizing amines such as morpholine, methoxypropylamine, and ethanolamine among others are added to the

demineralized feed water to raise pH, inhibiting corrosion in steam condensate systems.

Frequent monitoring of the chemistry ensures safe and efficient power plant operation. Ion chromatography with conductivity detection provides an effective means to control amine addition in alkaline water-steam circuits of thermal power plants. Precise, reliable trace analysis requires the method to be automated as much as possible. Metrohm Process Analytics offers a complete solution for this task: **the 2060 Ion Chromatograph (IC) Process Analyzer** featuring the Metrohm intelligent Partial Loop Technique (MiPT) option.



Figure 2. Chromatogram of a simulated water-steam circuit sample treated with 1 mg/L each: sodium, ammonium, ethanolamine, potassium, dimethylamine (DMA), morpholine, nickel, 3-methoxypropylamine, zinc, magnesium, and calcium; sample volume: 100 µL.

APPLICATION

In a single analysis, the 2060 IC Process Analyzer is able to measure numerous ionic compounds in aqueous media from ng/L to % concentrations. Most important is the sensitive determination of **sodium** next to the high **ammonium** or **amine** concentrations, because an increase thereof indicates that cooling water is seeping into the circuit. The analysis system is fed directly and continuously with samples via a bypass in the process. The Metrohm Partial Loop Technique allows, in addition to the automatic calibration feature, a working **calcium** and **magnesium** determination. Automated calibration guarantees excellent detection limits, a high reproducibility, and excellent recovery rates. Additionally, sequential cation suppression reduces baseline noise, considerably lowering the detection limits. The analysis is carried out fully automatically. Analyte detection is by conductivity.



Figure 3. The 2060 IC Process Analyzer is available with either one or two measurement channels, along with integrated liquid handling modules and several automated sample preparation options.

REMARKS

The column oven should be used in this application to maintain analytical column stability above room

temperature (up to 40 °C).

BENEFITS FOR IC IN PROCESS

- **Inline eluent preparation** ensures consistently stable baselines
- **Safe working environment** and automated sampling
- **High precision analyses** for a wide spectrum of analytes with multiple types of detectors
- Protect valuable **company assets** (e.g. pipes, PWR, and turbines, which are prone to corrosion)



FURTHER READING

Related application notes

[AN-C-049 Trace cations in power plant feed water stabilized with 7 ppm monoethanolamine \(MEA\)](#)

[AN-CS-010 Traces of lithium and sodium besides monoethanolamine in water-steam circuits of thermal](#)

[power plants](#)

[AN-C-139 Cations and amines in the water-steam cycle](#)

CONTACT

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CONFIGURATION



2060 IC Process Analyzer

Der **2060 Ion Chromatograph (IC) Process Analyzer** von Metrohm Process Analytics basiert auf dem modularen Konzept der 2060-Plattform. Dank dieser modularen Architektur können die Schränke getrennt und an unterschiedlichen Standorten in einem Betrieb aufgestellt werden. Darüber hinaus können für zeitsparende sequenzielle Analysen in mehreren Bereichen eines Betriebs bis zu 20 Probenströme angeschlossen werden.

Dieses Analysengerät hat keinerlei Einschränkungen hinsichtlich Hardware, Software und Individualisierung der Anwendungen. Vom beständigen Eluent Production Module über Nassteilmodule für die Probenkonditionierung bis hin zu mehreren IC-Detektorblöcken bietet der 2060 IC Process Analyzer alle Optionen für beliebige industrielle Anwendungen.

Die Software des 2060 ist eine Komplettlösung zur Steuerung des Analysengeräts bei der Durchführung von Routineanalysen und bietet verschiedene Betriebsarten, Zeitprogramme und Trenddiagramme. Darüber hinaus kann die Software des 2060 dank der Vielzahl an Kommunikationsprotokollen (z. B. Modbus oder diskreter E/A) so programmiert werden, dass automatisch Rückmeldungen und Alarmer an den Prozess gesendet und bei Bedarf Massnahmen ergriffen werden (z. B. erneute Messung einer Probe oder Start eines Reinigungszyklus). Alle diese Funktionen gewährleisten eine vollautomatische Diagnose des industriellen Prozesses rund um die Uhr, sieben Tage die Woche.