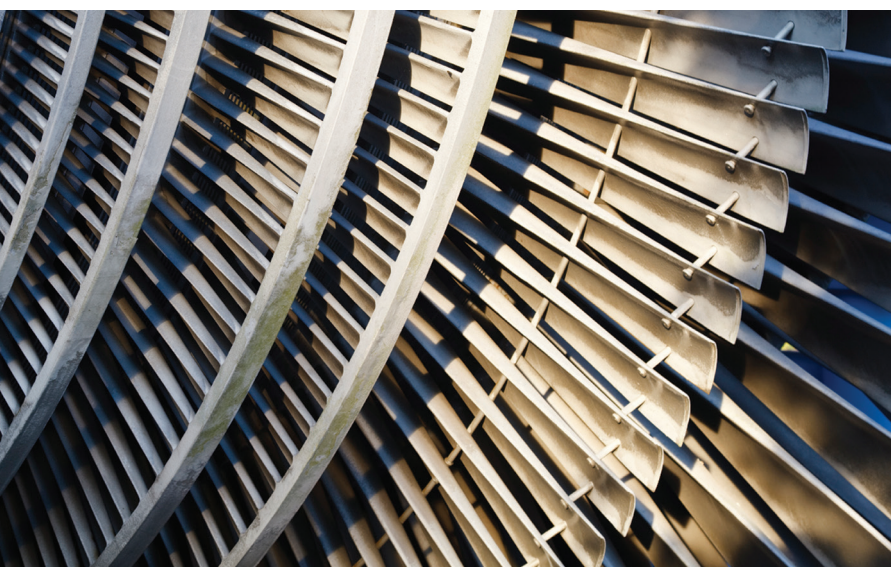


# Controlling sodium concentrations through on-line analysis

Using ABB's Navigator 500 Sodium analyzer to optimize steam loop efficiency



Improving boiler performance and steam quality through accurate and reliable sodium monitoring

## Measurement made easy

On-line sodium monitoring

## Introduction

Extensive on-line chemical monitoring of both the water/steam cycle and water treatment plant on modern power stations is now a very well established practice. This enables careful control of the water chemistry, to achieve peak efficiency and minimize down time due to excessive boiler corrosion or scaling.

Achieving well-balanced water chemistry is vital to optimizing the efficiency and availability of boiler plant in power station applications. If the plant chemistry is allowed to vary from specified limits, expensive plant outages can occur, potentially incurring costs of over \$1,000,000 per day.

Accurate and reliable monitoring of water quality across a range of parameters is therefore critical in ensuring continuous and efficient operation of power generating equipment.

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## The application

As the root cause of many different types of corrosion in boilers, sodium is one of the most important parameters to measure in power plant applications. Although conductivity measurement has traditionally been used to indicate total dissolved solids or chemical contamination, it lacks the sensitivity needed for accurate sodium measurement at very low levels.

Sodium is the sixth most abundant element on Earth. Although it is a metal, it is very reactive. It occurs in large quantities in relatively few compounds, the most common of which is sodium chloride.

A challenge for power plant operators is that nearly all sodium compounds are water soluble, presenting a problem not only within the boiler itself but also in the steam supply through carryover.

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## The challenge

A particular problem is the formation of sodium hydroxide (NaOH). Sodium hydroxide is typically formed as concentrations of sodium carbonate used in the feedwater treatment process increase in the boiler as the water evaporates. As it builds up, the sodium carbonate undergoes hydrolysis, forming sodium hydroxide, which then attacks the iron in the boiler. As the iron dissolves, sodium ferroate is formed, which also undergoes hydrolysis, effectively regenerating the sodium hydroxide levels in the boiler.

The consequence of this cycle is the embrittlement of boiler components. Particularly affecting rivets, bends and joints where stresses are greatest, embrittlement causes metal to lose its ductility, making it brittle and increasing the likelihood of cracking or breaking under stress.

Further problems are caused where sodium hydroxide is carried over into steam. As the steam condenses, the sodium hydroxide can accumulate in critical components, including the steam turbine, where it can attack the turbine blades.

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## The solution

Given its aggressive nature and its ability to permeate throughout the boiler and steam loop, sodium levels must be checked at key points in the steam generation and distribution processes.

Sample points must include the water treatment plant, the condenser extractor pump, the polishing plant outlet and the saturated and superheated steam distribution loops.

At the water treatment plant, monitoring for sodium helps to identify any sodium breakthrough from the cation exchange and mixed bed outlets caused by exhaustion of the ion exchange beds. As sodium is a monovalent ion, it is much more likely to break through first, providing an early indicator of bed exhaustion. As such, monitoring for sodium also acts as a useful measure of bed efficiency as well as a precursor measurement for potential sodium contamination further down the line.

On-line sodium measurement after the extraction pump provides a useful indicator of condenser leaks. Operated under high vacuum, the condenser is prone to leaks that cause cooling water to become mixed with the condensate. A key concern here is the ingress of chloride and sulphate, which occur mainly in the form of sodium chloride and sodium sulphate. As sodium monitors have 10 to 100 times the sensitivity of on-line chloride measurement techniques, measuring sodium levels provides a good way of detecting for the presence of chloride and sulphate.

Working in a similar way to water treatment plant, polishing plants can use sodium monitors to detect ion exchange bed exhaustion as well as for monitoring water quality. In some power stations, the polishing plant is incorporated into the main water treatment plant.

In high pressure boilers, any chemical contaminants present in the steam can quickly build up in the boiler drum and can be carried over in the steam to the turbine.

Monitoring for sodium in the saturated and superheated steam distribution loops helps to protect against corrosion and the formation of sodium salts on the superheater or turbines caused by steam carryover. By measuring the purity of the steam and comparing it to the measurements taken from the saturated steam before the superheater and condensate stages, operators can assess whether quality is being affected by issues such as deposition of sodium salts or condenser leaks. The same measurement can also be performed for Once Through boilers, where the sample is taken from the superheated steam before the turbine.

## What can ABB offer?

ABB's Navigator 500 Sodium provides a continuous measurement of sodium concentrations. It uses an ABB sodium ion-selective electrode and reference electrode to measure the sodium ion concentration in demineralization plants and in the steam/water cycle of steam-raising plants. The Navigator 500 Sodium is an accurate, reliable instrument that requires very little maintenance and measures sodium ion concentrations within the range 0.10 parts per billion to 10 parts per million. This accuracy is reinforced by automatic temperature compensation, ensuring that readings reflect the actual process conditions.

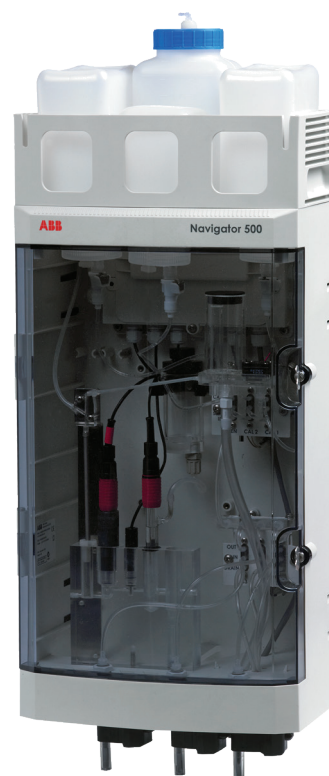
The ABB Navigator 500 Sodium is available in both single-stream and multiple-stream versions. This enables either four single-stream wet sections or one multi-stream wet section to be connected to a single transmitter.

Key features of the Navigator 500 Sodium include a grab sample mode and automatic electrode regeneration.

The grab sample mode enables the device to be used to test a sample from elsewhere in the plant. Unlike conventional devices where the operator must switch to analysis mode, wait for a reading and switch back to measurement mode, the Navigator 500 Sodium stores a reading in its audit log and automatically switches back to measurement mode as soon as the analysis is done. This eliminates the need for the operator to wait for a reading, which can take several minutes.

The automatic electrode regeneration helps to prolong the life of the sensor electrode, particularly useful in applications where sodium must be measured at very low levels for long periods. To prevent diminishing sensor performance, the Navigator 500 Sodium can be preset to automatically regenerate the electrode by adding a regeneration reagent at set periods.

Other features also include automatic calibration and a choice of reagent chemistries to ensure accurate, reliable analysis. The transmitter is also available with the option of digital communications, including Ethernet capability, enabling data to be relayed to a central control room.



ABB's Navigator 500 sodium analyzer

The Navigator 500 Sodium is part of ABB's Navigator 500 analyzer family, which brings a compact, reliable and accurate range of instruments for high purity water treatment and boiler chemistry monitoring applications. Providing continuous on-line monitoring of boiler feedwater quality, the Navigator 500 Hydrazine, Dissolved Oxygen and Sodium analyzers help ensure optimum efficiency of both boiler plant and ancillary equipment throughout the steam distribution loop.

A key feature across the range is its separate sensor and transmitter section design. All analysis and signal conditioning is conducted within the sensor section and transmitted digitally to the transmitter. Each transmitter can collect data from up to four sensing systems. This enables monitoring at multiple points without the cost associated with purchasing and installing separate transmitters. The four transmitter inputs can be used to collect signals on one parameter or can be mixed and matched, with multiple parameters being fed to one unit.

The transmitter is also available with the option of digital communications, including Ethernet capability, enabling data to be relayed to a central control room.

ABB's Navigator 500 and 600 on-line analyzers provide complete monitoring of all the key boiler chemistry parameters.

Navigator ASO500  
Sodium



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