Liquid Analysis

Long live your power plant!

Modular SWAS panels for a safe water/steam cycle

The smart solution for monitoring water/steam cycle

Optimum instrumentation:
Specialized analytical devices minimize maintenance costs and plant downtime and help extend your power plant's service life.

Flexible engineering:
Each panel is adapted to your water/steam cycle, presenting a turnkey solution.

Reliable documentation:
Sophisticated documentation tools simplify quality and plant asset management.

Seamless system integration:
Easily integrated into your process control system thanks to certified communication standards.

Strong partner:
Measuring technology, consulting and global support from a single source make the SWAS solution easy and future-proof.

Endress+Hauser
People for Process Automation

How do you monitor your water/steam cycle?

In power plants, the quality of the water is a key factor in keeping the water/steam cycle free from contamination. Turbines, boilers and pipes can become corroded and encrusted if the water is not pure enough, leading to expensive repairs or even complete unit replacement.

The quality of the demineralized water used in power plants depends on a number of parameters. Sodium and silicate indicate the condition of the ion exchange resin in the feedwater treatment system. The conductivity value is an indicator of the ion concentration in the water. If it's too high, this can lead to the build-up of deposits in the systems. If the pH value of the water is too low or the oxygen value too high, there is a risk of corrosion. By measuring the dissolved oxygen, it is also possible to determine whether the negative pressure is causing air leaks in the condenser, to check whether degassing is sufficient and to monitor the integrity of the feedwater circuit. The presence of metals such as iron and copper in the steam/water cycle are an indicator of heat exchanger corrosion.

The readings for the individual parameters therefore provide information on the purity of the water and help you make the right decisions, such as whether to add ammonia to increase the pH value, or use bisulfite or hydrazine to bond the oxygen dissolved in the water.

Monitoring the water/steam cycle

- Prevents damage to your plant and keeps it running effectively.
- Minimizes plant downtime and maintenance costs.
- Documented readings provide proof that water quality has always been within the required range. This way you are always on the safe side in the event of warranty issues with your boiler and turbine suppliers.

Steam/Water Analysis System (SWAS)

The high temperatures and pressures in the water/steam cycle and the low measuring ranges demand smart solutions. SWAS panels (SWAS = Steam/Water Analysis System) have proven to be especially suitable. All the measuring technology that is needed to monitor a water/steam cycle is installed on these panels. The measurements are performed online, i.e. a sample of the feedwater comes directly from the cycle, passes through a temperature and pressure reduction system (sample preparation) and is then sent to the sensors and analyzers that are mounted on the panel. The sample is discarded after the measurement.

Conductivity – the key parameter

The conductivity provides information about the corrosive quality, contamination and condition of the water. In the power industry, a distinction is made between different types of conductivity:

Total (also direct or specific) conductivity
This is a measure of the purity of the water. A sudden increase in the total conductivity is often an indicator of leaks (air entering) or cracks or flaws in the heat exchanger or the ion exchange resin. It also reflects the level of additives and alkalis that have been added.

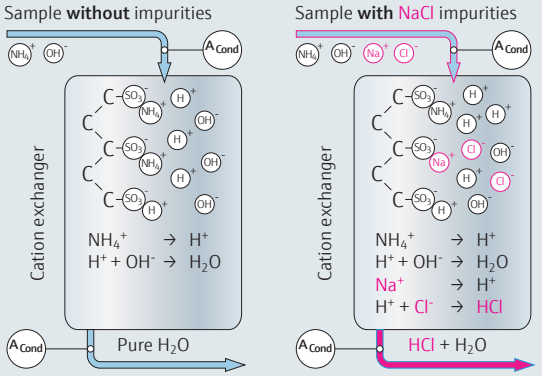
Cation conductivity (also acid conductivity)
In the cation exchanger, any impurities are transformed into acid, causing a significantly higher conductivity reading – the cation conductivity. This means that even minute amounts of impurities are quickly visible and suitable measures can be taken.

Differential conductivity
The differential conductivity is an indicator of the concentration of alkalis in the ultrapure water. It is also used to calculate - and therefore regulate - the pH value. For example, if the pH value is falling, alkalization agents such as ammonia can be added to quickly return the pH value to the optimum level. This protects the plant from corrosion.

Degassed cation conductivity
When the turbines are started, air and therefore also carbon dioxide are drawn into the condensate, thereby driving up the cation conductivity reading. The degassed cation conductivity value indicates whether this higher reading is caused by impurities or by the less problematic carbon dioxide. If impurities can be ruled out as the cause, the start-up phase is shortened considerably: electricity generation can start earlier, saving you time and money.

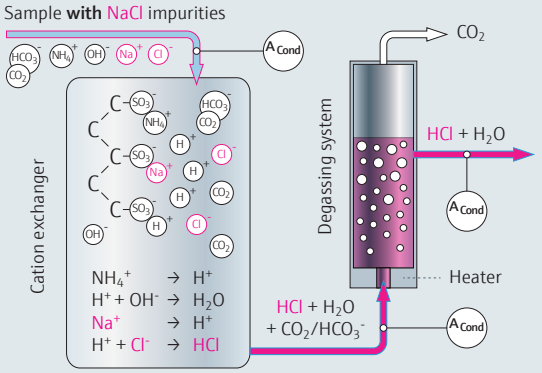
The Condumax CLS15D conductivity sensor accurately measures all kinds of conductivity and is both durable and low maintenance.

Cation, differential and total conductivity



The **total conductivity** is measured upstream from the cation exchanger. In the exchanger, all the cations are replaced by H^+ ions. If the water does not contain impurities (example on the top left), the result is pure water with a lower conductivity downstream from the cation exchanger.
Any impurities in the water, such as salts, are transformed to their acid form in the cation exchanger (example on the top right: sodium chloride/NaCl → hydrochloric acid/HCl). The resulting higher **cation conductivity** is measured at the outlet of the cation exchanger.
Differential conductivity is derived from the two measurements upstream and downstream from the cation exchanger. In the transmitter, it is displayed as a pH value in accordance with the VGB.

Degassed cation conductivity



CO_2 dissolved in the form of HCO_3^- (carbonic acid) occurs when the turbine is started and can affect the cation conductivity value. To be able to factor out this effect, the **degassed cation conductivity** is determined. For this, the sample is heated in a degassing system to drive out the CO_2. The sample is then measured a second time. In the above example, the sample contains CO_2 and NaCl (becomes HCl in the cation exchanger). With the degassed cation conductivity, it is possible to reliably identify the NaCl despite the presence of CO_2.

The solution for a long power plant life: Endress+Hauser SWAS panels

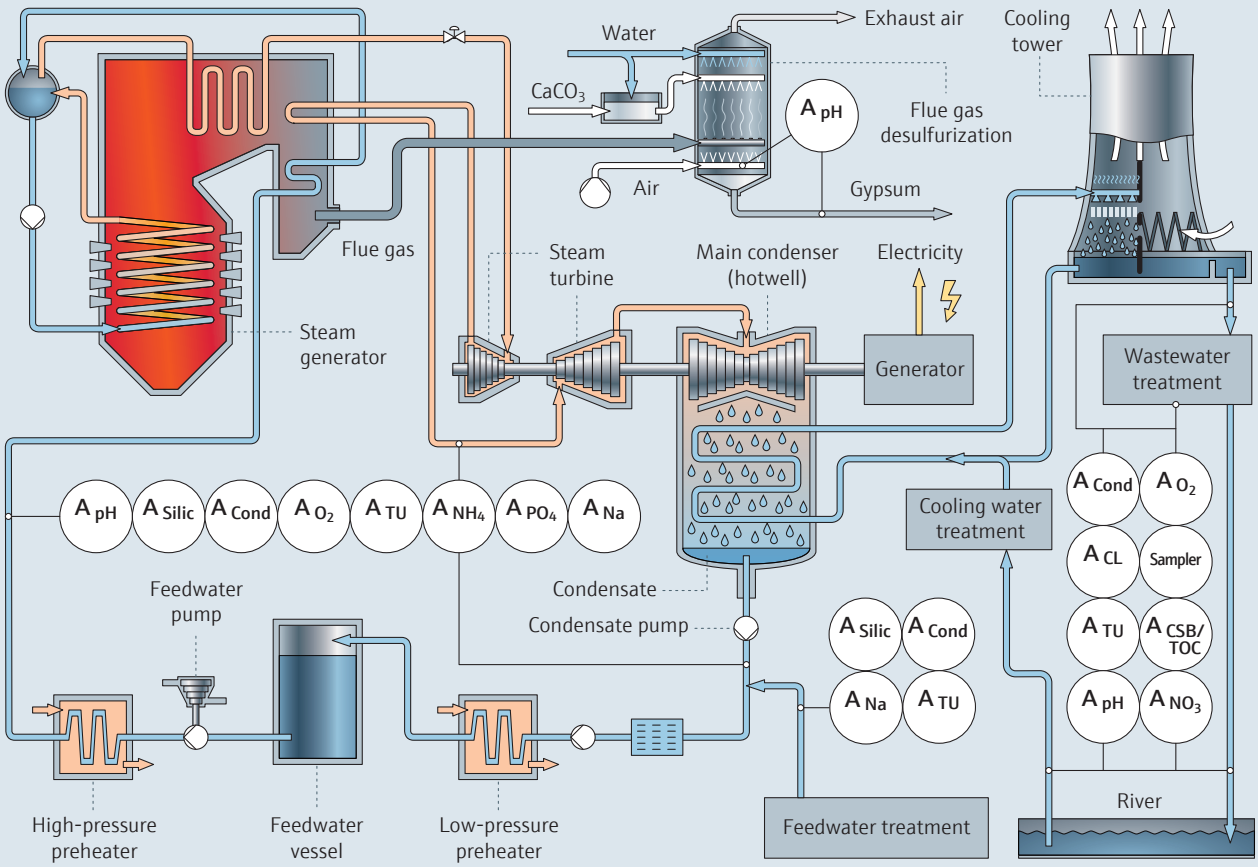
We know the importance of water/steam circuit monitoring for your power plant. That's why our SWAS panels come equipped with cutting-edge measurement technology that delivers accurate and reliable measurements even in very low measuring ranges. They are so reliable and maintenance-free that you hardly need to think about them – the measurements are simply taken. And what if maintenance is due? Thanks to the fact that our devices are based on Memosens technology (see p. 6), you can plan ahead and perform the maintenance swiftly. In this way, you increase your efficiency and avoid expensive plant downtime.

Memosens can do even more: measuring signals are reliably transmitted without any interference. As a result, you always have an accurate and reliable overview of the quality of your water/steam circuit and the status of the individual measuring points that are installed on your panel. If measured values are abnormal, clear messages are displayed so you can take the appropriate action in the right place. This helps you to protect your plant from damage and ensure plant longevity. In addition, all values and events are securely logged.

Our SWAS solution has been tried and tested in a number of applications. At the same time, it is always individual – from sample preparation to the flowmeter, our experienced engineering experts design the panels so that they are perfectly adapted to your water/steam circuit. In the bidding phase, we provide 3D drawings so you can visualize how your solution will look later on. Furthermore, we also create mechanical and electrical diagrams in accordance with the VGB that enable swift integration into your plant. This means that you receive a turnkey solution that you simply need to link up to process connections.

Whenever you need us, we will be there to provide you with advice and assistance. For instance, we can provide training to pass on our expertise to your staff. Or you can use our knowledge to guarantee seamless installation, commissioning and maintenance for your SWAS solution. Our service teams will assist you in ensuring maximum availability and performance for your plant and optimizing your maintenance costs. What's more, we also offer suitable solutions for other analytical measuring points in your power station. Just ask!

Examples of analytical measuring points in a power plant



Products and solutions for all analytical measuring points in a power plant

Feedwater, steam and condensate monitoring

Parameter	Instrument	Information
Sample preparation	As per customer specification	System for pressure and temperature reduction
Total conductivity Cation conductivity Differential conductivity Degassed cation conductivity	CLS15D	Sensor for low measuring ranges ≥ 0.05 µS/cm
Oxygen	COS22D-##3	Sensor for low measuring ranges ≥ 1 ppb
pH	CPS11D-7AS CPS41D	Long-life sensor thanks to salt ring Sensor with liquid-filled KCl reference
Turbidity	CUS52D CUE21 / CUE22	Sensor for process and bypass installation System for bypass installation
Silicate	71359918	6 channels, measuring range: 0 – 5000 ppb
Ammonium	CA80AM	2 channels, measuring range: 0.05 – 100 mg/l
Phosphate	CA80PH	2 channels, measuring range: 0.05 – 50 mg/l
Sodium	CA76NA	6 channels, measuring range: 0.1 – 2000 µg/kg

Cooling water, wastewater and flue gas desulfurization

Parameter	Instrument	Information
Conductivity	CLS21D CLS50D	Conductive sensor for average measuring range Inductive sensor for high measuring range
Chlorine	CCS142D	Sensor for free chlorine
Turbidity / solids	CUS51D	Sensor with automatic cleaning
pH (flue gas desulfurization)	CPS11D-7BT CPA871 CDC90	Robust sensor Pneumatic retractable assembly Automatic cleaning and calibration system
Oxygen	COS51D COS61D	Amperometric sensor Optical sensor
Organic carbon	CA80COD CA72TOC	1 channel, measuring range: 10 – 10,000 mg/l 2 channels, measuring range: 0.25 – 12,000 mg/l
Nitrate	CAS51D	Optical UV sensor
Samplers	CSP44 / CSF48	Portable / stationary

All-in solutions and accessories

Solution / Accessory	Instrument	Information
SWAS panel	As per customer specification	Complete system for water/steam cycles
Measurement cabinet / container	As per customer specification	For all measuring tasks in external areas
Transmitter	Liquiline CM44	Multi-parameter device with up to 8 channels
Handheld	Liquiline To Go CYM290	Quick onsite measurement and calibration
Sensor management	Memobase Plus CYZ71D	Measuring, calibration, documentation software
Standards und buffers	CPY20 CLY11 COY8	pH buffers Conductivity standards Gel for oxygen zero point calibration

Increase the efficiency of your power station – with Memosens and Liquiline

Liquiline CM44 transmitters make life easier thanks to user-friendly operation and a well designed maintenance concept. For instance, you can replace used sensors with sensors that have been calibrated in advance in your laboratory or workshop. The transmitter recognizes every sensor automatically and reads out the (calibration) data saved in the sensor. As a result, it is ready to measure again in seconds and your process can continue without any delays.

The ideal transmitter for your analytical measuring points

- Ability to connect up to 8 sensors for different parameters
- Uniform hardware components and operation concepts for all transmitters, analyzers and samplers in the Liquiline series
- The integrated calculation models are recognized by the power plant industry (VGB)
- Storage of process data, e.g. for warranty issues
- Integrated controller functions, e.g. for pH regulation, disinfection, precipitant dosage
- Calculation of the remaining operating time of the cation exchanger for predictive maintenance
- Seamless integration into every process control system (PCS) via 0/4 to 20 mA, HART, PROFIBUS DP, Modbus TCP, Modbus RS485, EtherNet/IP and web server

What's more, Liquiline transmitters can also save your process data if required. The data is protected against manipulation and can easily be transferred to a PC. If your turbine is damaged, this enables you to reliably prove that the water quality in your water/steam circuit remained within the required range, thereby allowing you to assert warranty claims against the manufacturer.

Liquiline CM44 as a field version (at back) and as DIN rail version with optional display.

Memosens: The cutting-edge sensor technology

Memosens digitizes the measured value within the sensor and provides non-contact interference-free transfer to the transmitter. Since its introduction in 2004, it has become the worldwide leading standard in liquid analysis. Since then, a large portfolio of Memosens products enhances the safety, efficiency, transparency and quality of processes in all industries.

- Safe digital data transmission: inductive, corrosion-free, 100% reliable
- Easy-to-handle sensor connection
- Sensor head stores measurement data and sensor information for predictive maintenance
- Fast plug & play with pre-calibrated sensors
- International standard

Automated pH measurement in flue gas desulfurization (FGD)

The pH value is very important for a properly functioning flue gas cleaning system – ultimately, it is used to control lime milk metering. It must be high enough that the sulfur dioxide is reliably bonded. If it is too high, however, lime will be wasted and the gypsum will be contaminated. This increases costs and reduces the yield of 'saleable' gypsum.

The pH sensors are exposed to tough conditions in the gas scrubber. The mixture of lime, gypsum, etc. is highly abrasive and quickly leads to the formation of coatings, encrustations and blockages. To determine a reliable, precise pH value, the sensors therefore need to be cleaned frequently and calibrated regularly.

For this task, we recommend automating the cleaning and calibration of the sensors. This not only reduces your maintenance costs, but also ensures that the quality of your pH measurements remains consistently high.

The smart pH measuring system for your FGD plant
With Liquiline Control CDC90, we offer you a pH measuring system that cleans and calibrates pH electrodes fully automatically. As soon as contamination is detected on a sensor or a pre-set maintenance interval is reached, the cleaning cycle begins. The sensor is first moved pneumatically into the assembly. There, it is thoroughly cleaned using water and cleaning agents and, if necessary, calibrated using pH buffers 4 and 7. Then, the sensor is moved back into the measuring position. A measuring point that is automated in this way guarantees reliable, accurate pH measurements – even in the aggressive and highly contaminated environment of a gas scrubber.

Why is flue gas cleaned?

Burning sulfurous fuels such as carbon and oil generates sulfur dioxide, which is an extremely environmentally harmful gas that causes acid rain. Before power stations release their flue gas into the environment, the sulfur dioxide therefore needs to be bonded. The process used most frequently for this is lime scrubbing. In a flue gas desulfurization (FGD) plant, the acidic sulfur dioxide is absorbed by a basic solution of lime and water (lime milk). The end product of this process is gypsum, which is then either sold to the building materials industry or disposed of, depending on its quality (residual moisture, purity, etc.).

Your benefits

- Optimized cleaning and calibration cycles ensure reliable measured values and longer sensor operating times.
- More time for other process-related tasks: Maintenance is limited to the planned replacement of the pH electrodes, buffer and cleaning solution.
- Pre-defined cleaning and calibration programs enable fast adaptation to your process.
- Convenient remote access to the entire measuring point using the control system or a mobile terminal of your choice such as a tablet, smartphone or notebook.
- Integrated Liquiline transmitter enables pH sensors with Memosens technology to be connected.
- Liquiline Control CDC90 can control two measuring points at the same time, or operate one measurement redundantly.

Liquiline Control CDC90 cleans, validates, calibrates and adjusts pH electrodes fully automatically.

1 Transmitter with industry PC and touch display

2 Pneumatic control unit

3 Double-membrane pumps

4 Cleaner and buffer canisters

The robust CPS11D-7BT pH electrode is ideal for any measuring point in your flue gas cleaning system.

The pneumatic CPA871 retractable assembly moves the sensor out of the process into a closed "service chamber". There, it is cleaned using water and cleaner and, if necessary, calibrated using pH buffers.

“The water/steam cycle in our combined heat and power plant is monitored by a SWAS panel from Endress+Hauser. We are amazed how reliable and low maintenance the solution is and can fully recommend it to other power plant operators.”

Lutz Loos, Project leader, Heizkraftwerk Zwickau Süd GmbH

More information about our SWAS solutions is available at
www.endress.com/SWAS

www.addresses.endress.com

CP01111C/07/EN/02.17

Endress+Hauser
People for Process Automation