

Disinfection is all around us

Clean and safe water for
waterworks, wastewater treatment
plants and industry



Disinfection is all around us

Overview of disinfection applications

How many liquids have you already come across today? This might include the milk in your breakfast, the water in your shower or the drops in your medical cabinet. All of these liquids have one thing in common. In all likelihood, they have been subjected to disinfection measurements – either because the water itself was disinfected or because these liquids flow through pipes or are stored in bottles that were disinfected. After all, disinfection plays a key role in many production processes that are relevant to everyday life. This wide range of applications is shown in the figure below.

Disinfection applications will continue to grow in importance in the future. However, water treatment faces particular challenges. For example, the issue of water scarcity is becoming more and more pressing due to demographic growth, industrialization, micropollutants and climate change. Nevertheless, having access to clean and safe water is and remains a prerequisite to a healthy life. Many of our partners and customers are committed to ensuring this supply in the future - by using our wide range of disinfection products.



1 Utilities and process water

- For process water: To ensure high-quality water and production safety, and to save money.
- In cooling towers and cooling applications: To prevent the formation of pathogens and biofilms.
- For industrial wastewater and wastewater reuse: The treatment and reuse of wastewater in secondary processes can be efficient because less fresh water is required and the costs for wastewater disposal are reduced. If this is not possible, discharging it into the sewerage system or a body of water is the only option. In both cases, analyzing disinfection parameters improves the safety of processes and enables compliance with limit values.

2 Drinking water

- In waterworks and in the distribution network: To ensure good quality drinking water by using as much disinfection as necessary but also as little as possible. Ozone can be used for disinfection at the inlet of the waterworks. However, at the outlet, free available chlorine or chlorine dioxide is typically used for the rest of the transport route due to the depot effect. Given that high doses can be harmful, compliance with limit values and regulations is particularly important.

3 Wastewater

- In wastewater treatment plants: To be able to return the effluent water back into the natural water cycle and therefore contribute to the safe exchange of water. Depending on the legislation, evidence of a value based on total chlorine or free available chlorine is required.
- In wastewater reuse: Global developments, such as changes in the climate and demographic growth, are leading to water becoming increasingly scarce. The field of wastewater reuse presents a particular opportunity to meet this challenge (for example, for agricultural irrigation). While the precise requirements of treatments are dependent on the type of wastewater and the purpose of reuse, disinfection (and therefore disinfection measurements) play a key role in every treatment method.

4 Food industry

- For cleaning bottles, cans and cool CIP cleaning: To ensure hygienic filling. Chlorine dioxide is particularly suitable for these cleaning processes because, unlike chlorine, it does not form any harmful compounds and is easy to wash out.
- In washing water: To ensure high food quality, for example when disinfecting ready-to-eat salads. Substances and concentrations used in the food industry vary greatly according to local regulations.
- In aquaculture facilities: To protect the livestock of fish and shrimp farms and therefore ensure the success of the aquaculture facility.
- In reverse osmosis systems: To prevent damage to the membrane and thus protect these valuable systems (for more information, see page 7).
- In beverage production: To ensure that there is no impact on taste.

5 Swimming pools and thermal baths

- Chlorination ensures healthy water conditions. Thermal baths often use free available bromine as a disinfecting agent due to the salinity of the water. Free available bromine is also increasingly used in swimming pools since it does not lead to unpleasant-smelling compounds being formed when it is combined with ammonia and therefore avoids the "traditional swimming pool odor".

6 Sea water desalination

- In desalination plants: In many dry areas of the world, seawater is used to produce drinking water and, in coastal regions, it has many uses as process water and coolant in industry. However, the water must be disinfected before it can be desalinated. The goal is to minimize the biological activity of the water and therefore to maximize the operating times of the downstream filters and the desalination plant (for more information about the special role of bromine compounds in disinfection, see page 5).

Overview of disinfection

How it works, measuring principles and disinfection methods

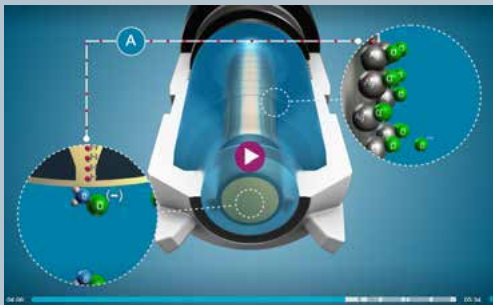
Meaning and how it works

The applications on page 3 show that disinfection protects us humans and our environment. This is done by reducing pathogens, bacteria and viruses to such an extent as to rule out infection. Disinfecting liquids with chlorine, chlorine dioxide and ozone inactivates bacteria by breaking down or penetrating their cell walls and preventing metabolic processes in the cells. This is an interdependent process. Chlorine's effectiveness is strongly related to certain bacteria, while chlorine dioxide also treats viruses and unicellular organisms, and ozone's reactivity means that it oxidizes almost anything. The dosing must be very precise because it needs to be high enough to eliminate pathogens but also as low as possible so as not to endanger health and safety for people and the environment. Moreover, this prevents unnecessary costs due to overdosage.



What do a boxer, a superhero and our disinfection sensors have in common? Find out in this video about disinfection methods and applications:

<https://eh.digital/disinfection-video>



You can find an overview of disinfection and a video about the amperometric measurement method at:

<https://eh.digital/disinfection>



Measuring principle: Advantages of amperometric sensors

Our disinfection sensors work according to the amperometric measuring principle. The electrochemical reaction of the disinfecting agent at the cathode generates a very small current in the sensor. The technology in the transmitter converts this current into the concentration of the disinfecting agent in milligrams per liter. Chlorine parameters can also be measured colorimetrically using the DPD method. However, the advantages of amperometric measuring – and therefore of Endress+Hauser's disinfection sensors – include:

- Continuous measurement and fast response time compared to individual measurements. This means that the process can be consistently monitored and controlled.
- No costly reagents required
- Large measuring range
- Digital data management

All of this helps to optimize dosing, reduces the number of personnel and time required, and leads to lower operating costs for the measuring point.

Overview of disinfection methods

Medium	Common areas of use*	How it works	Advantages	Disadvantages
Free chlorine (Memosens CCS51E)	Protecting the drinking water network, sometimes in the food industry, process water, swimming pools and utilities	Inactivating bacteria by breaking down their cell walls, oxidative effects within the cell	Deposit-forming, virtually odorless, strong disinfection performance	Effective in limited 4.5–7.5 pH range, pH measurement required for compensation, possible formation of odor and byproducts such as trichloromethane, only partially permitted in the food industry
Chlorine dioxide (Memosens CCS50E)	Drinking water network, sometimes in the food industry (e.g. washing water and beverage production), process water, filling plants, reverse osmosis, utilities (e.g. coolant)	Inactivating bacteria by penetrating their cell walls, oxidative effects within the cell, improved disinfection effect (dissolves biofilms)	Deposit-forming, effective over a wide pH range, not pH-dependent, no chlorinated byproducts, bacteria do not develop resistance, less corrosive	Only partially permitted in the food industry
Total chlorine (Memosens CCS53E)	The special case of total chlorine measurement (free available and combined chlorine) is used in process water and particularly in wastewater treatment plants, where it is a good indicator of residues of the disinfecting agent.	The effluent of treated wastewater contains ammonium, which forms chloramines during chlorination with free chlorine. These chloramines also have a disinfecting property but this is greatly reduced compared to free chlorine. The chloramines can be determined as sum parameter using total chlorine sensors.**	Fewer byproducts with organic materials than when using free available chlorine	Lower oxidation potential and lower reactivity than free available chlorine
Free bromine (Memosens CCS55E)	Water desalination, swimming pools and thermal baths, process water, marine applications, fish farming	Disinfecting seawater with free chlorine leads to the formation of bromine, which also have a disinfectant effect. Given that this would cause measuring errors in pure chlorine monitoring and the disinfection performance would be underestimated, a bromine measurement is required.	More odor-neutral, higher pH value tolerance than free available chlorine	pH measurement required for compensation
Ozone (Memosens CCS58E)	Water treatment process, wastewater (4th cleaning stage), process water, sometimes in the food industry, piping	Oxidation above all in close proximity	Highly reactive	Not deposit-forming

* There are sometimes large country-specific differences and local laws determine which components are permitted.

** However, depending on the legislation, a value based on free chlorine may also be required. In this process, free chlorine is added to the medium until all of the chloramines have been re-oxidized and converted.

Our range of disinfection products

Everything you need for your disinfection measuring task

Components of a disinfection measuring point

Panels

Sensors



Assemblies



Transmitters and cables



Our extensive range of disinfection products contains the ideal solution for every measuring task – all from a single source. For example, a compatible immersion or flow assembly in conjunction with the Liquiline transmitter platform allows you to easily combine your disinfection measurement with other parameters like pH or conductivity.

Sensor	Measuring ranges	Polarization time	Response time*
Memosens CCS51E (free available chlorine) www.endress.com/CCS51E	<ul style="list-style-type: none"> 0 to 5 mg/l (ppm) HOCl 0 to 20 mg/l (ppm) HOCl 0 to 200 mg/l (ppm) HOCl 	Initial commissioning 45 min, recommissioning 20 min	$t_{90} < 25 \text{ s}^{**}$
Memosens CCS50E (chlorine dioxide) www.endress.com/CCS50E	<ul style="list-style-type: none"> 0 to 5 mg/l (ppm) ClO₂ 0 to 20 mg/l (ppm) ClO₂ 0 to 200 mg/l (ppm) ClO₂ 	Initial commissioning 45 min, recommissioning 20 min	$t_{90} < 15 \text{ s}$
Also available in a product bundle: https://eh.digital/disinfection			
Memosens CCS53E (total chlorine)	<ul style="list-style-type: none"> 0 to 5 mg/l (ppm) TC 0 to 20 mg/l (ppm) TC 	n/a	n/a
Memosens CCS55E (free available bromine) www.endress.com/CCS55E	<ul style="list-style-type: none"> 0 to 5 mg/l (ppm) HOBr 0 to 20 mg/l (ppm) HOBr 0 to 200 mg/l (ppm) HOBr 	Initial commissioning 45 min, recommissioning 20 min	$t_{90} < 20 \text{ s}^{**}$
Also available in a product bundle: https://eh.digital/bundle-bromine			
Memosens CCS58E (ozone) www.endress.com/CCS58E	<ul style="list-style-type: none"> 0.1 to 2 mg/l (ppm) O₃ 	Initial commissioning 60 min, recommissioning 20 min	$t_{90} < 440 \text{ s}$ (under reference conditions)

Additional products	Description
Drinking water, cooling and process water panels and custom solutions https://eh.digital/panels-drinkingwater und https://eh.digital/panels-process-water	We have developed panels to address complex measurement tasks, simplify operation and save space. These are made up of multiple components and come pre-installed. We also design customer-specific solutions depending on your specifications.
Netilion Services www.netilion.endress.com	Netilion, our cloud-based IIoT ecosystem, connects the physical and digital worlds. This allows you to automatically turn data from the field into valuable information and use it in many different ways.

* After polarization

** The t_{90} time may be longer under certain conditions. If the sensor is in a disinfectant-free medium longer time, the sensor responds straight away when the disinfectant is present. However, there is a delay until the sensor measures the precise concentration.

Features and benefits

■ Your partner for process improvement

As a world-leading supplier of measuring devices, services and solutions, we can offer you both range and depth of disinfection products – all from a single source. As a result, you benefit from patented technologies such as Memosens 2.0 (see information box on the right) and Heartbeat Technology, which feature in a host of different products. This technology helps to work out the ideal maintenance interval for your disinfection measuring point – long before a critical state is reached. The warning regarding the electrolyte consumption, for example, clearly shows when the electrolyte needs to be topped up or the membrane cap needs to be replaced.

■ Low-maintenance and precise measurement with long-term stability

The highly precise measurement allows the smallest possible concentrations of disinfectants. Robust components, such as the convex membrane made from dense and dirt-repellent material, minimize maintenance requirements.

■ Fast response times

The challenge for chlorine sensors in membrane filtration is to provide reliable measurements, even after long periods of time when no chlorine is present. Memosens chlorine sensors are not deactivated in these conditions, but start measuring as soon as chlorine is present. This ensures a quick response to process changes, as well as efficient process control.

■ Minimal cross-sensitivity

The interaction of technological features of membrane, electrolyte and electrode ensures that the sensors show high selectivity for their particular disinfectant, especially compared to open cell sensors.

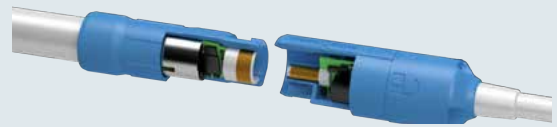
■ Amperometric measuring principle

The advantages resulting from the sensors' amperometric measurement method lead to a reduced total cost of ownership (see page 4 for more information).

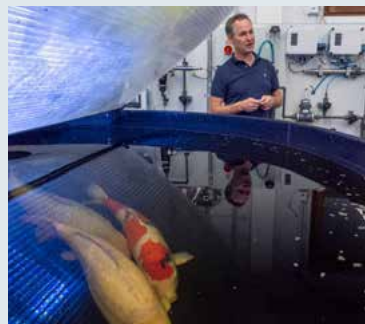


Memosens 2.0 technology

- **Simple:** Operation is user-friendly thanks to laboratory calibration under optimal conditions, rotation-proof bayonet lock and true plug-and-play.
- **Safe:** Contactless, digital transmission of measured values eliminates the effects of moisture and corrosion, preventing falsified measurements. If there are any signal transmission faults, messages will be actively output.
- **Connected:** Memosens 2.0 offers extended storage of calibration, sensor and process data. It enables improved trend identification and more precise process management, while creating a future-proof basis for predictive maintenance and IIoT services.
- **Less operating costs and increased plant availability:** Quicker polarization time accelerates commissioning, sensor replacement in the field using pre-calibrated sensors minimizes process downtime and periodic regeneration extends the service life of the sensor.



For more information on Memosens, watch:
www.youtube.com/watch?v=8Zwh6xvAXpA



We are your partner for improving your processes. This is how, together, we play a part in using valuable resources carefully, ensuring the world's growing population has everything it needs, and effectively protecting our environment.

"After several years of operation, we are very pleased with the Endress+Hauser analysis panels measuring the free chlorine and enable us to monitor the disinfection of the potable water in real time."

Thierry Illy
Manager of the water treatment plant in Moselle, France

You can find the whole success story, including a video, at:
<https://eh.digital/success-story>



Links

- You can use the product finder to easily filter for the entire disinfection range:
www.endress.com/product-finder
- To go to the Applicator (an online tool for choosing a product according to the application), visit:
www.endress.com/applicator

www.addresses.endress.com