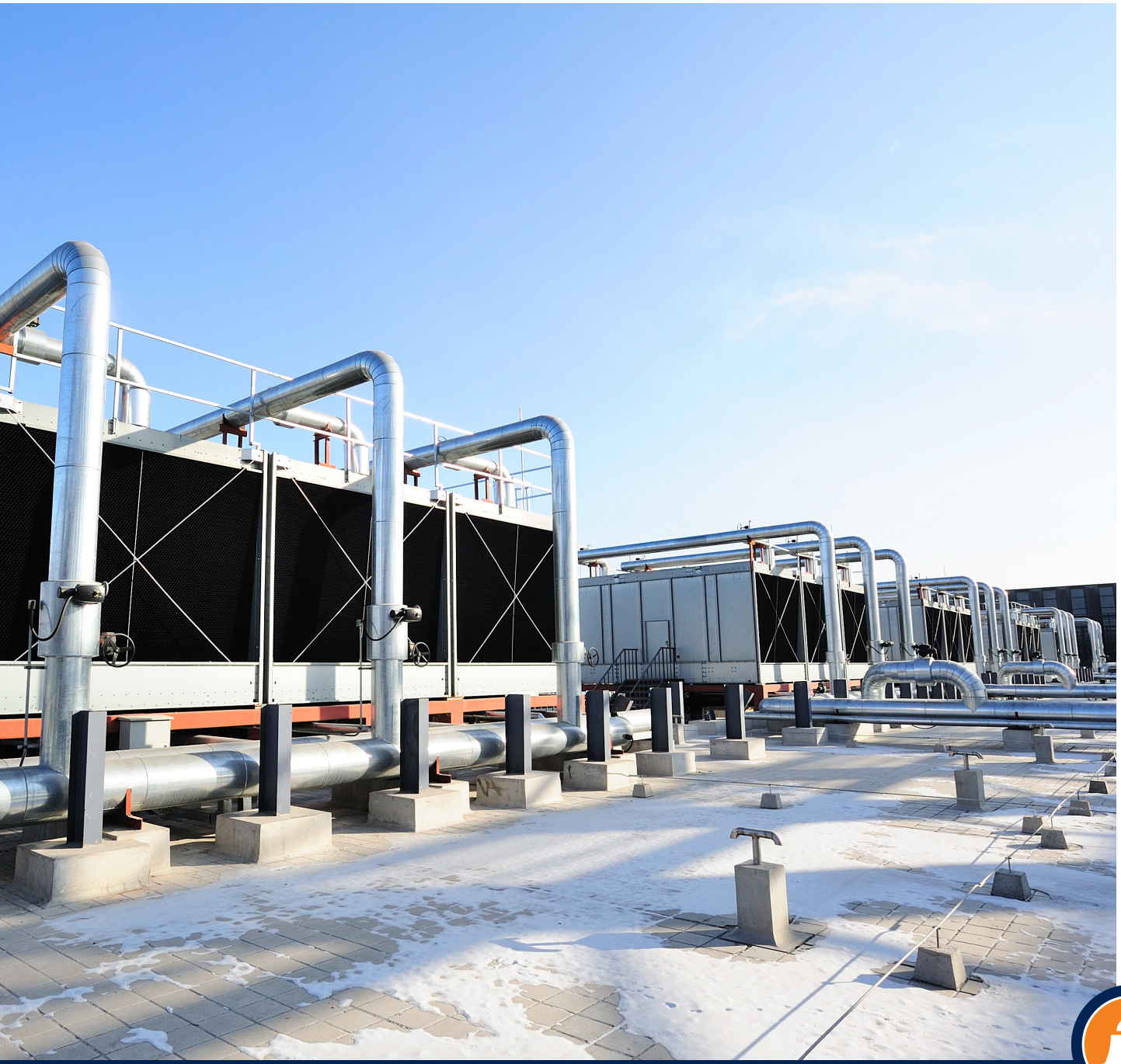
EVAPORATIVE COOLING TOWERS

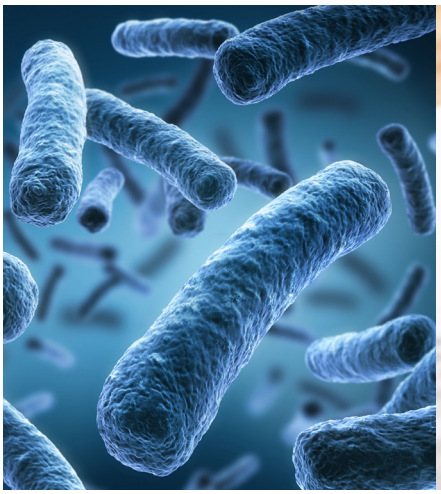
MONITORING COOLING WATER QUALITY

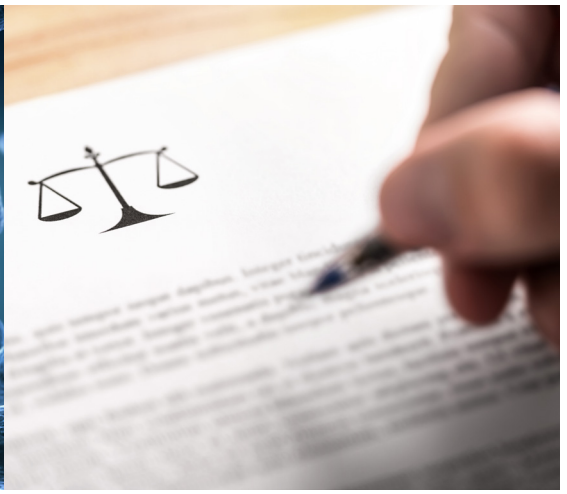
ProMinent®



www.prominent.com

Background information





COOLING WATER

To operate an evaporative cooling tower as efficiently as possible, cooling water consumption needs to be reduced. Secondly, the entire system's protection from corrosion, deposits and biological growth needs to be improved. However, since only pure water evaporates in cooling systems, the concentration of salt in the process water will steadily increase if no fresh water is added. Excessive salinity and mineral concentrations result in limescale and corrosion in the cooling system and its pipework. The formation of algae and biofilms as well as dust particles entering from the ambient air also impact negatively on the system's cooling performance and damage the materials used. Consequently, for an evaporative cooling tower to run trouble-free and economically, fresh water treatment and process water conditioning are essential.

COOLING WATER TREATMENT

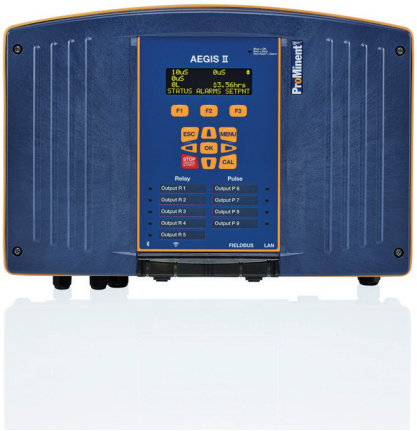
The concentrated process water caused by evaporation has to be regularly replaced with fresh makeup water. To ensure that the salt concentration does not rise to a range where it impacts negatively on the cooling system's efficiency and materials, the concentration of the process water should be continuously monitored by means of a conductivity measurement. Automatic blow down and an appropriate supply of fresh water minimize the risk of deposits and corrosion. Additionally, corrosion inhibitor and hardness stabilizer are added directly to the supplied fresh water, proportionate to volume, in order to protect the system. Since microbiological films also reduce the efficiency of the cooling system and may provide a home for pathogenic bacteria, biofilms have to be combated through the addition of chemicals.

STATUTORY OBLIGATIONS

Under certain circumstances evaporative cooling towers, natural draft cooling towers and scrubbers may emit water drops (aerosols) carrying legionella. Inhaling these aerosols causes serious lung infections, occasionally even with fatal consequences. In accordance with the 42nd Federal Immission Control Ordinance (BImSchV), all relevant systems have to be designed, set up and operated in such a way that state-of-the-art technology prevents contamination of the process water by microorganisms, especially legionella. Thus, extensive technical and organizational liabilities become effective and operators of relevant systems have to discharge these liabilities. Violation of the 42nd Federal Immission Control Ordinance (BImSchV) can be punished with a fine of up to 50.000 € or even lead to prosecution.

Control unit

In order to fulfil the hygienic requirements for evaporative cooling towers, contamination of the process water by microorganisms has to be avoided. In addition, from an economical point of view the system should be operated in such a way that corrosion is kept at a minimum level. Therefore, the fresh water and process water are treated accordingly with appropriate chemicals. To ensure that the chemicals used achieve the desired effect and at the same time the consumption of chemicals is minimized, continuous monitoring of the circulating cooling water is essential. Furthermore, operators of evaporative cooling towers are obligated to provide evidence that the system is operated according to the regulations by e.g. documenting the applied cooling water treatment in an operations diary.



The controller AEGIS II has been developed especially for the treatment of cooling water in evaporative cooling towers. It monitors, controls and documents all relevant parameters as requested by the regulations.

CONTROLLER AEGIS II

Blow down

- Continuous monitoring of conductivity to control blow down
- Blocking blow down after biocide metering
- Forcing blow down before biocide metering

Addition of biocide

- Time-controlled biocide metering
- Concentration-controlled biocide metering
- Measurement of ORP value as indirect disinfection parameter
- Measurement and if necessary, control of pH value

Monitoring corrosion

- Corrosion measurement via coupon method
- Real-time corrosion measurement via LPR method
- Metering of corrosion inhibitor, hardness stabiliser, etc. proportionate to volume

Documentation

- Continuous recording of all measured parameters
- Automatically generated daily or weekly reports (compliant with VDI 2047)
- Proof of biocide metering for operations diary

Communication

- Web interface for configuration and remote maintenance
- Operating state indicated by 10 status LEDs

Measurement units

Numerous factors affect the cooling water quality: composition of the makeup water, dissolved minerals, microbiological films, corrosion of the materials used, dust particles entering from the ambient air, etc. Sensors that measure cooling water parameters need to cope perfectly with this constantly fluctuating water quality. Measurements must be reliable and reproducible without any need for additional maintenance efforts or shortened service intervals. ProMinent offers sensors for most parameters that are commonly analysed to ensure cooling water quality. These sensors, ProMinent developed especially for this application, are optimised for high performance under challenging conditions.

SENSORS

Due to the nature of evaporative cooling towers, conductivity represents the most important parameter. Its system specific upper threshold defines the maximum tolerated process water concentration that in turn determines when and how much fresh water must be fed to the cooling water circulation. Optimising blow down intervals results in reduced fresh water consumption and increased protection of the system.

Conductivity sensor CTFS

- Robust sensor for conductive conductivity measurement
- Integrated temperature compensation
- Simultaneous flow rate measurement (for safety reasons no controlling of any parameter without water circulation)

Most operators also continuously monitor the pH of the process water. This value correlates with the occurrence of corrosion processes and, in addition, effects the activity of some oxidative biocides. If the process water is treated with an oxidative biocide, monitoring the ORP value provides an indirect measurement of the biocide's effectiveness.

pH & ORP sensors PHEI & RHEIC

- Robust sensors optimised for industrial applications
- Double Junction (second diaphragm to protect the chemically sensitive reference system)
- Robust platinum calotte
- Large dirt repellent PTFE diaphragm
- Large electrolyte reservoir for long lifetime

The physical and chemical conditions (slightly alkaline pH value, dissolved minerals, microbiological films, etc.) present in evaporative cooling towers aid the appearance of corrosion. Determining the system specific corrosion rate via LPR (Linear Polarization Resistance) measurement enables the detection of damages caused by corrosion at a very early stage and with that the avoidance of far reaching economic consequences.

LPR corrosion measurement

- Only real-time analysis of corrosion processes in the system
- Material of the electrodes same as that used in the system
- Corrosion rate stated in mpy (milli inches per year)
- Detection of short-term changes of the operation conditions

Biocide concentration measurement

No online measurement exists for non-oxidizing biocides. Therefore, no evidence can be provided automatically of successful biocide metering or efficient disinfection of the process water. In contrast, treating the process water with oxidizing biocides makes online monitoring of the disinfectant's activity possible, either indirectly via ORP value or directly via amperometric sensors (further information is provided in "**Focus on Evaporative Cooling Towers – Online Measurement of Oxidizing Biocides**").

Metering units

As mentioned before, operating an evaporative cooling tower trouble-free and economically requires appropriate treatment of the fresh water and process water. The amount of chemicals added depends on the specific, local conditions and varies for each system. In addition, according to the German Wastewater Ordinance, the consumption of chemicals must be minimised by considering physical, biological, chemical and other alternatives. Furthermore, the Ordinance also forbids continuous dosing of most chemicals. Reducing the amount of added chemicals also has a positive impact on the operator of the evaporative cooling tower by saving expenses.

SOLENOID-DRIVEN METERING PUMPS

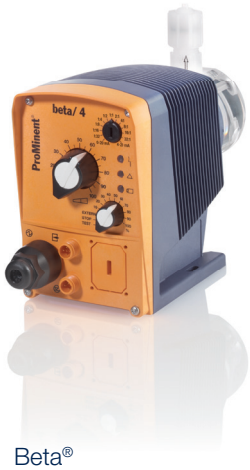
Consequently, the metering technology utilised for cooling water treatment has to reliably meter different chemicals in varying amounts at defined time intervals. As one of the market leaders in the area of solenoid-driven metering pumps, ProMinent has a wide experience that, in combination with continuous innovation and development of new technologies, results in the most modern and reliable metering pumps. Our pumps are ideally suited to meter the chemicals for the cooling water treatment, as they offer outstanding continuous run properties, require little maintenance and deliver precise feed rates.

Beta®

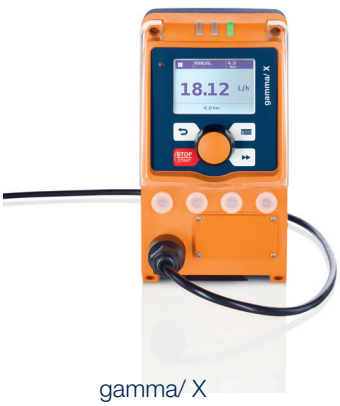
- Optional external control via 0/4-20 mA and potential-free contacts
- Simple adjustment of metering rate via stroke rate and stroke length
- Applicable for nearly all liquid chemicals
- Self-bleeding dosing head design
- Almost wear-free solenoid drive

gamma/ X

- Adjustment of the metering rate directly in l/h or external via 0/4-20 mA and potential-free contacts
- Direct input of final concentration when metering proportionate to volume
- Integrated 7-day timer for timed metering
- Integrated pressure measurement
- Suitable for continuous micro-metering from approx. 1 ml/h
- Applicable for nearly all liquid chemicals
- Connection to process control system via BUS interfaces

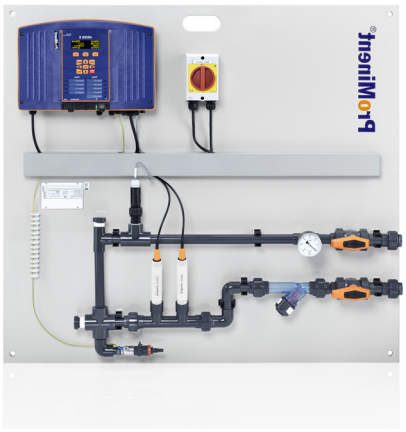


Beta®



gamma/ X

Pre-assembled panels for cooling water monitoring



ProMinent offers a very comprehensive range of products for various applications. Our experts are happy to advise on selecting the optimal products for your application and to establish individual solutions tailored to your needs. Furthermore, our portfolio also includes complete solutions ready to use, already pre-assembled on panels. Based on years of experience and the close collaboration with our customers we have designed six different versions with varying configuration for the application of cooling water treatment.

PRE-ASSEMBLED MEASURING AND CONTROL PANELS

The basic equipment of all versions consists of a pre-configured controller and sensors to measure the parameters pH, ORP and conductivity. In addition, predefined versions exist for corrosion measurement (LPR method; information about the sensor see page 4, about the method itself refer to the white paper ‘online corrosion monitoring’), determining the concentration of oxidizing biocides (monitoring concentration of individual biocidal substance by specific amperometric sensors; for further information see white paper ‘online measurement of oxidizing biocides’) and fluorescence measurement (as proof of chemical dosing; for further information see white paper ‘monitoring dosing of corrosion inhibitor by fluorescence sensors’). Another version includes DULCOnneX, ProMinent’s digital fluid management for real-time remote access to all installed devices and their measured parameters and recorded data independent of your location (details see page 8).
All pre-assembled panels can be easily integrated in the cooling water circuit and put into operation without the slightest effort. Thus, ProMinent provides complete pre-assembled and pre-configured solutions, smooth and quick to set up, that ensure a reliable monitoring of the cooling water circuit.

	pH sensor	ORP sensor	CTFS sensor	Corrosion sensor	Chlorine sensor	Fluorescence sensor	DULCOnneX
Variant 1	x	x	x				
Variant 2	x	x	x	x			
Variant 3	x	x	x	x		x	
Variant 4	x	x	x		x		
Variant 5	x	x	x	x	x		
Variant 6	x	x	x				x

Systems for on-site disinfectant production

On the one hand, biocides with the active substance hypochlorite are quite popular and widely used due to simple handling and attractive pricing. However, the effectiveness of the disinfectant hypochlorite strongly depends on the pH. Increasing pH significantly reduces its biocidal properties. Consequently, for cooling water circuits with pH > 7.5 the usage of hypochlorite is not recommended as under these conditions the biocidal effectiveness of the disinfectant is not sufficient anymore. Alternatively, oxidizing bromine compounds act reasonably as disinfectant over a broader pH range (up to pH 8.5). Yet, these bromine compounds as well as chlorine compounds generate toxic by-products (AOX-compounds). On the other hand, the biocides chlorine dioxide and ozone show effective disinfection strength independent of pH and have the additional advantage of not forming toxic AOX-compounds. Furthermore, because of their gaseous state these disinfectants fight microbiological films most efficiently. Due to the high reactivity of these gases, chlorine dioxide and ozone must be produced on-site in special systems and cannot be stored or transported as ready to use biocides. ProMinent developed, explicitly for the treatment of cooling water, reliable and secure complete systems for on-site, on demand production of these disinfectants.

DISINFECTION SYSTEMS

Chlorine dioxide system Bello Zon® CDLb

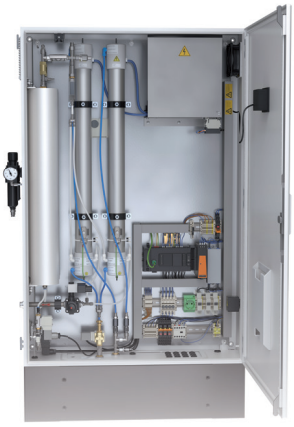
- pH independent disinfection strength
- High stability leads to significant depot effect
- Breakdown of existing biofilms
- No formation of THM- and AOX-compounds

Compared to the well-established and widely used biocides with active chlorine or bromine compounds, chlorine dioxide has several advantages. Firstly, its biocidal effectiveness is pH independent (pH range 4 – 10). Secondly, because of its considerable depot effect chlorine dioxide exists in the cooling water circuit for a longer time and with that fights microorganisms more efficiently. Thirdly, its gaseous state allows intensive penetration of microbiological films and for that reason, this disinfectant also destroys already existing biofilms. However, the high reactivity of chlorine dioxide requires its production on-site and on demand in special systems.

Ozone system OZONFILT® OZVb

- Environmentally friendly disinfectant (no chemicals, operating gas air or oxygen)
- On-site production as demanded conserves resources
- Prevention of biological growth (biofilm) and thus also minimizing microbiological corrosion
- Highly effective disinfection without any by-products (e.g. AOX-compounds)

Ozone shows an excellent disinfection behavior, fighting bacteria, viruses, fungi, as well as parasites extremely efficiently. Due to its high reactivity, ozone is produced from oxygen in appropriate generators on-site, and the desired amount of disinfectant is fed directly in the cooling water circuit as demanded and without temporary storage. As a highly reactive gas with a half-life of only a few minutes, ozone decomposes again into oxygen in water. Therefore, all components of the whole system must match perfectly in order to achieve an optimal relation between generation and effectiveness of ozone.



DIGITAL FLUID MANAGEMENT - DULCOnneX

As digitalization and networking advances more and more, new possibilities arise to monitor, control and optimize processes. Our solution for digital fluid management collects versatile information, processes all data and takes advantage of this information to efficiently control processes. Operators have location independent and real-time access to all available information required for optimal monitoring and control of any installed device, system or compound.

- Real-time monitoring independent of the location
- Increasing process reliability through transparency of all relevant data
- Less downtime through automatic alarm in case of failure
- Predictive, on demand maintenance based on monitoring tendencies
- Automatically generated reports of conveniently edited operating data
- Configuration of devices based on backups enables efficient commissioning