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Product Description
TARAsys ® MT10-CL

Continuous measuring of minimal chlorine concentrations
and permanent monitoring of the absence of chlorine

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Reiss GmbH
Eisleber Str. 5 · 69469 Weinheim · Germany
Fon +49 (0) 6201 25939-0 · Fax +49 (0) 6201 25939-10
info@reiss-gmbh.com · www.reiss-gmbh.com
Managing Directors: Dr. Gerhard Reiss & Tanja Strasser
Amtsgericht Mannheim · Registernummer: HRB 711012 · VAT-ID: DE274672530

fig. 1: Drawing of TARAsys ® MT10-CL

a) controller
b) flow chamber
c) magnetic valve
d) sensor
e) electrolysis cell

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1. Introduction

In general, membrane-covered amperometric sensors are able to measure very low chlorine concentrations (~20 ppb) or to monitor the absence of chlorine. This is, however, possible for short periods of time, i.e. a few days, only. If an amperometric chlorine sensor is continuously operated in water with very low chlorine concentrations or water containing no chlorine at all, one observes a continuously attenuating signal just after a few days of operation. The attenuation of the signal is caused by the formation of a biofilm on the membrane of the sensor due to the low or non-existing disinfection strength of the measuring water.
The biofilm impedes the diffusion of the chlorine to be measured through the sensor membrane. Basically, two effects can be observed:

a) The already mentioned continuously attenuating signal until there is virtually no signal at all.
b) In addition, an increasingly longer response time of the sensor to a change of chlorine concentration in the measuring water.

If the effects described are to be prevented, the formation of the biofilm has to be stopped or the built-up biofilm has to be eliminated.

One possibility is to add a disinfectant to the measuring water at specific intervals to prevent the formation of a biofilm.

But this solution is often not economical as the disinfectant would have to be added to the entire measuring water. This would require the storage or generation of larger amounts of disinfectant at the measuring point. Additionally, the disinfectant would have to be injected into the measuring water, which would make the installation of other devices necessary. Another disadvantage of this method is that disinfectant would be present in the measuring water afterwards, which is not desirable in some applications.

With TARAsys MT10-CL, Reiss GmbH has developed a measuring and control board which ensures the measuring function of a membrane-covered amperometric chlorine sensor even with minimal chlorine concentrations and/or in case of absence of chlorine in the measuring water. It is not necessary to add disinfecting chemicals to the measuring water manually or by way of a dosing apparatus or to introduce such chemicals into the measuring water and store them exclusively for this purpose. This makes TARAsys MT10-CL an easy-to-use and economical system.

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2. TARAsys ® MT10-CL

With the TARAsys MT10-CL Measuring and Control Board, membrane-covered amperometric sensors made by Reiss GmbH are able to continuously and reliably measure minimal chlorine concentrations (e.g. 20 ppb) or to monitor the absence of chlorine. According to the EN ISO 15839:2006 standard, a repeat accuracy of 3 ppb was determined at a chlorine concentration of 20 ppb.

These special properties are achieved by way of a miniaturised electrolysis cell which is located directly in front of the sensor (see fig. 2) and generates the disinfectant ClO_2 there. The distance between the sensor and the electrolysis cell is ~2 mm. Due to the small distance, the electrolysis cell has to generate just a few µg of ClO_2 to keep the membrane of the sensor free from biofilms. The ClO_2 generated is present only locally and has no influence on the measuring water.
The following passages explain the cleaning and measuring process in more detail.

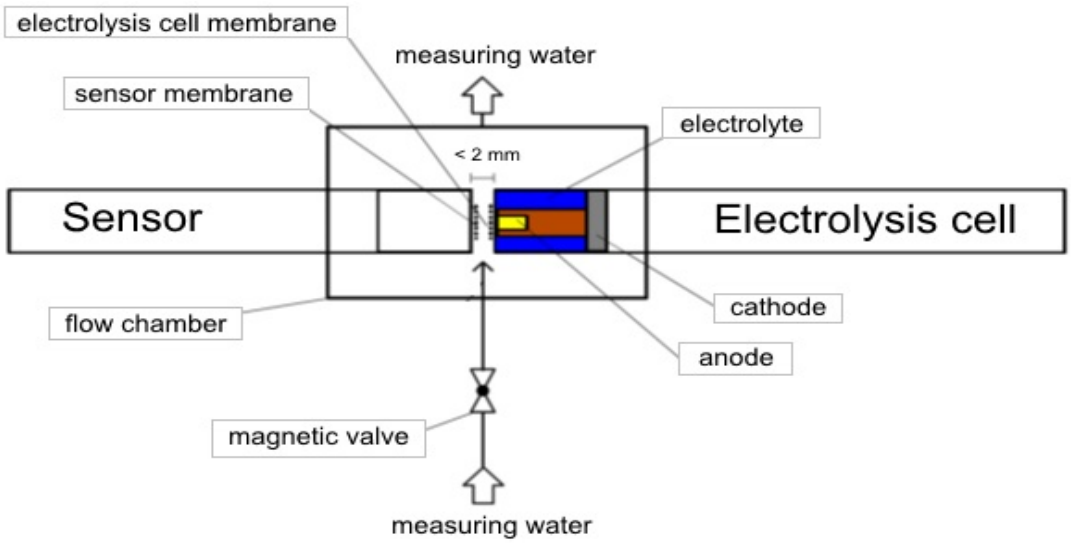

fig. 2: Section of the design of the TARAsys MT10-CL.
The flow chamber includes both the sensor and the electrolysis cell which generates the necessary disinfectant.*

** The sensor is not included in the scope of supply of the TARAsys MT10-CL.*

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2.1. The measuring process

There is a continuous flow of measuring water between the sensor membrane and the membrane of the electrolysis cell during the measuring process. The concentration of disinfectant in the measuring water is not influenced by the electrolysis cell as its design ensures that only traces of the disinfectant are generated locally on the membrane of the electrolysis cell. This ensures that the sensor can measure the actual chlorine concentration in the measuring water without being influenced by the electrolysis cell.

2.2. The cleaning process on the electrolysis cell

An automated controller performs the cleaning process once per day. To start the cleaning process, the flow of the measuring water is stopped by way of a solenoid valve. This allows for the disinfectant (chlorine dioxide) to diffuse from the electrolysis cell into the sensor membrane and to remove the biofilm, if any. During the cleaning process, the sensor signal is “frozen” for 40 minutes. This means that the sensor is available for measuring on 23.3 hours per day.
The electrolysis cell has its own electrolyte, which makes it independent of the quality of the measuring water.

2.3. Self-monitoring

When a sensor is used to monitor the absence of chlorine, the chlorine concentration is above 0 ppm most of the time. As a chlorine sensor frequently outputs a 0 ppm signal in case of a malfunction, it is not possible to distinguish between the actual signal and the error.
This involves a high risk of misinterpretation. Possible causes that may result in a 0 ppm signal being put out:

- Formation of a biofilm on the membrane
- Membrane clogged by substances contained in the water
- Reference electrode used up

The TARAsys MT10-CL Measuring and Control Board generates a small amount of chlorine dioxide every day to disinfect the sensor. The chlorine dioxide results in a measurable signal of the chlorine sensor (cross-sensitivity). This signal is evaluated by the controller. If the signal is not within the expected range, the control and measuring board automatically issues a maintenance message which can be sent by email, if desired. This considerably increases fail-safety.

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3. Calibration

If the measuring water contains chlorine, the sensor can be calibrated as usual by taking a sample at the flow chamber and calibration with the DPD method. If the measuring water contains no chlorine, the sensor must be calibrated externally:
Remove the sensor from the flow chamber and calibrate it in an external container (e.g. with TARAcal EKV-1).

4. Applications

There are various applications in which minimal chlorine concentrations have to be measured or the measuring water has to be checked for absence of chlorine. With the TARAsys MT10-CL, a proven sensor made by Reiss GmbH and combined with the TARAsys MT10-CL Measuring and Control Board can perform these tasks.

4.1. Reverse osmosis

Reverse osmosis is one of the typical applications where monitoring the measuring water for the absence of chlorine plays an important part. For this purpose, chlorine is frequently added to the raw water for disinfection. Before the chlorine reaches the reverse osmosis membrane, it has to be removed from the raw water again as otherwise the reverse osmosis membrane would be damaged [1]. Chlorine is usually removed by using activated carbon or a reducing agent. The operation of a chlorine sensor after chlorine removal with activated carbon or the addition of a reducing agent is a frequent requirement to be able to detect the penetration of chlorine early enough.

4.2. Drinking water

Drinking water treatment includes applications where no chlorine is present in the measuring water in normal operation. Chlorine is added to drinking water only [2] if it is contaminated by germs. In this event, an operational chlorine sensor should already have been installed to ensure uninterrupted measurement.

4.3. Wastewater

Some applications in wastewater treatment require the presence of a small amount of chlorine to permit the discharge of the wastewater in public bodies of water. The limit value for maximum chlorine concentration is very low in some cases and cannot always be complied with. As a result, there are sometimes phases in which the measuring water does not contain any chlorine. If a conventional membrane-covered chlorine sensor is used, a new calibration or even a replacement of the membrane cap is necessary [3, 4] after each longer chlorine-free phase (>1 day), which results in very high maintenance requirements.
Consequently, the operation of amperometric chlorine sensors in

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chlorine-free water is required over long periods of time. The TARAsys MT10-CL Board has been designed for measuring the chlorine concentration in such applications in a reliable manner and with minimal service requirements.

5. References

[1] S. W. Klaus Hancke, „Wasseraufbereitung,“ in *Umgekehrte Osmose*, Trier, VDI Verlag, 2003, pp. 254 - 257.

[2] M. W. Dr. Peter Dilly, „Trinkwasserverordnung,“ in *Beschaffenheit des Wasser für den menschlichen Gebrauch*, Stuttgart, Wissenschaftliche Verlagsgesellschaft mbH Stuttgart 2003, 2003, pp. 29 - 35.

[3] R. Finger, D. Harrington und L. and Paxton, „Development of an On-Line Zero Chlorine Residual Measurement and Control,“ in *Journal of the Water Pollution Control Federation 57.*, pp. 1068-1073.

[4] EPA, „Wastewater Technology Fact Sheet Dechlorination,“ *EPA, U.S.*, p. 7, September 2000.

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