App note

Reliable Monitoring Of Drinking Water Quality

Water Treatment Plant Aschaffenburg, Germany

Drinking water is the most closely monitored food product in Germany.
This is due to strict legal requirements, that ensure constant monitoring of the drinking water quality.

Continuous measurement technology plays a decisive role in this by providing precise and reliable data on various water parameters such as turbidity, conductivity, dissolved oxygen or pH value. This data increase process transparency and enable water treatment plant operators to optimize control. There are many challenges in dealing with measurement technology, ranging from maintenance and calibration of the devices to the transmission and management of data.

The newly developed WTW Drinking Water Panel minimizes these challenges and has now been extensively tested at the Aschaffenburg water treatment plant. In this report, you will find out what practical experiences were made and what tips and insights were gained for similar applications in the water industry. Read on to find out more about the new WTW Drinking Water Panel and its application at the Aschaffenburg water treatment plant.

Fig. 1: The Aschaffenburg water treatment plant

1. The Aschaffenburg Water Treatment Plant

The plant draws its raw water from the Großostheim Basin, a ground-water reservoir of almost 200 million cubic meters of water with a water protection area of 3,000 hectares. Around eight million cubic meters of raw water (the equivalent of around 1,000 cubic meters per hour) are extracted from seven wells at depths of 25 to 60 meters each year, supplying the 130,000 inhabitants of the Aschaffenburg region with drinking water. The raw water undergoes three main treatment steps,

- **decarbonization** to reduce the total hardness,
- **biological denitrification** for nitrate reduction and
- post-purification, consisting of **multi-layer filtration**, which removes residues from decarbonization and denitrification, **UV disinfection**, which sanitizes the drinking water, and **activated carbon filtration**, which removes residues of pesticides and trace substances.

A detailed process diagram (only in German) can be found on the operator's website.

Plant output: approx. 1000 m^3/h

Water quality:

Raw water | Pure water

- Nitrate: 52 mg/l | 27 mg/l
- Total hardness: 19° dH | 13° dH
- Carbon hardness: 13° dH | 7° dH

*Information according to operator

2. Requirements for drinking water measurement technology

Precise measurement and monitoring of drinking water quality at the outlet of a water treatment plant is a central task for operators, but one that is associated with various metrological and operational challenges.

Measurement technology must be easy to integrate and robust enough to function reliably in fluctuating environmental conditions while ensuring high precision and long-term stability. It requires sensor-dependent maintenance and calibration due to:

- External influences:
  Contamination and mineral deposits on the sensors

- Sensor-specific properties:
  Consumption or wear of components, e.g. consumption of the electrolyte of a pH electrode

This requires not only technical expertise, but also time and resources that must be planned for during ongoing operations. At an operational level, data integration and management must be implemented and collected measurement data must be recorded, analyzed and documented in real time. This flood of data must be integrated into existing operational systems without disrupting operations. Interface problems, the compatibility of different systems and ensuring data integrity are frequent challenges.

Last but not least, possible failures or malfunctions of the measurement technology must be considered. These can put waterworks operators in a difficult situation, especially if this could affect water quality or compliance with legal limits.

3. The WTW Drinking Water Panel

The new WTW Drinking Water Panel addresses all these challenges and combines our intelligent IQ Sensor Net system with a configurable selection of our proven compact IDS sensors (Intelligent Digital Sensors), known from laboratory applications. The panel can also be equipped with a chlorine sensor and a turbidity analyzer.

The setup installed at the Aschaffenburg water treatment plant (see Fig. 2) consists of an IQ Sensor Net System 2020 3G with three IDS sensors and an analyzer and can measure the parameters pH, dissolved oxygen (O_2), conductivity and turbidity.

Fig. 2: Installation and commissioning of the Drinking Water Panel in June 2023

> “I know the Sensors from the lab”

Quote, Eric Bischoff
(Employee Water Technology, Laboratory)

Products used in this application

- Drinking Water Panel DW/P for 3 IDS sensors
- IQ Sensor Net MIQ/TC 2020 3G with the following modules: MIQ/IDS, MIQ/PS, MIQ/IC2
- IDS sensors:
  TetraCon® 925, SenTix® 945 & FDO® 925
- Turbidity analyzer Turb PLUS 2000

The installation took place at the end of June 2023 and only took around 90 minutes. The advantage of the panel is that the pipework and hoses are already installed on the panel and have been tested for leaks at the factory. In addition, the connected sensors are automatically recognized. This means that all that remains on site is the mounting (in this case on the wall), the supply and discharge of the measuring medium and the power supply.

A few practical tips have emerged in connection with the installation and commissioning of the panel:

- For a clean appearance, the spacers supplied should be used to allow the sensor cables to be guided along the rear.
- Correct positioning of the sensors in the flow cells in accordance with the operating instructions ensures a better flow and response time and therefore reliable measured values.
- The set flow rate should be checked the next day at the latest and readjusted if necessary, as the flow rate may drop due to filling and the displacement of air. The flow rate should not fall below the minimum flow rate specified in the instructions.

Fig. 3: Sensors after five months of operation (Left: oxygen sensor, center: conductivity sensor, right: pH sensor)

4. Measurement results

It should be noted that the installed sensors were deliberately not calibrated and maintained over the entire period in order to determine the drift behavior and the cleaning intervals.

The pH electrode in particular was able to impress with its minimal drift of approx. 0.2 pH within a year, while the existing pH electrode was removed, cleaned and calibrated every eight to ten weeks.

A visual inspection of the sensors in November 2023 and after the end of the pilot confirmed that the sensors were in very good condition, despite deliberately not being maintained. This indicates good resistance to external influences. Figure 3 shows photos of the sensors after five months of operation. To achieve the best possible measurement results, we recommend an application-specific maintenance cycle.

> "The sensors look very good after this running time, the values still fit."

Quote, Eric Bischoff
(Employee Water Technology, Laboratory)

The WTW measurement equipment produces nearly identical measurement results compared to data from existing measurement equipment. Fig. 4 shows this for the parameters pH, O_2 in mg/l and conductivity in µS/cm over a period of one month each. The three sensors also record the temperature and automatically compensate temperature for the respective main value.

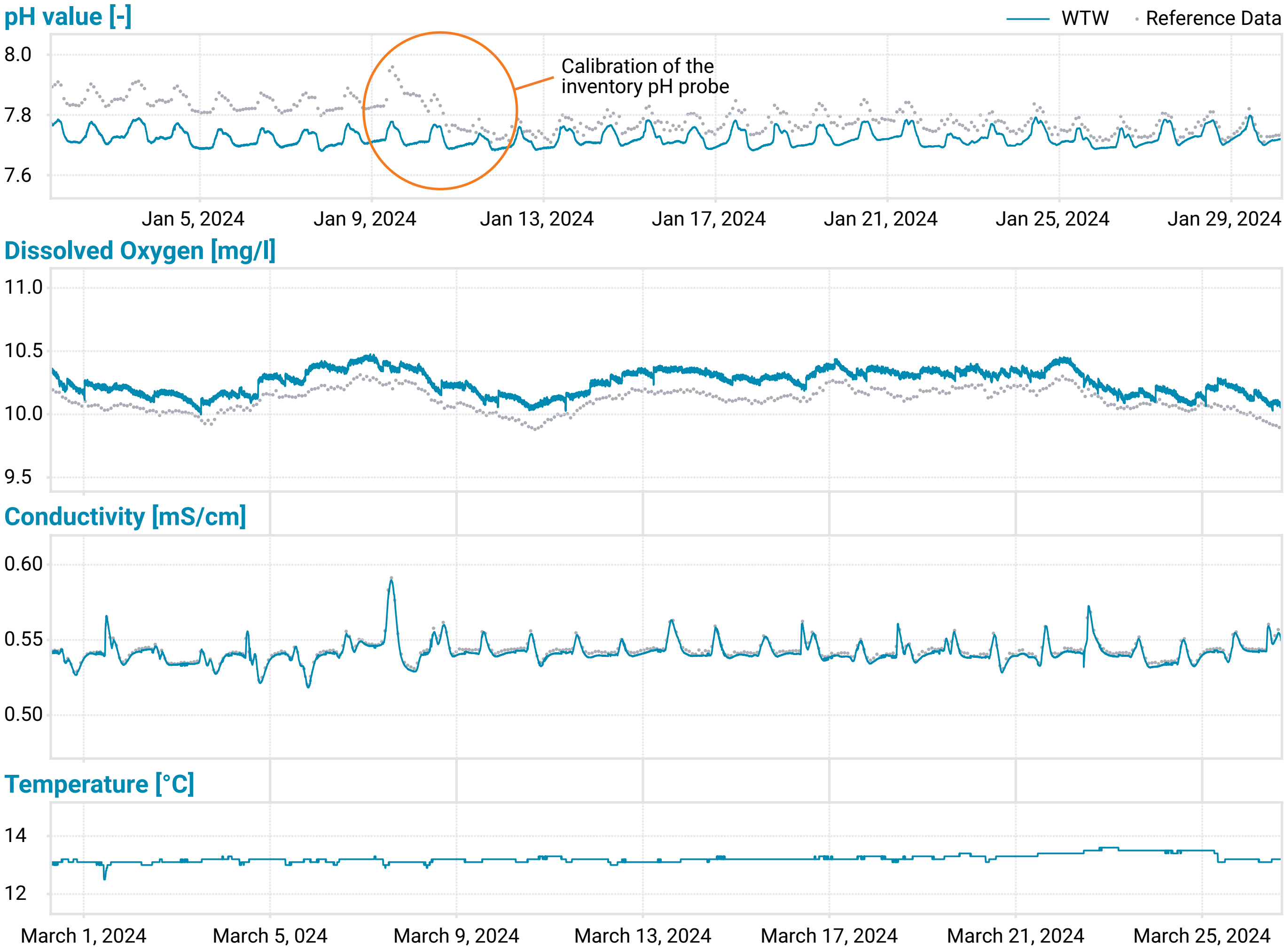

Fig. 4: Extract of the measured values for pH, dissolved oxygen (O_2), conductivity (LF) and temperature at the Aschaffenburg water treatment plant

The pH value in the period shown is between 7.6 and 7.8 for the WTW sensor (blue line) and shows a peak in the diurnal cycle. The comparative values (green dots) follow the curve, but are around 0.3 higher in the first ten days. In the marked area, around the 11th Jan 2024, the comparison values approach the blue line, which is due to a calibration of the pH sensor from the extisting equipment.

The O_2 values measured with the WTW sensor are between 10 and 10.5 mg/l and approx. 0.1 mg/l higher than the results from the existing equipment. The small deviation is possibly due to different calibrations or response times.

The conductivity values measured with the WTW sensor are around 540 µS/cm and are almost congruent with the comparative measurement. Here, too, there are peaks in the diurnal cycle. For both pH and conductivity, these can be attributed to the use and volume switching of raw water from different wells. Despite the local proximity, the raw water differs in pH value (6.8 - 7.3) and conductivity (500 - 1000 µS/cm).

5. Summary

With the pilot installation of the new WTW Drinking Water Panel at the Aschaffenburg water treatment plant, we were able to successfully demonstrate that the WTW Drinking Water Panel is easy to install and can be operated reliably and with low maintenance. It has run for a year without any problems and has delivered precise data that can be integrated into existing PLC systems via common interfaces such as Ethernet or Modbus. Valuable insights were gained regarding the installation and operation of the WTW Drinking Water Panel.

> "The WTW Drinking Water Panel is chic and ran for a year without any problems"

Quote, Eric Bischoff
(Employee Water Technology, Laboratory)

We would like to thank the waterwork of the "Aschaffenburger Versorgungs-GmbH" for their excellent cooperation.

Key Takeaways

- The new WTW Drinking Water Panel was installed at the Aschaffenburg water treatment plant at the end of June 2023 and ran smoothly for a year without cleaning, maintenance or calibration.
- The panel combines our intelligent IQ SENSOR NET system with a configurable selection of our compact and proven IDS sensors (Intelligent Digital Sensors), known from the laboratory.
- The IDS sensors delivered precise values and were able to convince.

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