PARADIGM SHIFT IN PROCESS CONTROL

Real-time measurement of microbiological quality

Romaqua, the biggest producer of mineral water in Romania, operates 17 bottling plants at five locations for water, fruit juices and beer. Committed to its quality promise to the customers, Romaqua largely relies on the production lines of the German manufacturer Krones. When it comes to product quality and monitoring, Romaqua has now taken a further step into the future and installed the first fully automated device for measuring the microbiological quality of water in its most advanced mineral water production line in Borsec, which was only completed in 2019.

Knowing the status of the microbiological water quality in real-time, this is what the laboratory and quality managers of the Romaqua site in Borsec wanted to achieve. Until now, they have waited for days for the result on the microbiological quality and there was no chance to get this important information faster.

The microbiological dimension

Microbiological quality is one of the most important water quality parameters in the food industry in general and in beverage production in particular. Until now, this important parameter has been determined by using culture-based lab methods, which take up to three days to obtain a result. The fact that this important information on product quality is only available after days of waiting must be taken into account through effective risk management and great efforts in quality assurance.There is a lot at stake: Production stoppages or even product recalls can inflict major economic damage and cause lasting impairment to a brand's reputation.

The focus is on quality

Being able to perform a measurement directly in the process or even to monitor the microbiology in the process completely automatically instead of determining the quality of manually drawn samples after several days of waiting in the laboratory, was therefore at the top of the priority list for the Romaqua team.

In their search for a solution to quickly determine the microbiological quality of water, they encountered VWMS in Lower Austria: the company offers a device called "ColiMinder," which is capable of measuring microbiological quality fully automated and within 15 minutes. A first inquiry at VWMS, a presentation, and three weeks later a ColiMinder was installed in the production process at Romaqua – despite the lockdown throughout entire Europe.

Romaqua initially rented a device to test the new technology first and especially to evaluate, whether the measurement results were consistent with the laboratory tests used so far. The reliability of the technology was evaluated through numerous comparative measurements with traditional laboratory methods. A wide variety of samples were examined in parallel in order to find out not only whether the results were correlating with traditional lab methods, but also evaluate the robustness of the technology and its possible field of application.

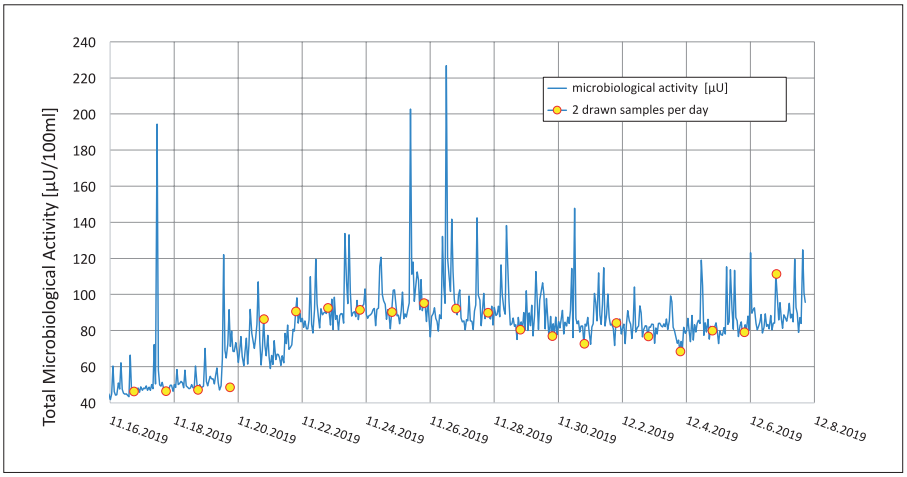
It quickly became evident that the ColiMinder delivers reliable measurement results – the correctness of the measurements was confirmed.

After just one month of trial period, Romaqua decided to purchase its first ColiMinder, which is since then monitoring the microbiological quality of the two mineral water wells – one still and one with natural carbonic acid – fully automated and 24/7. In addition, the device, which is installed directly in the production facility, also offers the option of measuring any manually drawn samples quickly and easily.

Wolfgang Vogl, GM and founder of VWMS GmbH, Aurel Atudorei, sales and service partner of VWMS in Romania, Nicolae Radeanu, laboratory manager at Romaqua (f.l.t.r.)

Fast bacteria measurement from Lower Austria

Exactly between Vienna and Bratislava, in the Marchfeld region, lie the headquarters of VWMS. There the founder Wolfgang Vogl and his team develop, produce, and distribute measurement technology for the rapid and fully automatic measurement of bacterial contamination of water, which is now used worldwide in a wide variety of applications: in drinking water, in food production, but also in surface and bathing water, in waste water and in industrial process water. The device measures the contamination



Example of a timeline of the microbiological activity in a drinking water pipeline. Blue line: the course of microbiological activity measured by the ColiMinder; yellow dots: two manually drawn samples per day

of the water with fecal indicators (E. coli or enterococci) or the total microbiological activity, which, similar to the laboratory tests for total microbial count, records all living organisms in the sample.

Measuring principle

The measurement principle of this fast and fully automatic method is based on a so-called "enzyme assay," a scientifically recognized method in which the enzymatic activity of the organisms present in the sample is measured. Living organisms – bacteria, but also all other micro organisms such as algae and fungi – need enzymes for their metabolism – so what could be more obvious than to use the enzyme activity of the target organisms as a measure of microbiological load?

Despite the short measurement time of 15 minutes, the detection limit of this enzyme-based method lies in the range of the usual culture-based methods, in many applications even significantly below. Due to the rapid succession of measurements, short-term fluctuations and peaks of the microbiological load are visible, which would never be detected with traditional methods. The technology therefore offers completely new insights into what is actually happening and enables a better understanding as well as evidence-based response.

The ColiMinder at Romaqua – installed at the raw water intake of still and naturally carbonated mineral water

Scientifically proven

ColiMinder has been in use since 2014 and has proven its accuracy and reliability in many installations worldwide. The customers of VWMS include water suppliers, utilities and industry, as well as numerous research institutes, including the Polytechnique Montreal, the University of Tokyo, the KIT (Karlsruhe Institute of Technology) and New Zealand's National Institute for Water and Atmosphere. The technology has already been validated in several independent and peer-reviewed scientific studies.

Quality Control and Risk Management

Martin Stone, Director of HACCP International, sees the entire process of microbial risk analysis in food production in a state of upheaval: "…if microbiological monitoring is available in real-time (…), the risk analysis system in place up to now will change completely: locations and number of Critical Control Points (CCPs) will change; and critical limits can be readjusted – up to now, a safety margin has generally been applied. And if monitoring takes place directly in the process, the type and timing of corrective measures can be changed: Thus, measures can be taken before critical limits are exceeded. (…)" [1)]

Microbiology in 15 minutes

The availability of the measurement results almost in real time now makes it possible for the first time to monitor the current status of the microbiological quality in every process step – whether at the raw water intake, during filtration, in the tank, directly before bottling or in the end product.

The results for the measured microbiological activity are displayed in a timeline which can be called up live and online at any time. In addition to the information about the level of the current microbiological contamination, form and course of the activity timeline

provide valuable information that allows conclusions to be drawn about the causes of changes in microbiology. The laboratory and quality management team at Romaqua was impressed by the completely new insight into the course of microbial quality.

At Romaqua's request, the ColiMinder was equipped with an automated sampling module that automatically fills a larger sample volume in the event of increased microbiological activity: up to 20 liters are then available for more precise analysis of the sample in the laboratory. At the same time, the measurement system automatically alarms the laboratory team or sends a warning message to the process control system.

Conclusion: evidence-based measures

The microbiological parameter was previously not available for process control and online monitoring of quality in the beverage industry because the results simply took too long. The possibility of receiving information about this process parameter in real time opens up completely new possibilities for increasing safety and efficiency in the filling process.

For example, a decision to stop production and start a CIP or SIP process can now be made based on current measurement results. With the help of this new technology, the bacterial contamination of the rinsing water of a bottle washing system can be continuously measured and thus the quality of this process can be continuously monitored.

The laboratory team also benefits from the technology: it creates a new perspective and offers insights into the microbiological processes – this reduces the risks and allows the targeted use of resources. Although the fully automated monitoring does not replace the prescribed laboratory tests, it adds this crucial real-time parameter to the information for process control and quality monitoring.

ColiMinder technology thus opens completely new possibilities for risk management and quality control, from raw water through all stages of the production process to the end product. Romaqua thus demonstrates the seriousness of its promise to invest in state-of-the-art technology – with the aim of offering its customers the highest product quality. □

Sources

[1]) Webinar "Microbial food and beverage process monitoring – a view from the future," September 10, 2020, Australia. Speakers: Martin Stone, Dr. Annette Davison, Risk Management Specialist for the food industry, and Wolfgang Vogl, CEO of VWMS GmbH, available at https://www.optimosgroup.com/products/webinar/

Isabel Neduchal

Isabel Neduchal has accompanied the development of the ColiMinder since 2010 and took over sales and marketing at VWMS in February 2018. With a lot of commitment and enthusiasm as well as 20 years of experience in international sales, she opens new doors for the ColiMinder.

Wolfgang Vogl

Dipl.-Ing. Wolfgang Vogl is the founder and managing director of VWMS GmbH. Since his first research on the technology in 2010, he and his team have been developing the technology into a ready-to-market product. He passionately convinces people and companies around the world of the performance of ColiMinder technology.