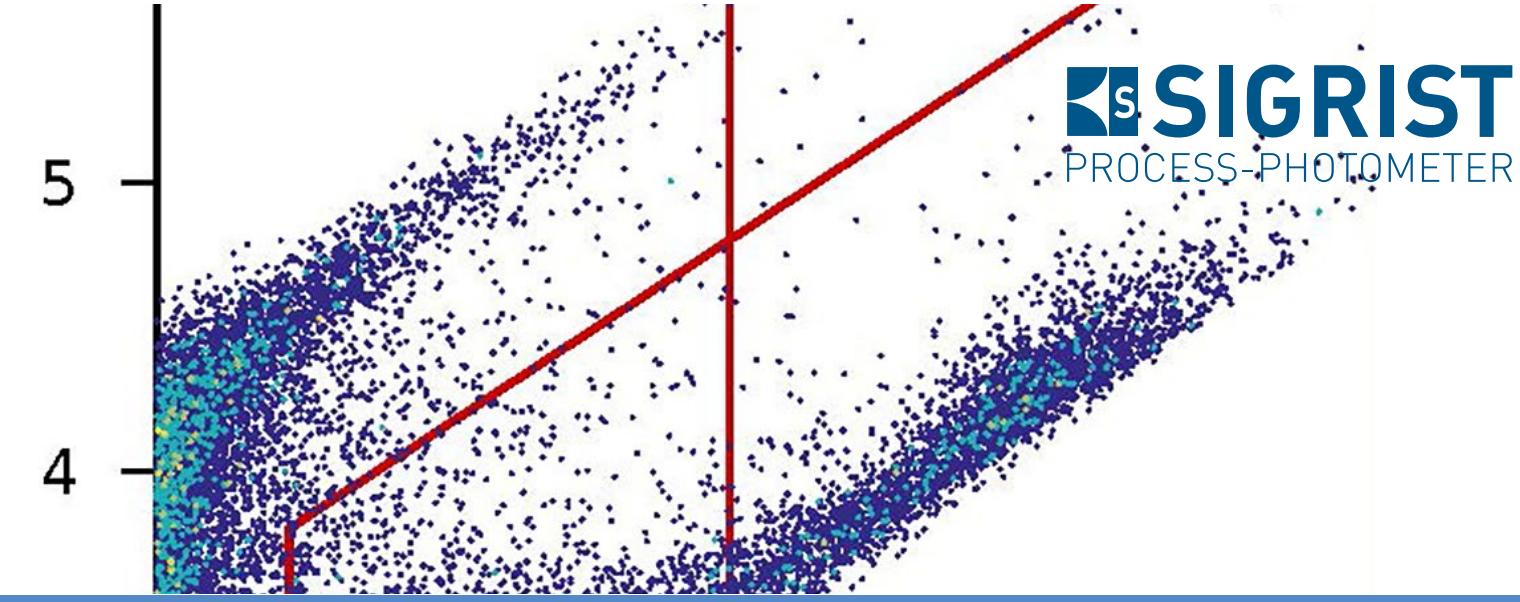


SIGRIST
PROCESS-PHOTOMETER

BactoSense TCC

Automated flow cytometer for online-monitoring of microbial cell number in drinking water

Whilst the continuous, automatic online monitoring of chemical and physical parameters in drinking water treatment has been practiced for years, microbiological data is only available days after the analysis due to the methods used.
However, thanks to flow cytometry the total cell count and other microbiological parameters can now be determined within just a few minutes. The new, robust, automated online device BactoSense has been tested continuously in practice.

Engineered by bNovate

Figure 1: BactoSense with cartridge

Continuous monitoring of drinking water

In contrast to a number of physical and chemical parameters, there were until recently no methods available for the quick determination of microbiological parameters, not to speak of the possibility to an online determination of such parameters. Results of cultivation-dependent plating methods for the hygiene-relevant faecal indicator bacteria Escherichia coli or Enterococcus are available after one to two days at the earliest. Meanwhile, results for the hetertrophic plate count (HPC), which provide an indication of the general microbiological water quality, are only available after three to ten days, depending on the methods used. Therefore, so far early warning of biological risks has been based on physical or chemical parameters that usually only have a weak correlation with microbiological data.

Figure 2: BactoSense installed in a groundwater well

Flow cytometry for rapid microbiological analysis

However, in the past ten years the development of flow cytometry (FC) methods for the rapid detection and partial characterisation of microbial cells in water has opened up some completely new possibilities. Here, the microbial cells present in the water sample (usually, the majority of them are bacteria) are stained briefly with a fluorescent dye that binds to the genetic material (DNA). Thus, using a flow cytometer, the total microbial cell count (TCC) can be determined in less than 15 minutes. At the same time, the percentage of strongly or weakly fluorescent (or simply larger or smaller) cells can also be determined.

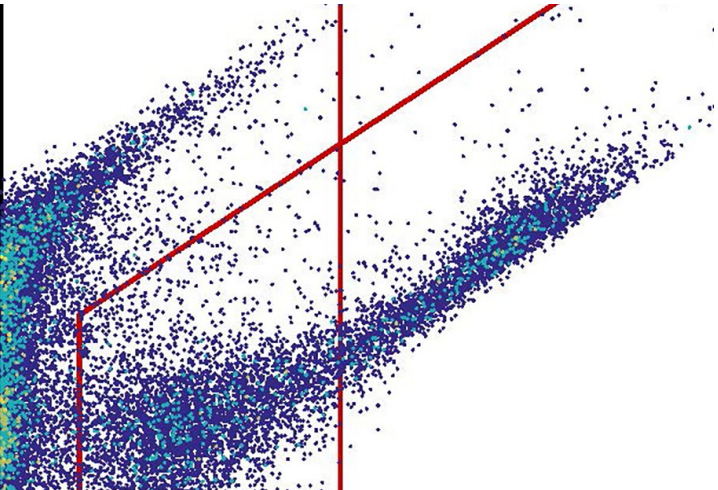
Practical tests have shown that the concentration of the total cell count and the ratio of large to small cells react extremely sensitively to contamination, and changes in the system. From raw water to the treatment process and distribution in communal networks all the way through to the piping system in buildings – microbiological processes can not only be monitored much quicker thanks to these flow cytometer parameters, the information obtained is also more realistic and significantly more reproducible than when using the HPC method.

Therefore, the determination of the TCC and the ratio of large to small cells using flow cytometry has been standardised and validated in Switzerland. Nowadays, the determination of the TCC using flow cytometry is an important addition (or even alternative in some cases) to HPC, and is already used routinely by some of the major waterworks in Switzerland.

Example: Detection of the presence of wastewater

In collaboration with several Swiss Water Works the performance of BactoSense was tested in practice in a number of different applications (described in Egli et al., 2017). For example, as part of an international research project Safewater, a test installation was constructed at the waterworks in Zurich (WVZ) in order to better understand the hydraulic processes in pipeline systems and to check the existing models. This installation represents a simple water distribution network that is completely disconnected from ongoing operations and the network. One of the goals was to mimic a contamination of drinking water with wastewater and to find out the percentage of wastewater that can be detected in drinking water using online sensors. To do this, 1 ml/l and 5 ml/l of pre-treated waste water (TCC ~30 x 10^6 cells/ml) was added to one of the drinking water lines. The chemical and physical parameters were monitored using a multi-parameter sensor system, which can measure a range of parameters at minute intervals (e.g. pH, redox potential, conductivity, dissolved oxygen, temperature). The TCC determined using flow cytometry and the percentage of larger cells (HNA %) were automatically determined online in the contaminated line using BactoSense at half-hour intervals. The results clearly show that, in contrast to the other chemical and physical parameters, even as little as 0.1% of waste water can already be reliably detected in the drinking water, both through the increase in TCC of approximately 25% and the increase in the percentage of larger cells. When 0.5% waste water was added, BactoSense showed an increase of around one-and-a-half times the TCC.

Source: Egli T., Zimmermann, S., Schärer P., Senouillet J., Künzi S., Köster O., Helbling J., Montandon P.-E., Martguet J.-F., Khajehnouri F. (2017). Automatische online-Überwachung der Bakterienzahl im Trinkwasser: Resultate aus der Praxis. Aqua & Gas, October issue, in print.



BactoSense TCC

Automated flow cytometer for online-monitoring of microbial cell number in drinking water

Applications

- Flow cytometric determination of total microbial cell count (TCC)
- Online or manual operation
- Determination of the water «fingerprints» and cell size ratios (LNA/HNA)
- Anywhere a fast answer concerning the general microbiological quality of drinking water is required
- Monitoring of raw water quality
- Monitoring of water treatment processes
- Monitoring of water distribution networks, flushing procedures, maintenance etc.
- Monitoring of private and public in-house water installations
- Rapid microbial contamination detection
- Integration into early warning system possible
- Disinfection control
- Research and troubleshooting

Features

- Fully automated flow cytometer specifically designed for industrial requirements
- Detection of more than 99% of microbial cells
- Result available 20 minutes after sampling
- Faster, cost saving and more realistic results than plating (HPC)
- Flexible settings for threshold values and alarms
- User-friendly operation and maintenance concept
- Safe-to-handle cartridge containing all chemicals and waste
- No handling of chemicals and no samples preparation necessary
- Compact instrument with a small footprint
- Easy system integration thanks to multiple interfaces

Industries

- Water treatment & distribution
- Food & beverage
- Laboratories & universities
- Pharmaceutics & cosmetics

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