

Fully Automated Bacterial Monitors as tools in drinking water control, presentation of 5 different installations in Norway.

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Automated, rapid and reliable tests for hygienic quality of drinking water can work as an important tools in water treatment control and distribution network monitoring. The traditional microbial testing normally includes a low number of samples and is often not able to detect small incidents or short-lived changes in the hygienic quality. Also, in many cases by the time the water sample has been analyzed and the final results are obtained the water has already been distributed and used by the consumers. The **Colifast ALARM™** is a stand-alone, fully automated at-line monitor for **detection of *E.coli*, total coliforms or thermotolerant coliforms in water**. The system detects down to one target bacteria per 100ml and the automated analysis is based on a combination of selective bacterial growth and specific enzyme activity of the target bacteria. This method is reliable and robust and detects only viable target organisms. The results are comparable to results obtained from laboratory analysis (James *et al.*, 2011). The total time from the **automatic sampling to result is 6-14 (15) hours**, which is very fast compared to the traditional testing including manual sampling, transportation and handling, laboratory analysis and reporting. The rapid and frequent at-site analysis and direct data transfer of results/alarms to operators can improve process control and also prevent incidents. The increased number of hygienic quality data generated by the system will in addition give operators and decision makers a considerable better overview of fluctuations and stability of the monitored water. To illustrate how these systems can be implemented as **tools in water control**, a selection of 5 different applications in Norway is further described:

Distribution Network Monitoring. IVAR IKS, Mosterøy, Stavanger: The Colifast ALARM™ was installed in 2010. The system samples from an elevated reservoir at a remote location of the water distribution network. This reservoir is located approximately 50km from the IVAR IKS water works. Historically there has been reported fecal indicators at this site, but during the later years the water quality has been good which is shown both with the daily analysis by the Colifast system and the periodic laboratory samples. The system will alarm operators if it detects 1 or more total coliforms in 100 ml sample.



Lake (raw water) Monitoring. VIVA, Jonsvatnet water works, Trondheim: The Colifast ALARM™ was installed in 2012. The system samples and analyze the raw water from lake Jonsvatnet. It is installed at the raw water intake station (traveling band screens) by the lake and perform one analysis per day. The lake water has good hygienic quality and *E.coli* is only sporadic present and in low numbers. The instrument generates valuable hygienic information for the operators at the water treatment plant and gives a better overview of the variations over time. The system will alarm operators if it detects 1 or more *E.coli* in 100 ml sample.



Water Treatment Monitoring. Jevnaker treatment plant, Jevnaker: The Colifast ALARM™ was installed at the filtration rig in 2012, at the water works situated by the south end of lake Randsfjorden. The raw water from Randsfjorden usually contains low levels of coliforms and *E.coli*. The system monitors the processed water after treatment by ultra filtration. The instrument analyze one sample every second day and works as a hygienic security system for the water treatment as filter damage and breakthrough might affect the drinking water quality. The system will alarm operators if it detects 1 or more total coliforms in 100 ml sample.

Ground Water Monitoring. GIVAS IKS, Kongsvinger: The Colifast ALARM™ was installed in 2011, at the Granli treatment plant. The system monitors the ground water which is normally used directly as drinking water without treatment. The ground water has high hygienic quality and contain no coliforms. But in some periods including flooding of the nearby river, the hygienic quality of the water may be affected and the water works will initiate chlorination treatment. The instrument analyze one sample per day and gives the operators a valuable warning if there are total coliforms present in the water. Based on this information they will start chlorination. The system send alarm to operators if 1 or more total coliforms are present in 100ml.



Lake (raw water) Monitoring. Oset treatment plant, Oslo: The Colifast ALARM™ was installed late 2012, at the water works situated by the raw water source of lake Maridalsvannet. This lake with its connecting lakes is the water source for the majority of the city's population. The raw water sporadically contains low levels of coliforms and *E.coli* which usually occurs during circulation periods (March to May and October to December). The system monitors the raw water intake and analyze one sample every day which increase the number of hygienic water quality data. The increased number of analysis gives an accurate indication of the hygienic change during circulation onset and also detects incidents in periods without circulation. The system will alarm operators if it detects 1 or more *E.coli* in 100 ml sample.



From the ETV Verification Statement:

Results Summary of Colifast ALARM

Parameter	TC	EC
	Dilution B	Dilution A
Sensitivity	100%	75%
Specificity	100%	100%
False Positive Rate	0%	0%
False Negative Rate	0%	25%

For total coliforms (TC), the chi-square test did not detect any differences between the results of the Colifast ALARM and SM 9221B.
For *E.coli* (EC), the chi-square test did not detect any differences between the results of the Colifast ALARM and SM 9221F.

The Colifast ALARM™ system was originally designed for monitoring drinking water at remote locations and critical points in the distribution network. After the product launch in 2010 it became evident that this type of system also would be useful as quality monitors in different steps of the drinking water production. The applications described in this poster shows the variations in use, from monitoring water in the distribution network, ground water, lake water (raw water) and in water treatment . These installations illustrates the demand for improved control by rapid results and more frequent data on the hygienic quality . The variations in use of these systems relates to differences and technical challenges in the local water supply.

References: James, R., Lorch, D., Pala,S., Dindal, A. and McKernan, J. (2011). Environmental Technology Verification Report, Colifast Alarm at-line automated remote monitor. Battelle, U.S. Environmental Protection Agency, www.epa.gov, www.ivar.no, www.trondheim.kommune.no, www.jevnaker.kommune.no, www.givas.no, www.vann-og-avloppetaten.oslo.kommune.no.