# Evaluation of online UV/Vis spectrometry-based event detection system at Bratislava waterworks

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## Introduction

BVS produces drinking water for the Bratislava agglomeration, with a total population of over 600.000 people. Its main raw water source is deep ground water of very high natural quality. Nevertheless, BVS decided an online water quality monitoring system is essential to ensure that this quality is never compromised. BVS is establishing a network that monitors all essential sources in real time.

## Materials and Methods

To select the appropriate equipment, BVS conducted a multi-stage evaluation consisting of the following steps:

1) definition of requirements
2) instrument manufacturer specifications review
3) field test of short-listed technologies
4) event detection test with contaminated samples

UV spectrometry was selected as the preferred technology as it allows the measurement of many conventional parameters (turbidity, TOC, DOC, nitrate ...) as well as detection of contaminants. The s::can spectro::lyser™ (100mm OPL) and the Hach Lange supplied Trios ProPS CW (60mm OPL) were evaluated in stages 3 and 4. (OPL = Optical pathlength)

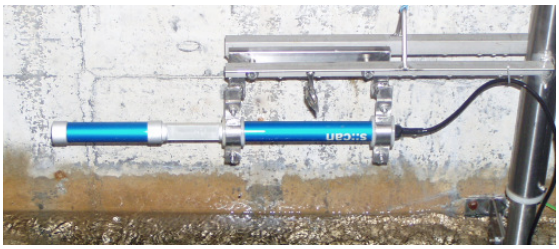

**Figure 1:** s::can spectro::lyser™ in ground water installation.

## Field Test

Both selected instruments were installed in one reservoir for 1.5 months. Both instruments showed an uptime of 100% and were operated free of drift during the test. The parameters BVS evaluated are TOC and $SAC_{254}$.

After calibration both instruments provided accurate and precise TOC results; 1.73 mg/L mean value, 95% confidence interval 0.116 mg/L, reference analysis 1.70 mg/L. $SAC_{25r}$ results; reference analysis = 1.0 Abs/m, spectro::lyser™ = 1.05 Abs/m, ProPS CS = 1.10 Abs/m. The spectro::lyser™ showed a markedly higher precision (+/- 0.009 Abs/m) than the ProPS CW (+/- 0.1 Abs/m). A 10 times more precise absorbance signal will positively affect both the precision of conventional parameters (e.g. TOC, DOC) and the capability to detect contamination events.

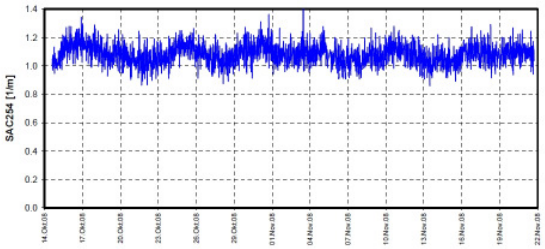


**Figure 2a:** Long term $SAC_{254}$ measurement. ProPS CW: —.

## Contamination Detection

The final step of the evaluation was comprised of an event detection competition. This was performed on-site, i.e. under field conditions. Solutions of KHP (1, 2, 4 mg/L). Carbendazim (20, 50 , 100 µg/L, figure 3) and benzene (150 µg/L) in BVS ground water were presented to both instruments.

The spectro::lyser™ was equipped with a spectral alarm system that was trained on the background spectrum, including its natural variation. The calibrated alarm system automatically produced an alarm with all samples presented. The ProPS CW was not equipped with such an automatic alarm system, therefore its spectral signal had to be evaluated manually. The ProPS CW failed to detect the presence of benzene.

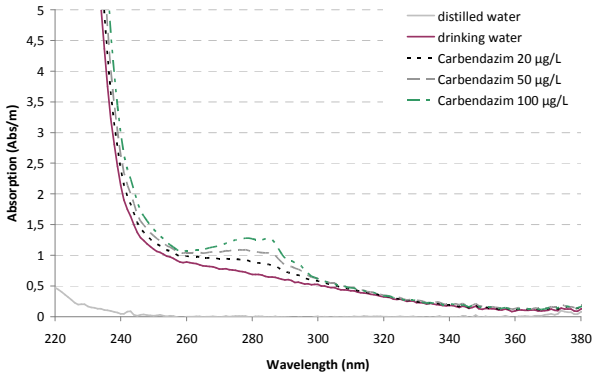


**Figure 3:** Absorbance spectra for Carbendazim measured with the spectro::lyser™ during the spike tests.

## Discussion

A performance difference between the tested instruments can clearly be distinguished. The better precision and sensitivity of the spectro::lyser™ are the result of a longer measurement cell in combination with use of a Xenon flash lamp instead of a continuous Deuterium lamp. As the Deuterium lamp of the ProPS CW needs periodical replacement, it reduces its operational performance.

## Conclusions

Online spectroscopy is a powerful method for water quality monitoring. Spectrometer probes pack multiple measurement capabilities (standard water quality parameters & event detection) into a small and easy to use package. Various contaminants were detected down to low µg/L concentrations. Due to demonstrated better measurement and operational performance as well as an automatic contaminant alarm detection system, BVS selected the s::can spectro::lyser™ for the online protection of the Bratislava drinking water.

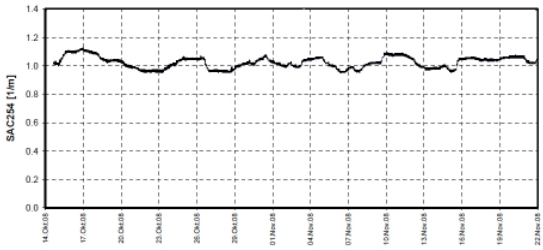


**Figure 2b: Long term SAC254 measurement. spectro::lyser™:** —.

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