Online sewer monitoring by means of UV/VIS spectroscopy

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Abstract
Monitoring of combined sewer systems is a challenging task due to difficult boundary conditions. Automatic sampling of wastewater is limited by its number of sampling bottles. UV/VIS spectroscopy seems an alternative for continuously monitoring. This kind of method is based on the Lambert-Beer’s absorption law. Typical correlations between absorption and equivalence concentrations are provided by the manufacturer. Theses provided correlations have limited significance due to the influence of the existing wastewater matrix (properties) to the absorption-concentration correlation. Therefore, a 24 h measurement has been carried out to improve the equivalence concentration of TSS and COD by means of multiple regression methods. The improvement of the concentrations shows the reliability of UV/VIS measurements in combined sewer systems.

Keywords
UV/VIS spectroscopy, combined sewer systems, online sewer monitoring, wastewater sampling

INTRODUCTION
Pollution measurements in combined sewer during dry as well as during wet weather conditions gain useful information which are considered for quality and integrated modelling, sewer management strategies (sewer sediments), real time control strategies (pollution based real time control), etc. The monitoring of sewers and of indirect discharger is traditionally done by means of measurement campaigns with automatic samplers, theses samples are afterwards analysed in the lab. Especially, the information due to insufficient time intervals is limited. On-line sensors are an alternative solution to fulfil the requirements to measure in sufficient time intervals. In the last years more and more UV/VIS sensors are installed for sewer and wastewater treatment plant monitoring. Hence, experiences of UV/VIS sensors application in wastewater can be presented (see e.g. Gruber et al., 2005; Langergraber et al., 2004) and demonstrate its practicability in sewers.

MATERIAL AND METHODS
In a main sewer collector at a combined sewer overflow in Linz a submersible UV/VIS sensor is situated in the top water layer and measures in this position the water quality. The sensor position is given by a swimming plastic frame where the probe is installed.

![Figure 1](image)

**Figure 1.** Example of absorbance spectra in UV-VIS range and the wavelength classification.
To guarantee a permanent clean measurement window the sensor is equipped with an auto cleaning system using pressurised air. The basis for this kind of measurement is Lambert-Beer’s law. If the absorbance (extinction) of different wavelengths is known, the spectral characteristics of the matter can be displayed (see figure 1). The measured absorption at a specific wavelength is the sum of single absorbances of different substances at the applied wavelength and is caused by effects of scattering and turbidity (Matsché et al., 2002).

RESULTS

The measured absorbance spectra are further calculated in equivalence concentrations for TSS and COD by means in this research with four different multiple linear regression methods: simple linear regression, least median squared regression, model tree regression, partial least squared regression (Hochedlinger et al. 2006). To accomplish these statistical analyses for the monitoring reference sampling data are needed for model training and validation. Therefore, a 24-h measurement campaigns has been carried out to gain reliable reference data of TSS and COD. The 24-h measurement campaign guarantees the consideration of temporal wastewater behaviour. It is of high importance to investigate the whole concentration range (low and high) to get reliable absorbance-concentration correlations.

Figure 2 displays the results of the 24-h measurement campaign for the TSS parameter of lab values, values of the sensor by means of partial least squared regression provided by the manufacturer and values based on a waste water matrix adjustment. The concentrations can be reproduced – especially with the improvement – in a reliable and acceptable way.

CONCLUSION

This research demonstrates the practicability of UV/VIS sensors for sewer monitoring due to high monitoring intervals. The equivalence concentrations for the parameter COD and TSS measured by the UV/VIS spectrometer are reliable; therefore, this kind of measurement can be an useful alternative.

REFERENCES