Monitoring of Ammonium Loads in Waste Water: Online Measurements Made Easy and Affordable

WATER WASTEWATER

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Removal of nitrogen containing substances and nutrients is one of the most important processes in waste water treatment plants. To monitor this nitrification / denitrification process, s::can™ now offers the ion selective ammonium sensor 'ammo::lyser'. The ammo::lyser is a robust and easy to operate ion selective sensor that is automatically compensated for possible cross-sensitivity to temperature, pH and potassium. Together with the s::can™ spectro::lyser™ (TSS, COD, NO3-) and the oxi::lyser (O2), the ammo::lyser puts s::can™ in a unique position, in that it can provide the online monitoring and control of all parameters relevant in the process of nitrogen removal in a single integrated measuring system.

Introduction

The removal of nutrients, especially nitrogen containing compounds, from waste water is one of the main tasks of WWTPs. High levels of nitrogen in the effluent will result in eutrophication of natural waters. Furthermore, incomplete conversion from organic and inorganic nitrogen compounds will result in the presence of toxic ammonium and/or nitrite in the effluent. Process monitoring and control during nitrification / denitrification processes is therefore highly desirable. s::can™ already offers the spectro::lyser™ spectrometer probe which can measure nitrite and nitrate simultaneously, and the oxi::lyser for monitoring dissolved oxygen. With the ammo::lyser s::can™ completes its range of intelligent, low maintenance sensors, and integrates it in an easy-to-use and cost-efficient digital environment (figure 1).

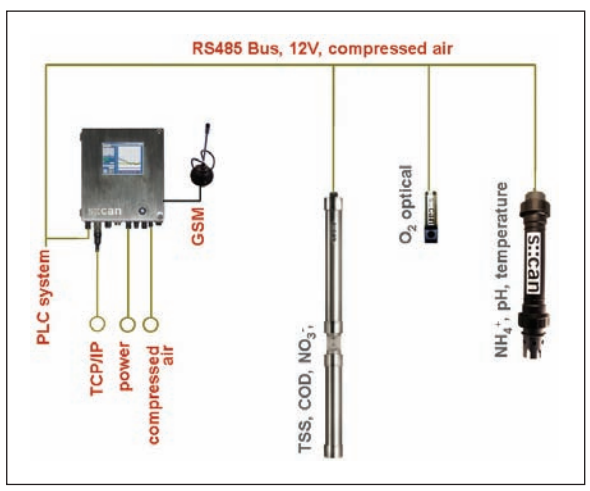

Figure 1: s::can™ Monitoring System providing readings for ammonium, pH, DO, TSS, NO3-N, COD, CODf, NH4-N, K and temperature.

The ammo::lyser

The ammo::lyser is a new system that monitors the concentration of ammonium ions in-situ using an ammonium selective electrode. A robust, ion selective membrane is used to selectively measure the ammonium ions in the water. To compensate automatically for possible remaining cross sensitivities, the ammo::lyser is equipped with sensors for pH, temperature and potassium. The readings of these additional sensors can, besides their use in the compensation, also be displayed online. This unique automatic compensation makes the results of the ammo::lyser much more reliable and robust than those obtained from the ion selective electrodes available today; It has proven superior to all other ion selective NH4+-sensors during 3 years of continuous measurements in various applications and was evaluated positively by several European Universities.

The device is simple to use, a quick calibration is all that is required before initial operation. After that, a check of the calibration is recommended twice per month, and applications where calibration only once every 6 months was necessary have been demonstrated. Manual cleaning of the electrodes is not required, as the instrument is equipped with a system for automatic cleaning with compressed air or water, which it has in common with all other s::can™ measuring systems. The only other maintenance is the replacement of the ion selective membranes every 4 – 6 months, the necessity of a membrane change will be indicated by the instrument itself. This results in lower maintenance and costs than those associated with the ammonium analysers commonly found in WWTP today.

Operation and control

Like all other s::can instruments, the ammo::lyser runs on 12V and is fully integrated into the validated s::can™ software and s::can ™ terminals via an RS485 protocol.

User interfaces for sensor operation and control are available on several performance levels:

-the ammo::lyser can be integrated into the measuring system controlled by the "con::stat-III" industrial process control terminal. This terminal offers data visualisation and manipulation, control and calibration of the probe, as well as the possibility to combine the ammo::lyser with any combination of other s::can instruments or other digital (RS485) or analogue (4-20 mA) sensors.
-for less demanding applications and smaller budgets, the compact "con::lyte" terminal is available. With the con::lyte, the ammo::lyser can be operated alone, or in combination with the oxi::lyser.

Proof of performance in real case applications

The ammo::lyser has demonstrated its ability in various waste water applications. The figures below show the results of three such applications. In figure 1 the ammonium and COD concentration at the influent of a waste water treatment plant are shown. These were measured with an ammo::lyser and spectro::lyser™ and show the daily cycle in the composition of the sewage. In this application the typical daily COD concentration range lies between 400 mg/L and 800 mg/L and the NH4-N concentration varies between 25 mg/L and 45 mg/L. It is quite evident that daily fluctuations of nutrients, which lie in the order of 100%, must be considered for an efficient operation of waste water treatment processes.

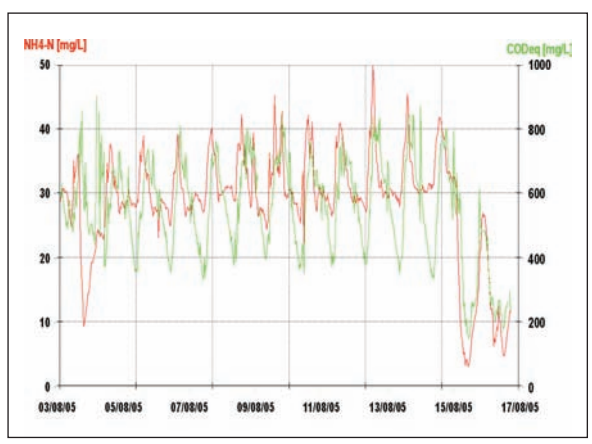

Figure 2: Monitoring sewage influent at a waste water treatment plant using ammo::lyser and spectro::lyser™ to measure ammonium and CODeq respectively.

In figure 3 the results of the parallel operation of an ammo::lyser and a cabinet ammonium analyser after the aeration basin are shown. The results of the two instruments are practically identical, and these readings were confirmed with laboratory measurements. At a much lower investment, and with lower maintenance, the ammo::lyser clearly compares favourably with the cabinet analyser. As the ammo::lyser is fully submersible, it can measure in-situ, which makes pipe installations, pumps and filters for sampling unnecessary. Furthermore, no reagents are required, reducing the costs of ownership to an level not matched by any other instrument.

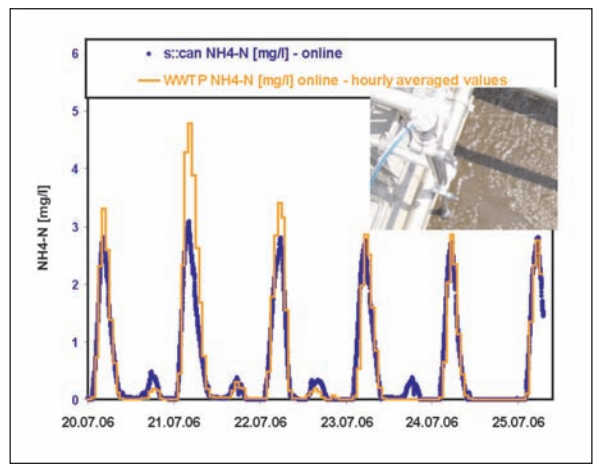

Figure 3: Ammonium concentrations measured after aeration WWTP. The daily peaks are caused by the recirculation of primary sludge necessary to maintain the optimal nutrient ration for the bacteria used in the nitrification / denitrification process.

In figure 4, the simultaneous monitoring of NH4 and O2 in a Sequencing Batch Reactor is depicted. In this case a combination of an ammo::lyser with an oxi::lyser was installed in-situ, directly in the reactor. The NH4 sensor was cleaned on an hourly basis by the compressed air cleaning system. The calibration of NH4 was checked on a weekly basis, and adjusted every 2 weeks. The measurements worked well at all solids concentrations.

Compared to a fixed time schedule the times for settling, denitrification and nitrification can be minimised and therefore the volumes of treated water can be maximised when the online readings of oxygen and ammonium are used for control of the SBR. (Lit.*).

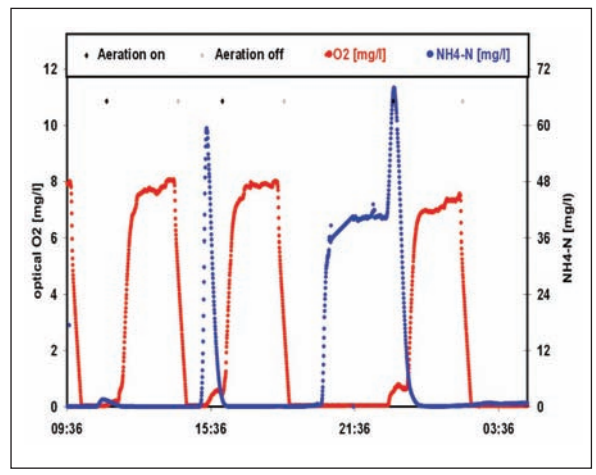

Figure 4: Simultaneous measurement of ammonium and dissolved oxygen in an SBR.

(Lit) ....*
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