Easy and Cost-efficient OnLine Monitoring
FOR WATER TREATMENT PLANTS

Author Details

DI Andreas Weingartner - President
s::can Messtechnik GmbH, Vienna
Brigittagasse 22-24, 1200 Vienna, Austria
Tel: +43 1 219 7393 - 0 Fax: +43 1 219 7393 - 12
Email: office@s-can.at Website: www.s-can.at or www.water-security.com

WATER/
Wastewater

Online spectrometry has found its way into the monitoring and management of modern water treatment plants. Since s::can introduced this method to the water market 6 years ago, more than 800 instruments are already in place, and other manufacturers are trying their first steps in the technology today. Despite the short timespan since the advent of the new method, it is becoming increasingly evident that online spectrometry will replace many of the classical analysers for organics like COD or TOC, as well as for Nitrate, Nitrate, TSS, and other parameters, mostly because of it's cost-efficiency, reliability, and low operational costs.

Triggered by the potential to operate i.e. a Nitrate-sensor for many months without touching it, the challenge arose for the rest of the measuring system to achieve comparable maintenance-free periods. Following this, homogeneous maintenance intervals and service plans can be set up, crucial for the cost efficient operation of a modern plant.

With a new optical O_2-analyser - the oxi::lyser – as well as a new Ammonium-Analyser - the ammo::lyser - s::can completes the range of intelligent, low maintenance sensors, and integrates them in an easy-to-use and cost-efficient digital environment.

A Full Range of New Sensors for OnLine Monitoring

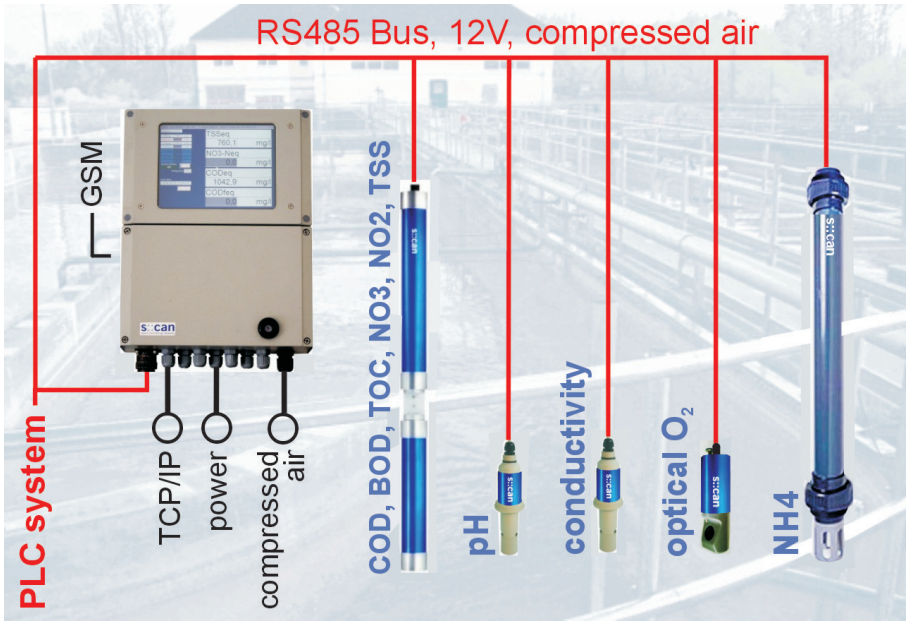

Figure 1: A full range of sensors

spectro::lysers are suitable for monitoring a wide range of waters from cleanest drinking waters to industrial process effluents. There are 3 housing materials available: A most resistive and light aluminium alloy, a bronze alloy for seawater and the stainless steel V4 / ISO1.4571 for industrial applications. The measured parameters are COD, COD-filtrated, BOD, TOC, DOC, UV-254, NO3, NO_2, TSS, Turbidity, Benzene, Toluene, Xylene, Phenol, many pesticides, and other chromophores, all based on the spectro-photometric principle by one measuring instrument.

NH4: The new ammo::lyser (see Figure 1) is based on a new potassium-compensated, ion-selective sensor, developed in co-operation with the Swiss specialist Nadler. The sensor has proven superior to all other ion selective NH4-sensors during 3 years of continuous measurements in sewage, activated sludge, effluents, rivers and fish farm, and was evaluated positively by several European Universities. Calibration is recommended twice per month, although there are examples of WWTP applications where it is only necessary twice per year; change of membrane is recommended for twice a year. Like all other s::can sensors, he ammo:lyser runs on 12V, RS485 protocol, compressed air or water cleaning and is fully integrated into the validated s::can software.

optical O_2: The new oxi::lyser (see Figure 1) measures the quenching of a fluorescing complex in a sol-gel matrix. In contrast to other equipment available on the market, the sensor works accurately even at O_2 levels below 0,1mg/l. Different to other optical O_2 sensors on the market, it is not damaged by exposure to sunlight, there is no regular calibration necessary and there is no need to replace the membrane every year, which reduces operational costs to almost zero. Routine sensor cleaning is typically not required, but the instrument can be directly plugged onto the s::can hydraulic cleaning system. The oxi::lyser is a smart sensor and is compatible with all types of s::can software and terminals and fully integrated into all s::can systems.

pH, conductivity and redox potential: Depending on the application, different high quality smart sensors are available from s::can for wastewater and for clean water applications. All of them are intelligent, fully integrated sensors, that can be equipped with compressed air or water cleaning if necessary.

Measurement Without Calibration

All s::can instruments except the NH4-sensor can be operated without initial calibration. New methods were developed by s::can together with University partners, allowing both to use the instrument in a very simple and robust "plug-and-play" modus ("Global Calibration"), but also to explore the full potential of UV-Vis chemometry, based on PCA/PLS analysis. (Lit.*)

- The unique concept of "Global Calibration" allows the measurement of chemical parameters like COD, NO_3 or O_2 for the first time without calibration.
- It was developed using thousands of spectra from thousands of samples, with s::can software tool based on PCA (Principal Component Analysis) and PLS (Partial Least Square Fit).
- There are pre-settings for many different applications and situations, to be defined with the order. Examples are: WWTP influent, WWTP effluent, WWTP aeration basin, river, ground water, paper mill, brewery, dairy, ...
- It allows simple plug-and-play use of most s::can instruments.
- If local calibration should be needed, it is done automatically while the instrument stays submersed in the water.

User Interfaces

User interfaces are available on several performance levels: With the new stainless steel "con::stat-III", s::can established a new standard for industrial process control terminals. Via a large colour display and a touch panel it allows menu-driven, user-friendly communication with all intelligent s::can sensors and basically any other digital (RS485) or 4-20 mA sensor of different make, as well as the operation of distributed systems, either via telephone, radio, GSM, or GPRS telemetry: all available in one terminal.

Recently, s::can has added another terminal to the range: The "con::lyte", a compact terminal for less demanding applications and smaller budgets, for the operation of up to 4 sensors. Thus, s::can now offers complete plug-and-measure, turnkey systems for every budget. All systems come factory-calibrated and often do not require any additional calibration for their lifetime. After easy installation, parameter concentrations from several probes are transmitted via 4-20 mA or RS485 to the PLC system, at measuring intervals of down to 15 sec.

Applications and Real Case Studies

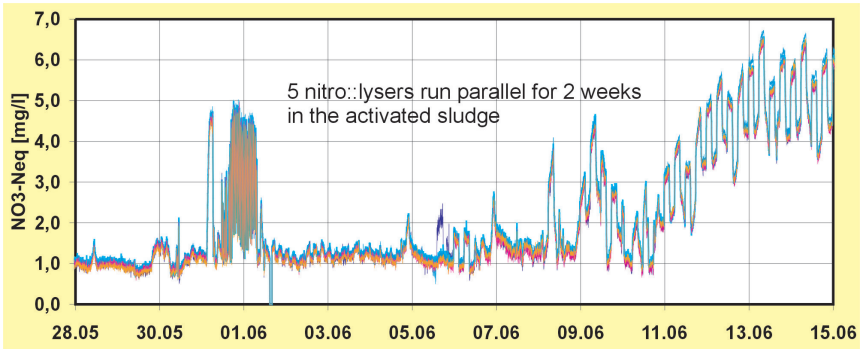

Figure 2: Result of comparability test

Waste Water Treatment Plant

The new wastewater plant of Vienna, Austria, is considered to be one of the most innovative and most efficient plants in Europe. The plant is capable to treat 4mio. inhabitant equivalents at a removal efficiency for BOD of 98%, and the second stage treatment facilitates the almost complete removal of Nitrogen. After 2 years of intensive tests, the plant managers selected s::can's instruments as being best suited for the control and monitoring of the plant, particularly superior as compared to conventional UV probes. 27 nitro::lysers and spectro::lysers now monitor the Nitrification/Denitrification process (NO_3 & TSS) and influent and effluent (COD, NO_3, TSS) for control of the plant. A special challenge in this project involved the spectral compensation of ferric oxides precipitating at the optical surfaces of the probes. Commission took place in June 2005 and included 8 instruments running in parallel over 2 weeks. All instruments showed identical concentration values respectively in nearly perfect accordance, and inter-instrumental comparability as well as accuracy were clearly within the specified limits (see Figure 2). In opposition to another recently introduced, more complicated spectrometer buoy, with s::can probes the speed and quality of the measurement is independent of the settling properties of sludge .

This success is a milestone for online sensors and further evidence for the suitability of on-line in-situ probes as an efficient means for the control and management of wastewater treatment plants (Lit*).

Papermill Norske Skog Bruck/Mur

Norske Skog Bruck/Mur is one of the largest paper mills in Austria, and well known for their innovative technology approach. Their location in a narrow Alpine valley does not allow the efficient enlargement of the local two-stage biological treatment plant. Thus the staff of the plant developed a new control strategy of nutrition dosage, aiming at the minimisation of Nitrogen discharge and at the same time the improvement of the efficiency of the plant. Measured Parameters are COD, TSS, and NO_3, by 3 spectro::lysers along the plant profile. The data are directly transmitted via a RS485 bus to the PLC system. Already at the end of the first year of operation under this new control strategy, the average yearly Nitrogen discharge was reduced by 20% and the dosage of urea-Nitrogen was reduced by 32% or more than 200 tons per year. Thus, the amortisation period of the investment was extremely short (Lit.*).

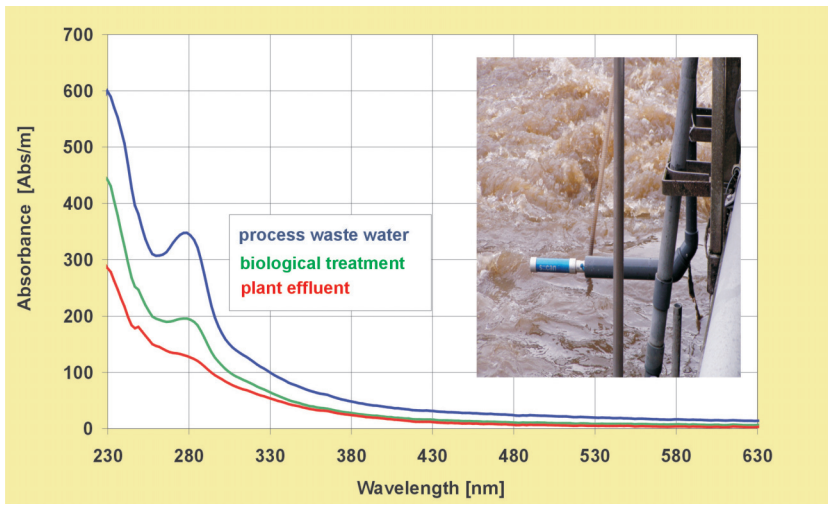

Figure 3: Control of a Paper Mill WWTP

Hydrocarbon Alarms for the Petrochemical Industry

The former Slovak state refinery, Slovnaft, has been investing strongly into the modernisation in an effort to elevate the efficiency of their water treatment plants to European environmental standards. After an intensive validation process, they have equipped several of their process- and plant effluents with s::can UV spectro::lysers in the beginning of 2005. The instruments are monitoring N.E.L. and Benzene concentrations at detection levels as low as 10 ppb, transmitting the data to a central station via GPRS. This most cost-efficient, low-maintenance and simultaneously sensitive method, allows Slovnaft to react to any kind of abnormal situation at the highest security level possible today, and in an early stage, thus preventing any kind of spill over to the environment . This success should encourage other European refineries toward equipping plants with s::can instrumentation for oil spill / hydrocarbon alarms.

SBR reactor

NH4 and O_2 were monitored simultaneously in an SBR reactor in Vienna, Austria. The sensors measured in-situ, directly in the reactor. NO_3, TSS and COD were monitored additionally by a spectro::lyser. The O_2-sensor did not require any cleaning or maintenance and was not connected to the cleaning system. 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 over 2 weeks. The correlation coefficients r^2 obtained for NH4-N and O_2 respectively were near to 1, in comparison with laboratory results. The measurements worked well at all solids concentrations.

Several characteristic points of an SBR cycle were monitored (see Figure 4). 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. By mounting the instrument at the flexible part of the decanter the amount of withdrawn water can be increased (Lit.*).

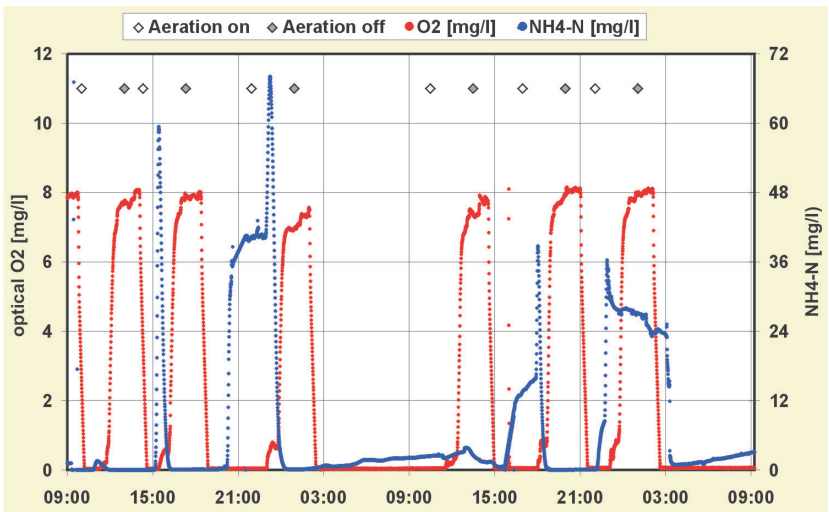

Figure 4: Measurement of NH4 and O_2 simultaneously in an SBR reactor

(Lit*) .... Please ask for our literature and reference lists on CD !