Monitoring the Quality of Industrial Waste Water

On-line Recognition of Product Losses and Irregularities in Processes

Water is used in practically every branch of industry, either as component of its products (food and beverage) or as an auxiliary agent, for example for cleaning or cooling. After usage, in most cases this water will have to be treated before it can be discharged into public sewer systems or surface waters. As the composition of the waste water changes with changing processes being operated in a plant, only online monitoring of the waste water can ensure optimal efficiency of the waste water treatment. Furthermore, an aspect that makes online spectrometry even more interesting for many industrial users is the fact, that the waste water composition can be often directly related to the performance of the industrial production processes themselves. Irregularities in the production processes, such as product losses, can be detected and characterised immediately, and countermeasures can be taken, thus reducing production costs.

Online Spectrometry in Industrial Waste Water

In order to meet the increasingly strict regulations regarding the quality of effluent of waste water treatment plants, the use of online monitoring systems is becoming more and more popular. The s::can spectro::lyser™, a compact and fully submersible UV/Vis spectrometer, is ideally suited for this type of application. It can monitor parameters such as nitrate, nitrite, total organics, total solids, colour as well as specific chemicals or product components in the areas of food, paper and petrochemical industry. The instrument monitoring these parameters simultaneously is available in stainless steel or other corrosion resistant housing materials and can be operated in explosive atmospheres (certified according to EN 60079). Long time stability and low maintenance are ensured by automatic cleaning via compressed air and operation without any need for chemicals, membranes, filters or moveable parts.

The most frequent application of the s::can spectrometer probe is surely the online monitoring of chemical oxygen demand (COD), total organic carbon (TOC) or biological oxygen demand (BOD). In these applications the s::can instrument replaces inefficient cabinet analysers. An impressive example of such an application are three spectrometer probes by the paper mill Norske Skog Bruck in Austria, used to control the dosing of urea into the influent of the waste water treatment plant. Already in the first year of operation the control system based on the online readings of s::can spectrometer probes was able to reduce the emission of nitrogen by 20% and at the same time the amount of urea used in waste water treatment was reduced by 32% (which equals 200 tonnes of urea).

Recognition of Product Components Losses and other Process Irregularities

The s::can spectro::lyser™ can provide much more information than just the monitoring of single parameters, such as the recognition of product components or operating fluids in industrial waters. The composition of industrial waste water always reflects the preceding production processes, and in many cases it can even be correlated with a single step in a process. This means that often the measured UV-Vis absorbance spectra (so called "fingerprint") provides information on the used production facilities and the fabricated products. In this way, s::can monitoring systems were able to detect product losses (e.g. in breweries), deviations in product quality (e.g. in fruit juices), product components (e.g. in dairies) and disturbances in processes (e.g. release of lubricants in a paper mill) by monitoring the quality of industrial waste water. In some cases this could even be linked to quantitative analysis, such as described in the examples below. The quick response that is facilitated by online detection of changes in processes has allowed many users to save substantial costs, and means that amortisation times can be as short as recognition and correction one single instance of product loss.

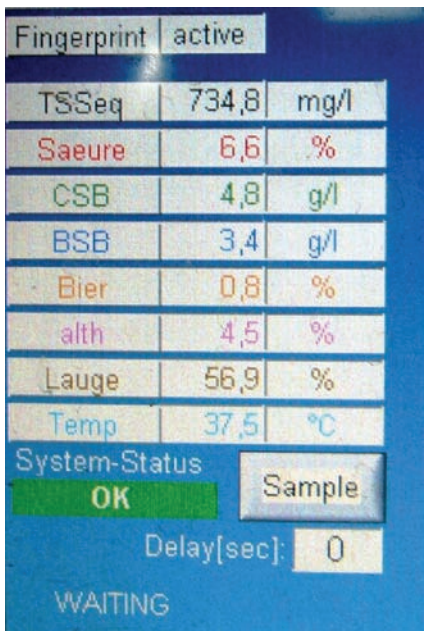

Figure 3: Parameters monitored by s::can spectro::lyser™ in brewery waste water

Brewery Waste Water - Status Monitoring of the Entire Process

During the production of beer, not only the final product, but also other media ranging from pure drinking water to cleaning agents can be found in the reactors. After each cleaning cycle it must be ensured that all reagents have been removed completely before the next production batch can be started. The s::can spectrometer probe has been used to verify this point in the process: In collaboration with the laboratory of a brewery it was possible to develop individual calibrations monitoring these important components in the effluent of the production process of beer. Not only the end of the cleaning cycle could be detected, but also two different states of the product (filtered and non-filtered beer)

Figure 1: s::can spectro::lyser™ in industrial waste water treatment plant.

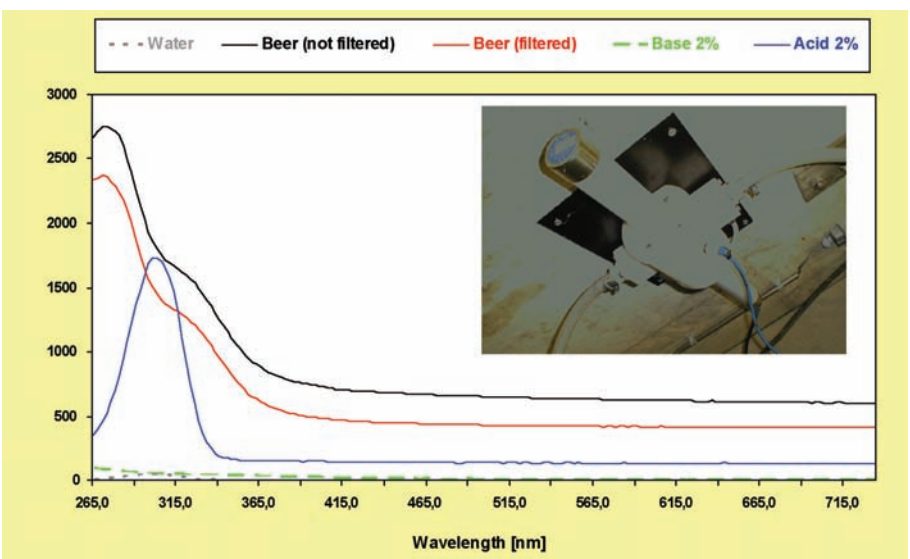

Figure 2: Absorbance spectra in brewery waste water (incl. s::can spectro::lyser™ in by-pass setup)

could be recognised in the waste water. This allowed the detection of leaks in the production process, as well as the determination of their source. Currently, s::can spectrometer probes are in use for this application by one of the largest brewery groups in Europe.

Using the absorbance spectra displayed in figure 2, a number of parameters can be calculated. An overview of the parameters actually monitored in an Austrian brewery is shown in figure 3, which is a screenshot of the operating software of the s::can spectrometer probe. With these parameters (total solids, acid, COD, BOD, beer, base, temperature), whose spectral algorithm were validated respectively developed by s::can Solutions in collaboration with the laboratory of this brewery, a very good picture of the current status of the process water can be obtained in real time, something that not only is of interest for the persons responsible for waste water treatment but also for the master brewer.

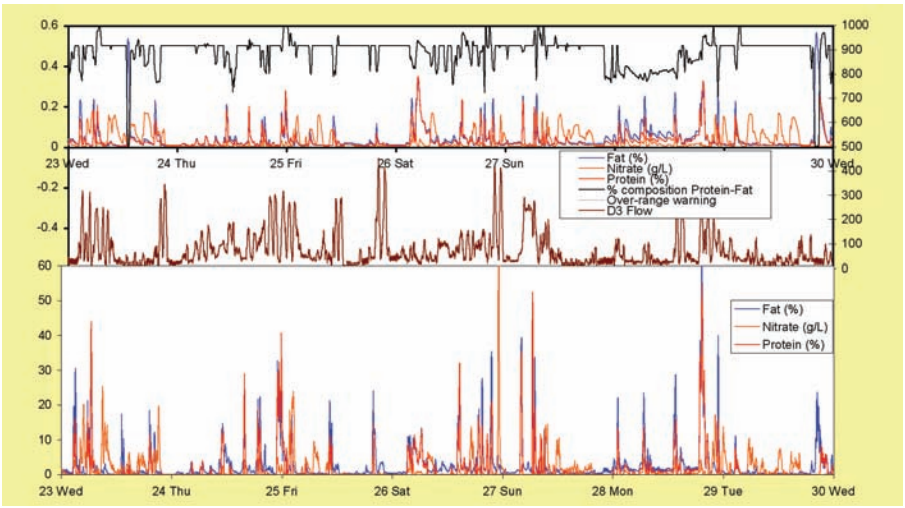

Figure 4: One week of online readings in dairy waste water (Fat, Nitrate, Protein, Flow & Protein/Fat ratio)

Dairy Waste Water - Recognition and Quantification of Product Components

From the waste water of dairy factories, just like in the above described brewery example, the actual status of the production process can be derived. Furthermore, next to the monitoring solids, COD and nitrate levels, important product components of milk such as fat and protein can be monitored online. This information is available directly from analysis of the fingerprints of the waste water. Analysing the fat/protein ratio present in the water in real time can be used for source determination of product losses. Detailed knowledge of the production process allows both optimisation of the production processes and the minimisation of product losses based on the online results of the s::can spectro::lyser™.

In similar applications, s::can spectrometer probes are used in meat processing factories, where, depending on the particular application, in addition to COD and total solids the recognition and quantification of protein, fat and blood can be performed.

Summary and outlook

In recent years, the use of s::can spectrometer probes in industrial waste waters has proven itself and has become a well established technique. The examples described above present only a small fraction of the possible applications of the spectro::lyser™. The introduced applications have already been used with numerous customers worldwide, amongst others in paper mills (AT, SLK, NO, CA), meat processing factories (AUS), breweries (NL, AT, HU) and dairy plants (D, CH, IRL, AUS, NZ). In many cases, the users have noticed themselves that UV-Vis spectrometry provides significantly more information compared to single parameter monitoring. Most of the industrial monitoring solutions described herein, as well as many more for other industries (e.g. petrochemical industry) can be provided as standardised products operated without initial calibration: s::can instruments can be used in a very simple yet robust "plug-and-play" modus ("Global Calibration"). Additionally the full exploration of the potential of UV-Vis by adjusting the instrument to local conditions can be provided by s::can Solutions: This service department offers the development of individual applications, allowing the identification and quantification of additional substances specific to the concrete needs of the user (e.g. in fine chemicals or pharmaceutical industry). s::can Solutions, as service department of the market leader in the field of online UV/Vis spectrometry, has all the necessary experience, access to measuring equipment from own production lines and last but not least the required experts to carry out such demanding projects in an economical way. The applications above are just some examples that show the potential behind online UV/Vis spectrometry.

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

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Fully Automatic Reducing Vaporisation Mercury Analyser

New NIC RA-3420 which completely automates wet chemical digestion and then the measurement of Mercury with ultra high sensitivity.

When it comes to Mercury analysis, over 60% of time is spent in sample preparation. On top of that, 65% of errors occur during this same stage. Now you can cut your time and errors by more than half with **Nippon's** (Japan) newest Mercury Analyser: the RA-3420.

Up to 100 samples can be processed in a single automatic run. Magnetic stirring keeps every sample perfectly homogenous. You can perform EPA digestions with programmable, self-optimising software. Patented Intelligent Light Sensing Technology continuously monitors the samples decomposing process.

The RA-3420 automates sample preparation eliminating the time-intensive process and potential errors from contamination, improper preparation or incomplete prep work. The process is simple, no babysitting the machine! All you have to do is load the samples. All the operation and liquid handling is controlled by computer.

On top of this the RA-3420 is highly sensitive, reading as low as parts per trillion (ppt).

There are many applications include Drinking Water and Waste Water as well as Sea, River, Lake and Marsh waters.

Submersible Level Transmitter for Waste-Water Applications

HORIBA Jobin Yvon (USA) is proud to introduce the M.A.S.T.E.R. and S.O.S. interactive tools to enhance the reliability of ICP-OES quantitative results.

These new interactive assistance tools emphasize the use of multi-line analysis in an ICP-OES system. The aim is to enhance reliability in quantitative analysis. The tools are used with the recently introduced CCD-based ICP system, the ACTIVA, and they take into account possible changes in matrix concentration and unexpected spectral interferences.

These new tools are:

The M.A.S.T.E.R.: Multi-line Analysis Selection Tools for Enhanced Reliability. Using a proprietary ICP-based spectra database containing not only wavelengths, but also limits of detection and line widths, the M.A.S.T.E.R. enables the user to easily perform multi-line selection with appropriate sensitivity and free of spectral interferences. The display of the selected analyte lines and their vicinity within the matrix environment makes possible a final validation. Moreover, because the display tool can also include blank spectra, it may be used to select adequate background corrections.

This tool, based on reconstituted spectra, basically reduces the need for the user to prepare various solutions and profile them. The S.O.S.: Statistical Outlier Survey. Once concentration measurements for each line have been obtained, an ANOVA-based statistical data processing tool is used to verify possible outliers providing a single reliable concentration result per element.

With these two major tools, the ACTIVA is able to take full benefit of its CCD detector by offering interactive assistance to the operator through multi-line analysis yielding the most accurate quantitative analysis results possible.