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Measuring technology for food safety and conservation of resources

INLINE PROCESS ANALYSES | Seli GmbH Automatisierungstechnik has been involved especially in optimisation of production processes for quite some time. With new developments, the company was able to contribute to conservation of resources and thus protect the environment. It is not necessary to initiate new projects worth millions all the time in order to make a contribution. In most instances, the existing structure of production processes has a lot of potential to bring about major outcomes with low investment.

IN THIS RESPECT, significant progress was made in developing new analysis tools. Updating cycles of conductivity and haze measuring devices could be reduced to a minimum, resulting in fast detection of changes in media and, based on that, rapid decisions in process plants. Depending on application, these two systems were able to optimise processes. Fast detection results in reduced losses of resources such as e.g. water/waste water, less product losses, energy and time savings, optimisation of cleaning cycles and, above all, ultrafast detection of contaminations and product ingress into heating and cooling circuits.

› Example 1: Inductive conductivity meter

Inductive conductivity meters are instruments for measuring electrical conductivity of liquids. This parameter is of interest in many applications such as environmental monitoring, water quality analyses, industrial process control of cleaning plants as well as phase separations, product definition, quantification and others.

Inductive conductivity meters are based on an induction principle to determine conductivity.

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Haze measurement is an ideal complement to conductivity measurement in many processes

The basic principle

When an electric voltage is applied to a liquid containing ions, these ions move due to their electric charge. In aqueous solutions, these are mainly dilute salts contributing ions. The more ions present, the better will the liquid conduct the stream, i.e. the higher the conductivity of the product.

Inductive conductivity meters use two coils as inductive devices to produce an alternating voltage in the medium. The ions in the medium have an influence on resistance and thus on the electrical current which flows through one of the coils and is transmitted.

The inductive device measures the change in electrical impedance (alternating current resistance) in the medium. This change is a measure of conductivity of the liquid.

The measured impedance is converted to s conductive reading and shown on the meter display.

This measurement method is intended to detect and react to a rapid change of conditions during a process. However, it is problematic that each medium in which conductivity is to be measured generally has a different temperature (temperature coefficient) and would thus falsify the measurement signal. Every conductivity meter thus has to be capable to detect such change in temperature and compensate for it by internal calculations.

Temperature coefficient of conductivity

The temperature coefficient of conductivity (also referred to as α or ασ) indicates the change in conductivity of a material as a function of temperature. As temperature has an influence on mobility of charge carriers, conductivity of a material may increase with rising temperature (positive temperature coefficient, this applies to many media) or go down (negative temperature coefficient).

By adjusting the so-called TK factor in the conductivity meter, this calculation is done internally and compensated for at the meter. Users of such meters naturally have to know this TK factor. Should it not be known, it has to be calculated and inputted in the conductivity meter.

This constitutes the major problem when using such meters. Most meters are installed in the plant and delivered ex works but the TK factor has not been adjusted for the respective product. The situation is confounded further when different products are used in the process. This situation would generally require a change for each individual product. Experience has shown that most users do not carry out these adjustments, sometimes because they are simply unaware of the necessity or, very frequently, because of excessive pressure of work during commissioning, laboratory measurements or calculations of the temperature coefficient of such conductivity meters.

The sensor can also be commissioned by untrained personnel

Development of the SLI04 conductivity meter followed another path. This meter does not require any laboratory analysis and calculation on the part of the user. The meter automatically detects changes in the process and, on this basis, calculates its user data.

As all calculations have to be done for each different product used, the meter is fitted with four channels each for a different product; the channels operate independently of each other.

Integrated multi-language operating instructions have been drawn up in order to facilitate operation of such demanding analytical devices for users. They can be called up by users via the operating display. Fast commissioning of devices on-site is thus possible without detailed knowledge.

The meters are also able to show and display concentration of a medium (e.g. HNO_3 in cleaning). This can be done in all four channels, independently of each other, for up to four different products. When suppliers of cleaning agents have provided a temperature table or concentration table, this can be easily read into the device. It is also possible to read in company-created laboratory data or, vice versa, read them out; this can be easily read into the device, using the free software SeliSoft that has additional advantages such as e.g. documentation of all data integrated in the device, live process observation, calibration, device inspection and documentation.

Measurement signals for conductivity, concentration and temperature are outputted as a 4-20mA signal. At the same time, all values are made available by the software at an integrated interface for documentation. An IO link interface is integrated in the meter as an additional digital link so that existing and also newer plants can be operated with this device.

The IO link interface has the advantage that all process data can be passed on to superimposed systems such as e.g. a PLC. Important settings already inputted such as e.g. TK compensation and all other device settings, are stored via the IO link master. Should the meter be replaced, all settings inputted for a particular process can be downloaded automatically to the new device without renewed parametrisation.

The overall concept makes it possible to cover practically all applications in the hygiene area of production in one device.

› Example 2: Haze meters

Haze meters are an ideal addition to the above-described conductivity meters in many processes. They are rapid and extremely precise measuring devices for product differentiation and qualification, they are installed in plants of beverage producers for all detection jobs in hazy media.

When controlling separators, it is possible to react immediately to the control configuration and qualified discarding of products via inline haze measurement. Time-based control is no longer necessary.

The system allows immediate intervention in case of particular product conditions and saving of time and money during monitoring and production.

Haze meters can also be used for rapid monitoring of contaminations in heating and cooling circuits and for direct filter monitoring. The physical characteristics of the meters make it possible to detect errors and react to them within fractions of a second. This also applies to monitoring cleaning processes. Haze measurement, in addition to conductivity measurement, is capable of monitoring contamination of returned media. This combination allows operators to control both concentration of cleaning agents as well as check whether the cleaning medium is unpolluted, with the objective of automatically monitoring dwell times and save cleaning agents and time. Haze meters, naturally, can be used for all yeast applications. It is important here that meters have a large dynamic range so that they can be used in applications with low and high haze conditions. This had hitherto not been the case with haze meters.

In developing novel technologies, new horizons were also explored.

An optical meter generally comprises the following elements:

- transmitter;
- receiver;
- electronic evaluation and calculation.

As far as technology is concerned, haze meters differ in terms of computing an angle of the transmitter and receiver system. Three different methods are available for determining, measuring and calculating hazes:

- The 180° or absorption method which can currently be used for medium hazes;
- the 90° method (or 90°/25°) suitable for low hazes;
- the backscatter method 360° for extreme hazes.

The development was aimed at integrating physical laws of optical systems in order to assure reproducibility and accuracy of measurement. This works only for the absorption method because light goes only in one direction and, thus, can be measured and evaluated during transmitting and receiving the light.

In other systems, the light is measured exclusively based on reflection or remission and is thus not reproducible. A change in particles and media measured will inevitably lead to a change in the measured value.

The new development largely eliminates the problem. At the same time, the meters reflect the state-of-the-art just as do the conductivity meters. ■