

Accurate pH-measurement with automatic electrode cleaning

SCA is a leading international manufacturer of tissue, fluff products, corrugated packing/ container board, publication papers, and wood products. The company is strategically organized into three business units: forest products, hygiene products, and packaging products. Packaging is a key growth area for SCA, with a targeted growth rate of 10 to 15% annually. SCA's state-of-the-art packaging plant located in Obbola, Sweden is continually being upgraded to position the company's operations ahead of other major international suppliers. A major renovation was undertaken in 1998 to rebuild the Obbola linerboard equipment, making it the widest linerboard machine in the world. Currently the Obbola facility produces 410 000 tons of pulp per year.

As part of its effort to remain a premiere competitor, the Obbola packaging plant also commissioned new in-line pH monitoring systems with automated cleaning features. As with the linerboard project, the goal of implementing new pH monitoring equipment was to maximize operating efficiency, increase yield, and eliminate downtime. In the headbox, just before the paper machine, the automated pH system is positioned where it continuously monitors pH status of the fibre suspension. The pH measuring system incorporates advanced integration technology, which facilitates real-time display of pH values in the central control room and fully automated integration with a pH buffering system. Controlling pH is arguably the most critical step at the wet-

end of the paper process because pH affects yield, quality, and durability of the final product. The Obbola plant leaves nothing to chance when pH is involved- especially since pH fluctuates rapidly in the headbox. The METTLER TOLEDO automated pH system triggers the addition of sulphuric acid when necessary to control pH, which in turn assures the needed hydrophobic properties and wet tensile strength of the paper. "We have operated the system since 1996 and the experiences have been good. The measurement environment is demanding; despite this, we haven't had any (function) interferences. The cleaning has been successful and the electrode has not been clogged. We do weekly controls and maintenance, that's all" says Bertil Edberg, responsible engineer at the Obbola facility.



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Automatic cleaning system

The automatic cleaning system of METTLER TOLEDO consists of:

- pH-transmitter 2500 with electronic control and multi-function LCD display panel
- cleaning armature, pH electrode, and retractable housing to automatically retract the electrode during cleaning

Electrode with Xerolyt® electrolyte

The difficulty associated with measuring pH in pulp and paper applications stems from a tendency for the pulp to coat the pH sensor and block the diaphragm within a short time. Active cleaning of the sensor is the only remedy for this situation and is required frequently.

Another issue to be addressed is the presence of sulphides, used as “cooking chemicals” during the pulp process. These ions combine with disassociated silver ions (Ag+) emanating from a silver wire located in the pH reference system of combination pH electrodes to form a non-soluble silver sulphide (Ag₂S) compound. Silver sulphide often clogs the ceramic diaphragm of conventional pH sensors. The Xerolyt electrode eliminates this problem completely by incorporating a patented reference system with a solid polymer electrolyte and an open junction (no diaphragm at all). This ensures accurate measurements and longer electrode life, thereby improving operating efficiency and reducing expense. The Xerolyt electrode features a pressure rating up to 8 bar (116 psi) at 130° C (266° F).

SCA Packaging in Obbola uses the automatic cleaning system to measure and control the pH value before the paper machine.



Made for demanding environments

The cleaning system from METTLER TOLEDO is specially designed for measurements in harsh environments. To guarantee simple and interference free operation, the pH systems chosen incorporate automatic cleaning. At pre-programmed intervals- in this case, twice per hour- the electrode is withdrawn and rinsed with warm water. Additionally, before the electrode is reinserted into the measurement position, it is controlled against a reference value to verify calibration. These simple-to-operate systems prevent clogging and provide a reliable acid dosage system to correct for pH fluctuations.

Normally pH is measured continuously to control sulphuric acid additions, but in extremely harsh and demanding environments the electrode can be retracted and kept in a “standby position” outside of the harsh process, then only inserted for measurements at specific intervals. Different functions can also be linked to the system. For example during a production break, the circulation pump driving the cleaning system is stopped so that the electrode automatically retracts into the standby position and is kept wet and ready to measure. ■

EasyClean – modularity reduces costs

EasyClean is able to carry out sensor maintenance such as cleaning and calibration fully autonomously. When developing the EasyClean Series, particular emphasis was placed on uniformity of system design and construction. The result is a high level of modularity. This allows subsequent upgrading of selected EasyClean models to a higher level with a minimum of effort.

EasyClean – sets new standards

A whole range of different maintenance procedures specific to the chemical process industry can be optimally performed by the EasyClean. During development work, particular attention was paid to being able to carry out subsequent on-site upgrading of individual models.

Flexibility of sensor maintenance

In conjunction with the METTLER TOLEDO Transmitter pH 2100 e, maintenance work can be fully automated. However, it is also possible to control the operations manually.

An integrated PLC serves to indicate on the display each ongoing working step as well as any functional problems within the system.

Safety

EasyClean carries out continuous system diagnostics. In the event of any functional defect the electrode remains inserted in the sample medium in order to ensure continued measurement of the parameter values.



Easy Clean 350
Fully automatic clearing and calibration of sensor.

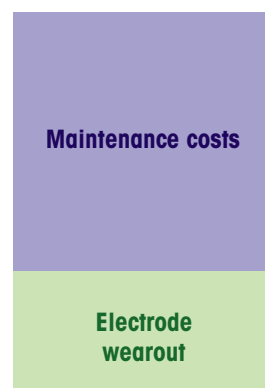
Cost reduction

The running costs of a measuring loop can be split up into the cost of labor and the cost of material. EasyClean systems bring about a steep reduction in manpower costs, and due to prolonged life of the sensor, decline in material costs at the same time. The diagram will assist you in establishing your individual savings potential.

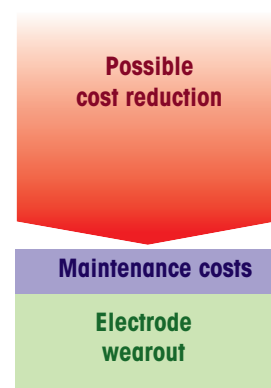
Calculate your running costs for service and maintenance of a measuring point		
	without EasyClean	with EasyClean
a Purchase price of electrode	300 US\$	300 US\$
b Life of electrode (mths.)	2	3
c Servicing effort (h/week)	2	0.2
d Cost of labor (US\$/h)	50 US\$	50 US\$
Calculation: $\frac{a \times 12}{b} + c \times d \times 52 =$	7000 US\$	1720 US\$*

* annual costs for a loop with high maintenance efforts

Without EasyClean

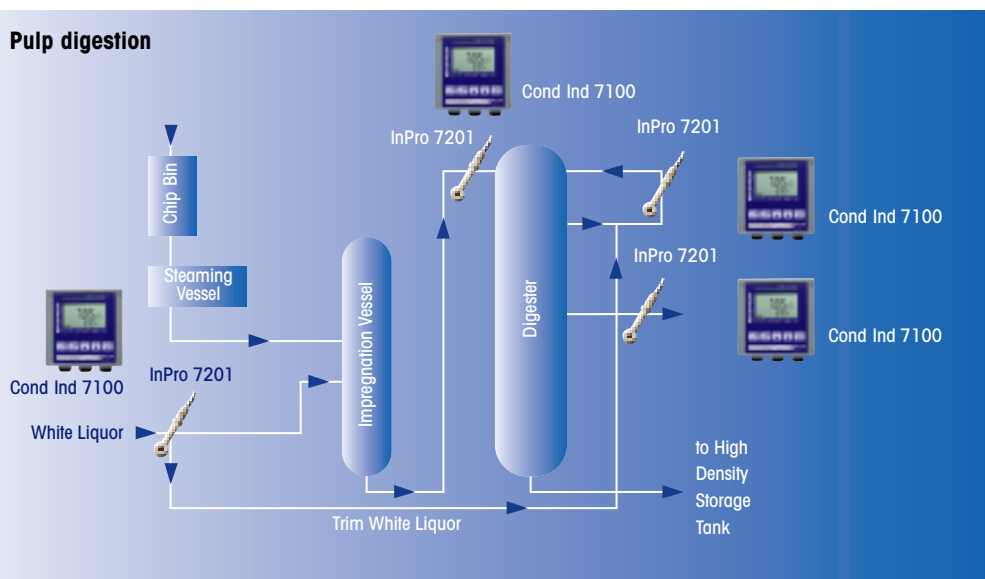


With EasyClean



Conductivity measurement in the pulp digestion

Pulp digestion



Paper is made from wood fibers soaked in solution – commonly known as pulp. Pulp, or chemical pulp to be more specific, is simply made by cooking wood chips in strong chemical solutions, mostly alkaline in nature. At elevated temperatures and pressures, the wood decomposes into cellulose fibers. This type of pulping is often referred to as the Kraft process and is carried out using strong solutions (10 to 15%) of NaOH, Na₂S, and Na₂CO₃. The process takes place in a digester at temperatures in the range of 170 °C/338 °F, or higher, and pressures between 5 and 8 bars. The resulting solutions are called liquors:

- White liquor in the beginning, when the solution is fresh and unused.
- Black liquor when the solution has been in the digester, and contains the wood chip residue.

The initial strength of the white liquor is important, as well as the residual alkali strength of the liquor in the digester. During the cooking process the strength of the liquor changes depending on the wood species, wood moisture and other factors. The “effective alkali” is the parameter that indicates whether the liquor is still strong enough to decompose wood at a reasonable rate. “Effective alkali” is defined as NaOH + 1/2 Na₂S (g/l). White liquor strength can be determined in the lab by means of analytical chemistry, but the results are usually

too late to be useful for on-line process control. Conductivity does not specifically measure any single ion, therefore, it will only indicate the conductivity of the sum of all ions. However, since NaOH and Na₂S are many times more conductive than the rest of the ions, conductivity will be representative of the effective alkali concentration. More important, compared to analytical lab methods, in-line measurement has the advantage of delivering real-time readings, which are essential for process control and could not be achieved by any other means.

Application challenges

The chemical and mechanical aggressiveness of the liquor, in conjunction with temperature and pressure ratings, makes this an application where wetted materials and installation design play a critical role. In addition, users must be able to correlate the conductivity data to effective alkali. More specifically an operator should have empirical data that allow him to compare the conductivity with lab data for the effective alkali. Once a correlation is established – conductivity can be used to control the process, and the lab data can be used to adjust the correlation.

Recommended system

The best solution for the above application is an inductive conductivity sensor. (i.e., InPro7201) Using an inductive sensor places no electrodes directly in contact with the process, and therefore reduces

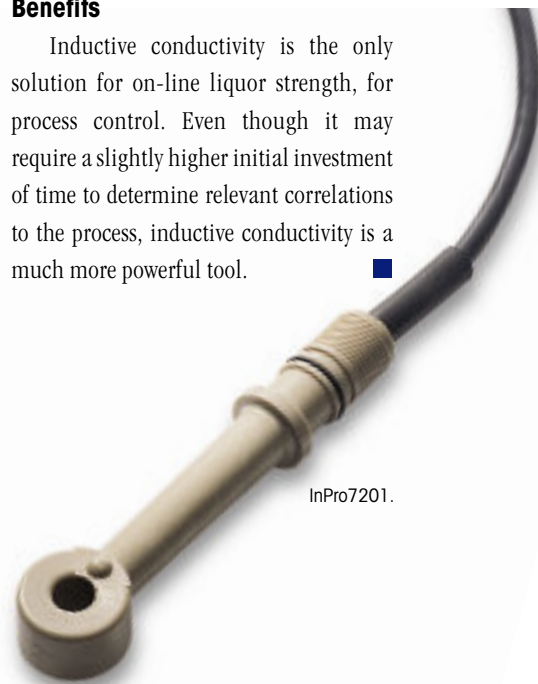
contamination risks. The best wetted material for very harsh alkali applications is PEEK, which can be used continuously at full temperature and pressure conditions. PEEK sensors require little maintenance; however, such harsh and challenging conditions are best managed with an organized inspection routine. Even though the sensor is not affected by contamination, and a plugged sensor will continue to function, the sample directly in contact with the sensor may not be representative of the actual liquor in the digester. This is also true for a bypass, which makes inspection easi-

er but is more prone to blockage. Installation in the upper or lower recirculation line, or in a bypass is most likely the best placement. The METTLER TOLEDO Cond Ind 7100 e series transmitter is an ideal choice for completing the system because of its simple operation, precision, reliability, and low cost of ownership.

The unique user interface (pictographs) and continuous transmitter and sensor diagnostics, make the Cond Ind 7100 e an excellent transmitter unit for all process applications.

Benefits

Inductive conductivity is the only solution for on-line liquor strength, for process control. Even though it may require a slightly higher initial investment of time to determine relevant correlations to the process, inductive conductivity is a much more powerful tool. ■



InPro7201.

Conductivity and pH transmitters with PROFIBUS PA interface

Communication systems in the field of (process) analytical measurement are moving more and more towards the use of digital technology. The advantages over conventional analog data transfer via 0/4...20 mA lie mainly in the ability, along with the actual measurement signal itself, to exchange additional information between the process control system (PCS) and the analytical measurement device on a two-way communication basis.

For some years, METTLER TOLEDO has been offering transmitters with HART® Communication which superimposes a digital signal on the customary 4...20 mA DC analog signal. This enables the transfer of additional information than just a measurement signal.

From now on, transmitter units are also available which incorporate a fully digital PROFIBUS PA interface according to the "Profile for Analytical Devices, Version 3", suitable for measurement of electrolytic conductivity (conductive and inductive) and pH value.

Simple connection to the PCS through Plug & Play

Connection to the PROFIBUS DP level is possible either by direct linkage or through a segment coupler. The maximum bit rate of 12 Mbits/s on the DP lane is thereby preserved. The instrument interface employs the FISCO model to ensure intrinsically safe networks. The existing well-proven functions such as automatic calibration (Calimatic®), sensor diagnostics (SensoCheck®) and parameterization can be accessed via the PCS just as easily and comfortably as before. ■



Wastewater monitoring: efficiently and economically

METTLER TOLEDO offers a complete selection of measuring systems especially for monitoring industrial and municipal wastewater, as well as for wastewater treatment. They can be used to measure pH values, redox potential, electrolytic conductivity and oxygen content.

Value Line

Economical transmitters

These devices are easy to use and offer in addition to basic functions:

- automatic calibration
- temperature compensation
- controller function
- 2 current outputs for signal processing
- 2 limit contacts
- alarm and wash contacts

Mounting can be either directly into a control panel cutout or in an optional stand-alone enclosure, as required.

It's the sensor that matters

INGOLD electrodes from METTLER TOLEDO are renowned for their long service life and reliability. For more than 40 years they have been used successfully in demanding biotechnology and chemistry applications. Value Line sensors, which have been developed specifically for

wastewater applications, offer many of the advantages of process sensors, at low cost.

The InPro 4010 pH electrode has a special polymer electrolyte that ensures its non-susceptibility to contamination even in heavily polluted wastewater. A Pt100 or Pt1000 is incorporated for automatic temperature compensation. The InPro 6050 oxygen sensor needs very little maintenance, is easy to service and has a long service life. Owing to the polarographic principle of measurement, the sensor is virtually independent of the flow.

Numerous options are available for process adaption of the sensors: immersion, insertion and flow-through housings as well as retractable housings. In conjunction with the EasyClean series of control systems, the sensors can be flushed, cleaned and calibrated automatically in-line where required. This keeps maintenance efforts to a minimum, while measurement accuracy and service life of the sensors is optimized. ■



Value Line transmitter for wastewater control and treatment.



Oxygen sensor InPro6050.



pH electrode InPro4500.



pH electrode InPro4010.

pH electrode for media containing fibers and particles

In the past, continuous measurement of the pH values in media containing fibers and particles was often impaired by the tendency of such solid matter to adhere to the glass membrane of the sensor. Calling upon its experienced engineering staff, METTLER TOLEDO Ingold designed a pH sensor which addressed the traditional limitations of sensors in fibrous media and other demanding pH applications. The result is the InPro4801SG, designed and manufactured specifically for industrial process market.

Resistant to fouling

The most common problem faced during pH measurement, is fouling of the diaphragm. For this reason, the InPro® 4801SG has a circular PTFE diaphragm which exploits the dirt-repelling features of Teflon®. To eliminate fibers from accumulating around the glass membrane of the electrode, the usual cylindrical or spherical bulb shape has been converted to a flat membrane for the InPro4801SG.

Integrated solution ground

Poorly earthed media, like reactor vessels and pipes made of plastic, often negatively influence pH measurement results. The easiest and most effective remedy is to incorporate an earthing pin in the loop, a so-called solution ground (SG). The InPro 4801SG has an integral solution ground, eliminating the challenges associated with loose wires and other ad-hoc grounding

efforts. The InPro4801SG incorporates an ancillary electrode made of titanium, commonly referred to as a “guard ring”.

Automatic temperature compensation

The built-in temperature sensor (Pt100 or Pt1000) guarantees correct results under all operating conditions. The influence of the temperature-dependent electrode slope is compensated according to the Nernst equation and rapid response is achieved by strategically locating the sensor directly behind the glass membrane of the electrode. Parallel monitoring of process temperature and pH is then possible from a single sensor.

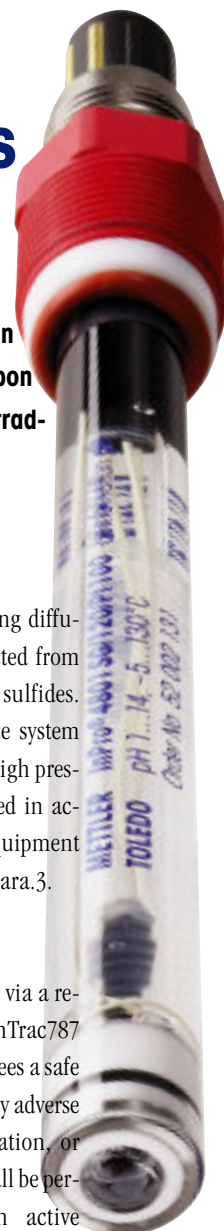
High durability

The maintenance-free reference system, based on a gel electrolyte, is highly resistant to oxidizing media and to strong acidic or alkaline solutions as well. Be-

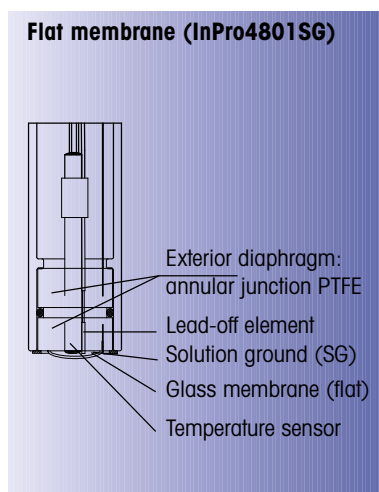
cause of a purposely designed long diffusion path, the electrode is protected from typical electrolyte poisons, like sulfides. A pressure-compensated reference system allows operation at particularly high pressures and the electrode is certified in accordance with the pressure equipment directive PED 97/23/EEC, Art.3, Para.3.

Safe process connection

Connecting the InPro4801SG via a retractable housing, such as the InTrac787 (Hot Tap) with ball valve guarantees a safe connection even under particularly adverse conditions. Maintenance, calibration, or replacement of the electrode can all be performed without disturbing an active process when the Hot Tap housing is in place. Certification according to ATEX 100a permits use in hazardous areas, Zones 2, 1 and 0. ■



Specification	InPro4801SG
pH range	1...14
Temperature range	-5...130 °C, 23...266 °F
Pressure range	1...13 bar, 14...188 psi
Temperature sensor	Pt100 or Pt1000
Ancillary electrode (solution ground SG)	titanium ring
Connector	VarioPin VP (IP68)
Overall length	120 mm
Use in hazardous areas	Zones, 2, 1 and 0
Certification	PED 97/23/EEC, Art.3, Para.3
	Ex II 1/2G EEx ia IIC T6/T5/T4



Regular maintenance increases safety and avoids production failures

O-rings have the important task of sealing moving parts such as sensors and housings in order to prevent the escape of medium. Mechanical and chemical stress effects in everyday production are so great, that O-rings should be replaced at regular intervals.

Mechanical stress intensifies in relation to the increase in solids content. The degree of chemical resistance depends upon the material composition of the O-ring, and is already commonly known for many chemicals. The most important specifications of the materials of the O-rings supplied by METTLER TOLEDO can be seen in the table below.

Due to the chemical and mechanical strain placed on O-rings in the industry, METTLER TOLEDO recommends that the O-rings are replaced at least once a year.

It is advisable to carry out replacement work 4 to 8 weeks before the start of the campaign.

O-rings can be replaced on site or at METTLER TOLEDO Service Center. Qualified service technicians carry out replacement according to the manufacturers' instructions and test and verify the operation of each retractable housing. If O-ring replacement is performed at a METTLER TOLEDO Service Center, the retractable housing is also subjected to a pressure test.

O-Ring-Material	Characteristics
Viton®	Well suited for use with many chemical liquids, particularly combustible products and fuels; not suitable for use in hot CIP alkaline solutions; high thermal stability
EPDM	Well suited for CIP operations in acids and leaches; moderate thermal stability
Silicone	Well suited for fats and oils, low thermal stability
Kalrez®	Chemical resistance, rubber-like elasticity of elastomers; high thermal stability

Mettler-Toledo GmbH
Process Analytics
Im Hackacker 15
CH-8902 Urdorf
Switzerland

INGOLD

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www.mtpro.com