GLASS LINED

Long-lasting pH probes in the food industry

The pH value is one of the most important and commonly measured values in many fields of process engineering. The stability of the entire production process can be increased by regulating the pH value in a targeted way. In food production, the pH value is also an important indicator of consistent quality, taste and reproducibility in a product, and a significant variable during and after cleaning of the production facilities. Thanks to their maintenance-free operation and long service lives, robust glass lined pH probes are a cost-effective option for constant use in the food industry.

The use of glass electrodes has certain disadvantages, such as short calibration intervals, drifting, high vulnerability during CIP and short service lives. Even the most up-to-date transmitters cannot fully compensate these disadvantages. Moreover, pH probes are subject to various mechanical stresses: flow rates and turbulences, pressures and pressure shocks, abrasion and contamination. Glass lined pH probes meet the mechanical requirements and ensure safe and cost-effective production.

Steel probe body

The glass lined pH probe comprises a steel probe body with a highly-resistant, anti-adhesive technical glass lining to protect the surface in contact with the product. This makes the probe resistant to mechanical strain by flows, pressure, abrasion and vibrations. Probes can therefore be installed in piping and vessels where they are directly exposed to the flow, enabling direct continuous online measurement in the main product stream.

Moreover, the smooth surface of the glass lining helps the probe protect it against corrosion and product build-up. Combined with a pressurized electrolyte system, these properties allow the probe to be installed in any position and direction, so the pH sensor can be installed directly at the point of use.

Reliable prevention of broken glass in the product is another vital consideration when glass lined pH measurement probes are used in food production.

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pH probe "Reiner" with adapter (Photos: © Pfaudler)

The pH measurement principle

pH determination is a potentiometric (electrochemical) analysis method. A typical measuring setup comprises two electrodes – a measuring electrode immersed in a process medium and a reference electrode immersed in an electrolyte liquid. The measuring electrode generates a potential that clearly identifies the chemical condition (hydrogen ion concentration) of the medium to be measured.

The reference electrode provides a constant known potential that is independent of the composition of the process medium. A transmitter connected to the pH measuring probe calculates the medium's pH value from the difference in potential between the two electrodes, depending on the measured temperature.

No ageing

The measuring electrode is fused with an insulated layer of ion-sensitive glass lining and directly connected to the metallic potential

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discharge line. Unlike in glass electrodes, there is no internal buffer (discharge electrode). In contrast to conventional glass electrodes, the ion-sensitive glass area is only in contact with the process medium on one side. This prevents ageing and drift of the pH sensor.

For absolute pH measurement, the reference electrode is installed either in the electrolyte vessel or in the sensor, depending on the sensor type. In all absolute measurement probes, the electrolytic connection between the reference electrode and the product to be measured is made through a ground-joint diaphragm. The electrolyte is in a separate, insulated pressure vessel connected to the sensor by a plastic hose.

The internal pressure of the electrolyte system is higher than the operating pressure to prevent the measured medium from penetrating the diaphragm zone. This means that the reference electrode cannot be poisoned, making the pH measurement significantly more reliable and increasing the probe‘s service life. All Pfaudler pH probes use automatic temperature compensation of the measured value, with an integrated Pt-100 or Pt-1000 measuring the temperature.

Simple design of differential probes

Differential pH probes provide values measured against a product-dependent reference parameter. The measured value is therefore a product-specific value (relative pH measurement) that allows a statement as to whether a process is performed according to defined specifications. This measured value is therefore ideal for controlling and monitoring recurring batch processes (e. g. formulations without changes) or continuous measurement in fermentation tanks, wort boilers, waste water treatment or monitoring of filling plants.

Differential pH probes are simple in structure: two ion-sensitive enamels are fused onto a steel probe carrier and form the measuring part of the sensor. One sensor surface responds to H^+ ions and provides a potential that depends only on the pH value; this is called the pH glass. The other sensor surface – the reference glass or reference electrode – responds to the salts dissolved in the liquid, especially the Na^+ ions present, and thus provides a product-specific reference potential.

Once the transmitter has been configured with data from the measurement and test report provided, the pH differential probe

pH ring probe 03N

is calibrated in its installed position using a product sample. The probe then works like a "normal" pH measurement device in the specified range. The special relative measurement principle means that the probe functions without an electrolytic liquid. This eliminates the risk of the product being contaminated by the electrolyte and ensures practically maintenance-free operation (no refilling of electrolyte).

Easy to clean

pH measurement methods using glass electrodes require the electrodes to be removed from the process for CIP or periodic calibration – often requiring the use of sophisticated and expensive retractable assemblies. Thanks to their smooth surface, glass lined pH probes are easy to clean and can remain in the plant for CIP and SIP. A chemical attack rarely occurs in such cleaning processes. The following CIP procedures are permitted for glass lined measuring probes:

– 1.5 to 2 % sodium hydroxide (NaOH), max. 85 °C, max. 1 h
– 1.5 to 2 % nitric acid (HNO_3), max. 60 °C, max. 15 min
– 1.5 to 2 % phosphoric acid (H_3PO_4), max. 85 °C, max. 1 h
– Steam at 134 °C, max. 2 h.

Depending on the CIP method used, it can take a few minutes or even several hours to compensate for the offset caused by cleaning. This compensation period can be shortened to less than ten minutes, if the glass lined sensor is regenerated with hot water or steam (>80 °C). In contrast, conventional glass electrodes usually need to be recalibrated after each sterilization process, and replaced after a number of cycles.

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If these specifications are observed, a service life of more than 1000 CIP processes is possible in normal food industry processes. In comparison, glass electrodes achieve 50 CIP processes at most. Moreover, the calibration values (e. g. gradient) of calibrated measuring probes remain constant over the entire lifetime, i. e. the probe does not age. Regular recalibration is therefore unnecessary. The result is significantly higher plant availability, and therefore enhanced productivity and cost-effectiveness.

Dry storage possible

Glass probes normally have to be kept from drying out, because this would damage them. As a result, care must be taken to prevent the glass probe from running dry during the production process or after CIP cleaning. Glass lined measurement probes can be stored dry for any length of time without problems. Once dried, the pH probe merely needs a certain recovery time before the sensitive glass layer can perform stable measurement again. □

Glass lined probes – the facts

– Can be cleaned / sterilized while mounted (CIP / SIP capable)
– Hygienic design (EHEDG approved)
– Constant measuring accuracy over the entire service life
– Very low maintenance costs, as practically no need for calibration
– No retractable assembly required
– Protected against glass breakage in product
– No product build-up thanks to smooth glass lined surfaces
– Robust against mechanical impacts
– Resistant to acids and organic solvents
– Not sensitive to oils and greases
– Resistant to pressure pulses
– No hysteresis during temperature changes
– Shockproof up to 1h at max. 120 °C
– Can be used with high flow rates
– Can be stored dry for any length of time.