Process Controls SalesNet
pH Applications

pH Measurement in Fermenters and Bioreactors

Non-glass pH electrode capabilities

- Reliable Durafet® solid state pH electrode withstands repeated steam sterilization
- Ion-Sensitive Field Effect Transistor (ISFET) sensor eliminates fragile glass membrane
- Fast, 1-second response is typical
- Durafet electrodes can be retrofit to existing electrode mountings
- Measures accurately with no sodium or ORP interference

Background
pH measurement and control are essential in microbial fermentation, enzyme production and cell culture for pharmaceutical and other products. This type of production is obtained through the growth of a selected strain of microorganisms in fermenters and bioreactors. The close control of temperature, pH and other parameters is essential for optimum growth.

The vessel is prepared for production by heat sterilization to destroy any unwanted microbes. For small research sized fermenters, the entire vessel and accessories are placed in an autoclave. For the larger production size fermenters, provision is made for in situ sterilization, filling the vessel with pressurized steam. Sterilization must develop temperatures at least to 121°C for a period of 20 to 30 minutes. pH electrodes must withstand the high temperatures and provide reliable performance during the batch production, which typically lasts a few days.

Continuous culture in a bioreactor is a newer and growing technology which meters in sterile media and harvests product on a continuous basis. Here, a production run may last several months and long term stable pH measurement is even more critical. Both research and production sized bioreactors for continuous culture depend on this long term performance.

Verification of electrode operation and initial calibration are accomplished by measuring standard buffer solutions before electrode installation and sterilization. Final calibration is usually based on an external measurement of a sample of the media. The on-line pH value is used to control reagent addition to balance the tendencies of microorganism growth to alter the pH. Carbon dioxide is usually added to lower pH and sodium bicarbonate is typically added to raise it. Precise pH control is essential to maximizing growth.

pH electrode requirements
pH electrodes must stand up to sterilization and provide consistent measurement during the production run. The high temperatures of repeated steam sterilization cause gradual

degradation of glass membrane pH response. It can even cause catastrophic failure if the high impedance insulation of the electrode loses integrity. Redundant pH electrodes are frequently installed for these reasons.

Reliable Durafet pH electrodes provide 21st century solutions - today

The non-glass Durafet electrode is a major improvement in the reliability of pH measurement in sterilizable applications. Based on new ion-sensitive field effect transistor technology, it eliminates the fragile glass membrane and the associated risk of breakage. Such breakage results in glass and electrolyte contamination of product and extensive downtime.

Durafet electrode response is less affected by repeated sterilization. Further, it eliminates the high impedance circuitry and vulnerability to insulation breakdown of glass membrane electrode signals. Durafet electrodes have no ORP interference or sodium ion error and have exceptionally fast pH response – typically within 1 second. Whether in the large production vessels or in small bench top units, Durafet electrodes generally out-perform glass electrodes.

Longer life of the solid state pH sensor is complemented by a reference electrode section with replaceable junction and gel electrolyte. No pressurization of the reference electrode is required. The probe also includes an integral temperature compensator to provide a compensated pH signal compatible with a variety of instrumentation.

Durafet electrodes can be retrofitted into a variety of standard 19 and 25 mm fittings including sanitary designs. They are compatible with the full line of Honeywell analyzers and two-wire transmitters. In addition, adapter modules are available to electronically interface the Durafet electrode to existing analyzers of nearly any manufacture.

A simple solution

Tomorrow's standards that Honeywell is setting today include:

- Solid-state ISFET sensor is virtually unbreakable.
- No sodium ion error or ORP interference.
- Replaceable reference junction gel reducing maintenance costs and increasing electrode life.
- Built-in counter electrode increasing measurement stability.
- Designed to meet sanitary standards for the food and dairy industry.
- Easy retrofits to existing systems, because it works with almost any analyzer.
- Complete selection of housings for insertion or sanitary mounting.

The sterilizable Durafet electrode is another example of Honeywell's powerful technology giving you a simple solution that increases productivity, ensures product quality, saves time, and increases process profitability.

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