

DELTA F CORPORATION

APPLICATION NOTE NO.

110



Measuring Oxygen in a Curing Oven

Certain curing applications require low levels of oxygen. Excess oxygen can ruin the coating of a product and, thus, the product itself. Monitoring oxygen can produce higher yield and improved product quality.

The Role of Oxygen Analyzers

Curing applications vary greatly from silicon coatings on fibers to urethane coatings on wood. While all coatings do not have to be cured in an oxygen free environment, there are many where it is the critical step between producing quality product and scrap. There are two common curing methods, ultraviolet (UV) and electron beam (EB).

In a curing oven, a product coated with a mixture of oligomers and monomers is passed under a UV light or an electron beam. The UV light or EB is a radiant energy source which expedites the curing or hardening of the coating to the substrate by imparting energy to the atoms to promote reactivity in the coating. By using UV or EB curing, more product can be made because of reduced drying times. On the other hand, in oxygen sensitive processes, excessive product loss can result from poor or uncontrolled purging.

In processes sensitive to oxygen, the coating may become uneven or discolored due to contamination. A continuous measurement of the oxygen content can help to prevent this.

Conventional Approaches to Monitoring Oxygen

The galvanic oxygen sensor technology uses two dissimilar metal electrodes, typically silver and lead, which are consumed in the process of measuring O₂. The sensors have a relatively short life span of several months because:

- The lead anode is consumed
- The silver cathode is attacked by acid gases
- The electrolyte is sensitive to off-gas vapor contamination

The galvanic sensors operate on a battery principle where the life expectancy is a function of usage. They will eventually read low due to a loss in sensitivity as electrode sites are depleted. Analyzers with replaceable battery-type galvanic sensors must also be recalibrated on a frequent basis because the silver cathode is poisoned by ppb level acid gases. These trace contaminants oxidize the sites of the silver cathode and periodic sensor replacements are required. If analyzer calibration is not done frequently, the sensor can read falsely low resulting in poor quality or scrap product.

The depleting, battery-type sensors are covered by a permeable membrane which separates the gas sample from the electrolyte and allows the oxygen ions to migrate into solution. If the sensor is exposed to an over-range condition, the membrane will saturate with oxygen from ambient air and it can take hours to return to PPM levels.

The Delta F Difference

Delta F has solved the problems associated with fuel cell based oxygen analyzers with its unique non-depleting coulometric sensor that has carbon electrodes which never under-go chemical change. The Delta F sensor provides unmatched performance features such as:

- Extremely Stable, Long-term, Drift-Free Operation
- No False Low Readings
- 5-Year Sensor Warranty
- Factory Calibrated to NIST Traceable Standards
- Acid Gas Operation with STAB-EL™ Option
- Quick Start-up and Rapid Response
- Immunity to O₂ Shock

Unlike other types of sensors, the Delta F sensor does not require periodic replacement and does not produce false low readings due to loss of measurement sensitivity or reaction with sample gas components. The sensors operate on a simple coulometric process whereby oxygen in the sample gas is reduced at the cathode to hydroxyl ions. Assisted by the potassium hydroxide electrolyte, the ions migrate to the anode, where they are oxidized back to oxygen which vents out the sensor. Whereas conventional electrochemical sensors use a consumable lead anode and a silver cathode. The

Delta F electrodes are made of carbon and are non-depleting, i.e. neither electrode under-goes chemical changes.

As a result, much better measurement stability is achieved and the need for periodic sensor replacement is eliminated. In contrast to galvanic sensors which require frequent calibrations, the Delta F sensor may only require semi-annual span checks, not recalibrations, and addition of water. The fast speed of response of the Delta F sensor gives immediate indication of changes in the oxygen level whether they are caused by an ambient air leak or by an incorrect nitrogen purge rate.

Delta F's STAB-EL™ option is available to protect the analyzer from the harmful effects of trace acid gas contaminants. The STAB-EL™ option counteracts electrolyte contamination and the carbon electrodes are highly resistant to acid gas poisoning.

Delta F Analyzers

Delta F offers a full line of analyzers to meet your needs. There are complete analyzers and OEM versions for customer integration. Analog outputs, adjustable setpoints with relays, and RS232 or RS485 outputs are available to interface with your computer system to allow you to control alarms or purge flow. Delta F custom configures analyzers to meet each customers' requirements.

Recognized For Quality

Delta F's R&D, Manufacturing, and Customer Support functions are certified to ISO-9001 by Lloyd's Register Quality Assurance Ltd. This demonstrated compliance with an internationally accepted standard assures you of the highest quality in product design, manufacturing, and service.

Delta F Oxygen Analyzers can be ordered with a full scale range of 0-2 parts per billion (ppb) to as high as 0-25 percent. For specific product recommendations, contact Delta F Corporation, 4 Constitution Way, Woburn, MA 01801-1087, Tel. (781)935-4600, FAX (781)938-0531, e-mail marketing@delta-f.com.