

In Situ O₂ Measurement Ensures Product Quality in Annealing Processes

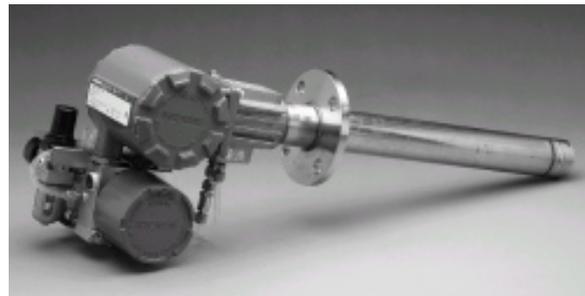


Cold rolled metal products must be annealed after rolling to eliminate work stresses induced by the rolling process. Usually some amount of “grain growth” is caused by the rolling process, depending on the amount of cross-sectional reduction accomplished. Various furnace types are utilized to execute the annealing process, which raises the metal temperature to a point where the crystalline structure is returned to normal.

It is important to prevent oxidization of the rolled metal during the annealing process so that final product quality is not compromised. An in situ O₂ probe placed in the furnace provides an accurate method of controlling the furnace atmosphere to a preset level, usually .05% to .1% O₂. Electric- or indirect-fired furnaces may vary nitrogen flow rates to maintain a preset O₂ level and direct-fired furnaces may adjust fuel/air ratio with the same goal of maintaining a very low O₂ atmosphere.

The zirconium oxide O₂ sensor is ideal for this application for the following reasons:

- Sensor output is inverse, and logarithmic, per the Nernst equation¹, yielding an accuracy of ± 0.75% of reading, or ± 0.05% O₂. Accuracy actually increases at the lower O₂ levels maintained in the annealing process.
- The sensor operates well at high furnace temperatures.
- Sensor stability is very good. A “calibration recommended” diagnostic is provided to indicate when infrequent calibration is needed. Integral solenoids can flow calibration gas via remote actuation.



Rosemount Analytical's Oxymitter™ 4000 In Situ Flue Gas Oxygen Transmitter and X-STREAM In Situ Oxygen Transmitter are O₂ transmitters that insert directly into the furnace, placing the sensing cell into the furnace atmosphere. There is no sampling system to maintain and speed of response is excellent. The Oxymitter and X-STREAM In Situ Oxygen Transmitter design incorporate the signal conditioning electronics onto the sensing probe for easy installation.

HART® or FOUNDATION™ fieldbus communications are available so calibrations and diagnostics can be executed without going to the instrument. An optional Asset Management Solutions (AMS) software package permits many HART or FOUNDATION fieldbus instruments to be viewed and accessed from a central PC.

¹ Nernst Equation

$$EMF = KT \log_{10} (P_1/P_2) + C$$

Where:

- P₂ = the partial pressure of the oxygen in the measured gas on one side of the cell.
- P₁ = the partial pressure of the oxygen in the reference gas on the other side.
- T = the absolute temperature.
- C = the cell constant.
- K = an arithmetic constant.

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