Oxygen Measurement Improves Efficiency and Product Quality in Cement Kilns

Traditionally, the measurement of oxygen (O_2) inside a rotating cement kiln has provided a good indication of combustion efficiency. This oxygen measurement can also provide an inferred indication of calcining rates and NO_x production. Maintaining a consistent oxygen rate can prevent variations in product quality.

NEW DESIGN ADDRESSES APPLICATION DIFFICULTIES

The zirconium oxide measurement technology has become the standard for measuring oxygen in combustion processes. Measurement accuracy is maximized at normal flue gas levels, output is stable, and the sensing cell is very robust. However, many application difficulties hamper getting a suitable measurement of oxygen in a rotating kiln.

The flue gas exit from the kiln presents the best opportunity for measuring oxygen, but outside air can leak through the rotating seal and bias the oxygen measurement upward.

Emerson's Rosemount Analytical Oxymitter In Situ Flue Gas Oxygen Analyzer is an **in situ** probe design. The probe is inserted directly into the flue gas stream and places the sensing cell in direct contact with the gases to be measured. An insertion length of 6 ft (1.8 m) is recommended to eliminate the effects of air leaking past the rotating seal. The gas sample diffuses into the sensing chamber without the use of a sample pump eliminating plugging problems experienced by extractive measuring techniques (Figure 1). The probe's maximum operating temperature is 1300°F (700°C), which is suitable for many kiln processes such as lime kilns, wet cement kilns and soda ash kilns. Some processes, however, require operating temperatures of up to 2000°F (1080°C) such as dry cement kilns, diatomaceous earth kilns and kilns using an afterburner such as hazardous waste or medical waste kilns.

In these instances a "Probe Mounting Jacket" houses the probe, simultaneously reducing flue gas temperatures [2000°F (1100°C) maximum] and providing physical protection for the probe

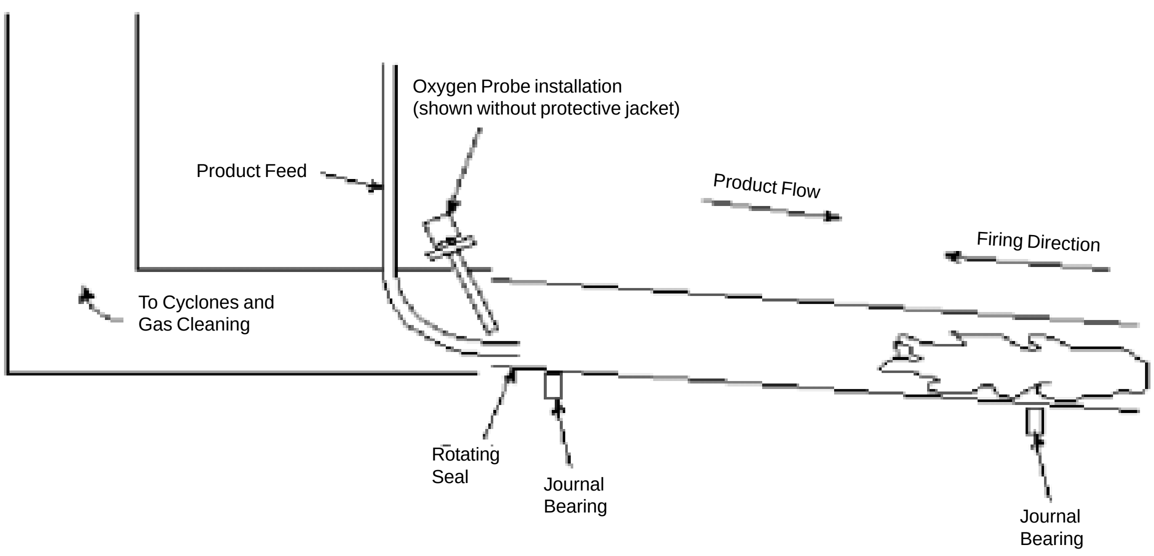


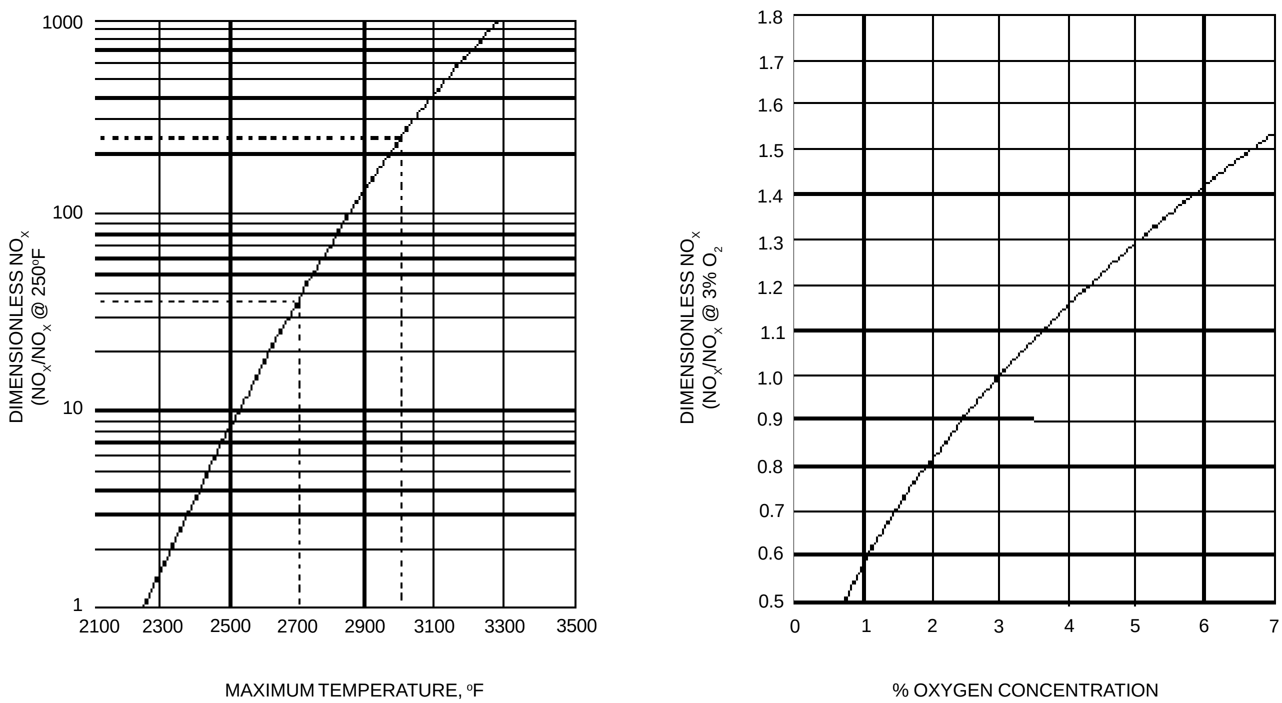
Figure 1. Proper installation of an oxygen probe in a rotating cement kiln

O_2/NO_x RELATIONSHIP

The formation of NO_x can be related to the process temperatures and O_2 levels. The following diagrams (Figure 2) depict the relationship between O_2, temperature and NO_x in a "dimensionless" chart. At kiln operating temperatures excess oxygen can be readily converted to NO_x. Thus, as temperature and percent oxygen concentration decrease, the production of NO_x decreases. Type of fuel, temperature variation and residence time will also affect this relationship in individual applications.

GAS ANALYSIS SOLUTIONS

Emerson manufactures a broad line of Rosemount Analytical gas analyzers for use in combustion processes. Other analyzers measure CO, SO_2, NO_x, opacity and NH_3 and can be certified for use as Continuous Emissions Monitoring Systems (CEMS). Call Emerson Process Management at 440-914-1261 or toll free in the U.S. and Canada at 1-800-433-6076 for more information and solutions to your gas measuring problems.



This figure should be used as a rough guide only. Mixing and local O_2 concentration significantly affect NO_x.

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Figure 2. The NO_x/O_2 Relationship

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