

Measuring false air in cement production



Rotary kilns in a cement plant

Cement production and the environmental challenge

CO₂ emissions from the cement industry contributes 6-7% of global human-related CO₂ emissions. Hence, a significant reduction in emissions from the cement industry is required for meeting the global greenhouse gas (GHG) emission targets. CO₂ generation is an inherent part of the cement production process, due to the calcination of its raw material, limestone (CaCO₃). CaCO₃ is converted into lime (CaO) and CO₂ and about 60% of the CO₂ emissions from cement

Components to be measured:

- Oxygen (O₂)

ABB Solution:

- AZ-series Zirconia in-situ oxygen analyzer

production are due to this conversion. The remaining 40% comes mostly from the combustion of fuels to provide heat for clinker production.

One option to significantly reduce greenhouse gas emissions from the cement industry is CO₂ Capture and Storage/Utilization (CCS/U). An alternative direct action could be to reduce the amount of energy needed for the same amount of cement produced.

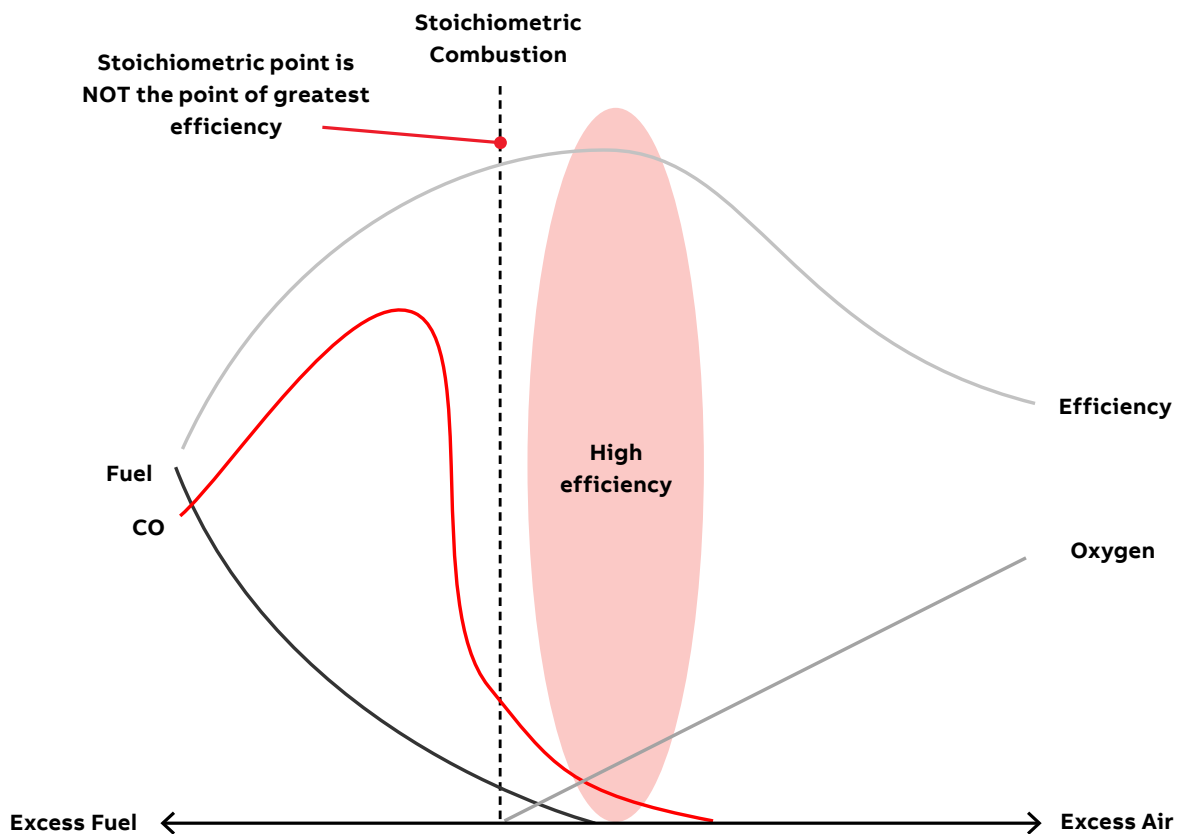
Increase plant efficiency and reduce CO₂ emissions

Cement production has high efficiency demands from combustion, particularly in the preheater and the rotary kiln, resulting in high CO₂ emissions. To reduce these emissions, it is important to control the combustion in the most efficient way possible, meaning we get as much energy as we can from as little fuel as possible. To achieve maximum efficiency, it is important to control the air/fuel mixture entering the combustion zone.

Too much fuel will result in fuel loss efficiency and an increase in general emissions such as CO because there is not enough oxygen and some fuel will pass through combustion without being fully burned. Too much air will result in stack losses because some of the energy released from burned fuel will be absorbed by the excess air and then lost to the atmosphere.

As we can see, the result of using too much fuel or too much air is that we must burn even more fuel to get the required energy output. This is both financially and environmentally wasteful.

From the graph below, we can see that the ideal efficiency does not occur at 'stoichiometric' conditions, when the air and fuel are in perfect balance. Peak efficiency occurs with a small amount of excess air, to allow for complete combustion because in real world conditions it takes time for the fuel and air to fully mix and combust. The exact amount of excess air required will vary depending on the fuel, combustion chamber design and other site-specific factors such as the build up of scale and deposits in the combustion zone or on heat exchangers.

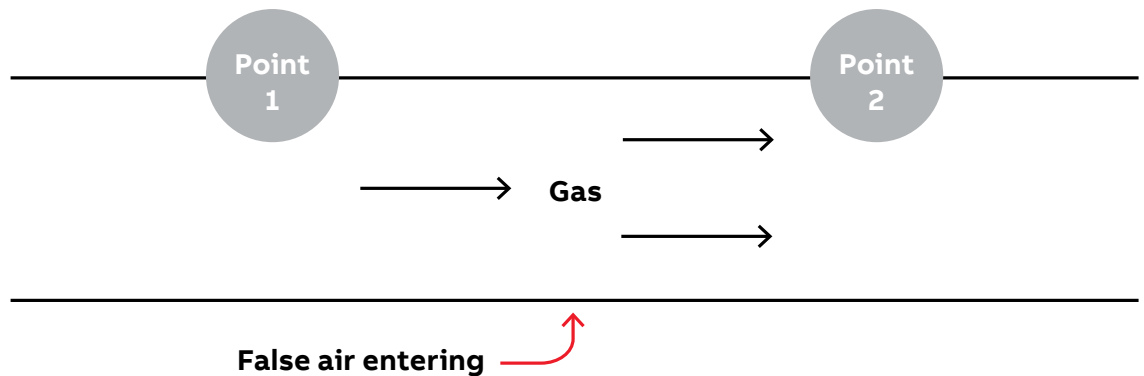


False air will drop plant efficiency

Because the air mix is so critical, it is important to avoid air leaks (also known as 'False air'), where additional unwanted air enters the process. One way of finding false air in gas streams of less than 21 % oxygen is to measure the oxygen content at different points in the process.

Due to its impact on combustion efficiency, the impact of false air in cement plant has got various effects:

- Increase of power consumption
- Increase of fuel consumption
- Unstable operation
- Reduction in productivity
- Higher wear of fans



False Air Ingress

In a cement plant, there several potential ingress points of false air, such as the kiln section, mill section or power sector. The ingress points at each section could be sector inlets, outlets, seals, inspection doors, fan casings etc. Due to the variation from site to site with different layouts and equipment, the areas at highest risk of false air ingress are plant specific.

By measuring the % oxygen content and flow measurement at carefully chosen locations, we can determine the amount of false air entering individual sectors, such as the pre-heater of mill circuit.

Calculating false air

In general the calculation is done in terms of outlet :

$$\% \text{ of false air} = \frac{(\% \text{O}_2 \text{ outlet} - \% \text{O}_2 \text{ inlet})}{(20,95 \% - \text{O}_2 \% \text{ inlet})} * 100 \%$$

Whereas 20,95% O₂ is said to be the average concentration of oxygen in dry air.

But the calculation can also be done as a calculation of the total volume of false air:

$$V_2 = V_t * \frac{(20,95 \% - \text{O}_2 \% \text{ outlet})}{(20,95 \% - \text{O}_2 \% \text{ inlet})}$$

Where

V₁ = normal volume

V₂ = false air volume

V_t = total volume (V₁ + V₂)

False air detection by Zirconia Oxygen Analyzer

Zirconia analyzers are an ideal choice for the measurement of oxygen concentration in industrial processes, even in the demanding environments present throughout cement production. They are therefore an ideal choice for the critical detection of false air in the cement industry.

Harsh environments demand rugged and robust measurement equipment; solutions that are effective and efficient even in the toughest applications. They also demand equipment that can be quickly and easily maintained, saving time in both

the maintenance and production departments. This is where the Endura AZ Series is introduced as the world leader in oxygen measurement.

The AZ series are available for temperature ranges from -20°C up to 1400 °C, making it suitable for a wide range of measuring points inside a cement plant and are available with a wide array of configurable options to ensure application suitability, such as additional dust protection and filter options.



Specifications AZ20 series :

- From -20 to 800°C process temperature
- Integral or remote transmitter
- Probe lengths up to 4 m (13 ft)
- Full servicing and maintenance on site

Specifications AZ25 series

- From 600 to 1400°C process temperature
- Remote transmitter only due to high application temperatures
- Probe lengths up to 1.25m (4ft)
- Variety of probe material options available to ensure application suitability

Conclusion

The AZ Endura in-situ Zirconia probes are ideally designed to measure false air ingress to achieve the following:

- Substantial potential for cost savings through improvement in both thermal and electrical energy efficiency, which can account for approximately 40-60 % of manufacturing costs in cement production.
- Energy efficiency also reduces greenhouse gas emissions, mitigating the environmental problems associated with cement production.

Sources :

CEMCAP report : Optimised operation of an oxyfuel cement plant, VDZ gGmbH, 2018
Cement & Beton Roadmap 2050, Febelcem 2021
False air calculator at mill, Thecementgrindingoffice.com

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/analytical

