



Ex-Situ Analyzer Overcomes Traditional Limitations of Flue Gas Analyzers

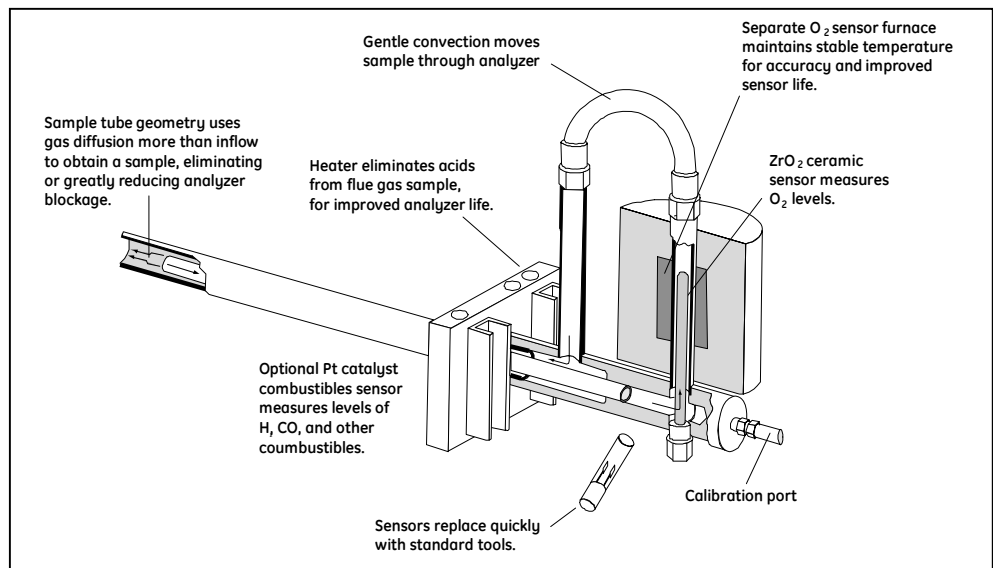
Introduction

The GE Sensing Ex-Situ Flue Gas Analyzer has overcome the limitations that have traditionally plagued other flue gas analyzers. By combining existing state-of-the-art flue gas measurement technology with the ex-situ diffusion/convection gas sampling technique, the Ex-Situ Analyzer provides the optimum solution to a very common problem.

Theory of Operation

A flue gas sample is continuously drawn into the sampling tube by gas diffusion and a gentle convection flow. The sample passes along the inner pipe into the analyzer where it is first heated to a temperature that prevents flue gas acid ($\text{H}_2\text{SO}_4 \bullet \text{H}_2\text{O}$) from condensing in the analyzer.

The sample passes the combustibles detector, then into the furnace section of the analyzer, which contains the zirconium oxide sensor. This separate temperature-controlled furnace heats the sample and the oxygen sensor to 700°C , the optimum temperature for oxygen measurement using ZrO_2 technology.



The Series 300 Flue Gas Analyzer Theory



Theory of Operation
(cont.)

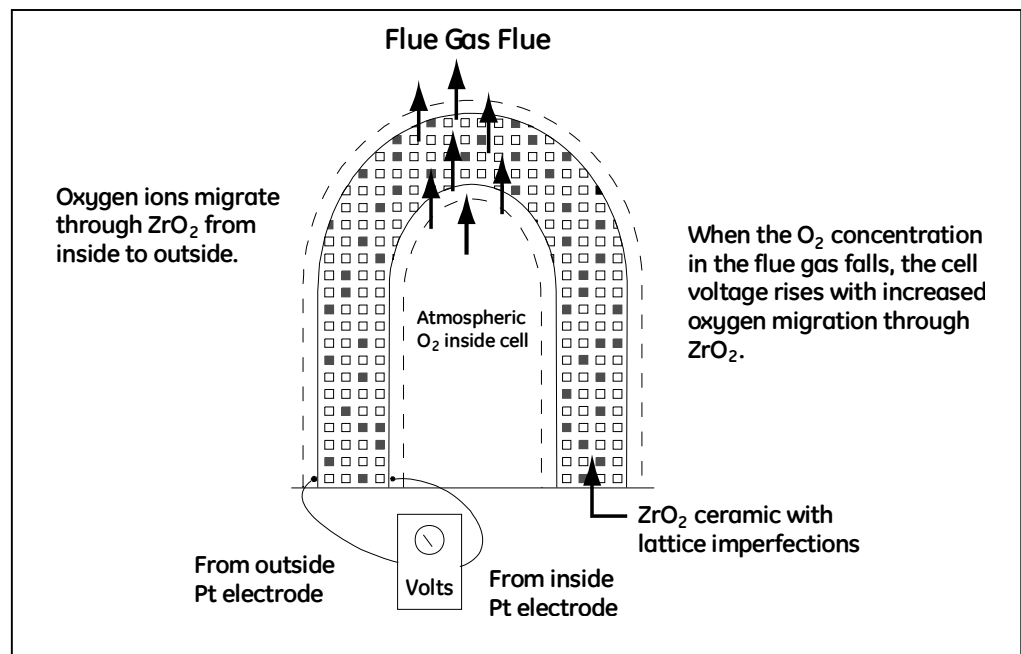
Finally, the sample passes through the convection loop and the outer pipe, back to the sampling inlet area where it is vented back into the flue gas in the stack. Particulates do not enter the sampling tube due to their relatively heavy mass and are carried away by the flue gas in the stack.

The analyzer design thus minimizes corrosion by acids and blockage by particulates, while providing accurate, consistent monitoring of oxygen and/or combustibles.

The Zirconium Oxide
Oxygen Sensor

The inside and outside of the zirconium oxide cell are coated with porous platinum forming two electrodes. The flue gas sample flows past the outside of the test-tube-shaped cell, while atmospheric air, freely circulating on the inside with a relatively constant oxygen concentration, constitutes the reference gas.

At the 700°C operating temperature of the cell, the atmosphere reference oxygen is electrochemically reduced at the inner electrode, and the resulting oxygen ions seek to equalize the low oxygen concentration on the sample side of the cell by migrating through small lattice imperfections in the ceramic toward the outer electrode. At the outer electrode, they give up electrons to become oxygen molecules again and are swept away by the sample flow.



Zirconium Oxide Oxygen Sensor Theory



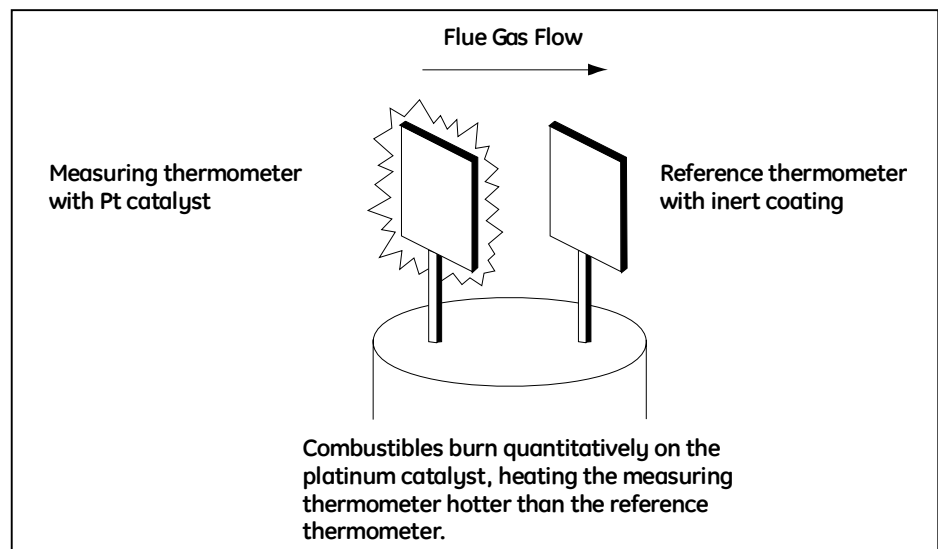
The Zirconium Oxide Oxygen Sensor (cont.)

The lower the concentration of oxygen in the flue gas sample, the greater the rate of ion migration through the ceramic, and the higher the cell voltage due to electron exchange at the electrodes. The cell voltage rises evenly as the amount of oxygen in the flue gas falls, allowing the accurate measurement of very small amounts of flue gas oxygen.

The Platinum Catalyst Combustibles Sensor

The combustibles sensor consists of two resistance thermometers that are placed side by side in the flue gas sample. One thermometer is used to measure and the other serves as a reference. The measuring thermometer is coated with a platinum catalyst on an inert support. The reference thermometer has only an inert coating. At the elevated temperature inside the analyzer, flue gas combustibles will ignite spontaneously on the platinum catalyst of the measuring thermometer.

As the sample passes over the measuring thermometer, combustibles burn on the catalyst, thereby raising the temperature of the measuring thermometer. The difference in temperature between the measuring and the reference thermometers is proportional to the concentration of combustibles in the sample, and it generates a resistance change which can be converted into a reading of parts per million by volume (ppm_v) of combustibles.



Platinum Catalyst Combustibles Sensor Theory