

Net vs. Gross/Wet vs. Dry Oxygen Measurements

BACKGROUND

When a portable oxygen analyzer is utilized to check the calibration of an in situ oxygen analyzer, the portable analyzer will often produce a measurement which is higher than the measurement produced by the in situ analyzer.

Although the two readings differ, they may in fact indicate that the in situ oxygen analyzer is properly calibrated. The difference in readings is explained by the difference in “net” oxygen measurement versus “gross” oxygen measurement; and the difference between “wet” oxygen measurement versus “dry” oxygen measurement.

NET/GROSS

The definition of “net” oxygen measurement is based on the assumption that free oxygen will combine or “burn” with combustibles in the flue gas stream. The remaining free oxygen is considered the “net” oxygen. This “net” effect applies to zirconium oxide sensors, such as the Model 6888 O₂ Analyzer, due to the required elevated temperature necessary for the sensor’s operation.

The definition of “gross” oxygen measurement is based on the assumption that free oxygen will NOT combine with combustibles in the flue stream. Thus, the free oxygen is the “gross” oxygen. The “gross” effect applies to those sensors NOT requiring an elevated temperature for sensor operation, including those utilized with portable oxygen analyzers.

The two methods of measuring oxygen will produce different results. The assumption is that the difference is due solely to the presence of combustibles. As combustibles appear in the flue stream, “gross” oxygen measures higher than “net” oxygen.

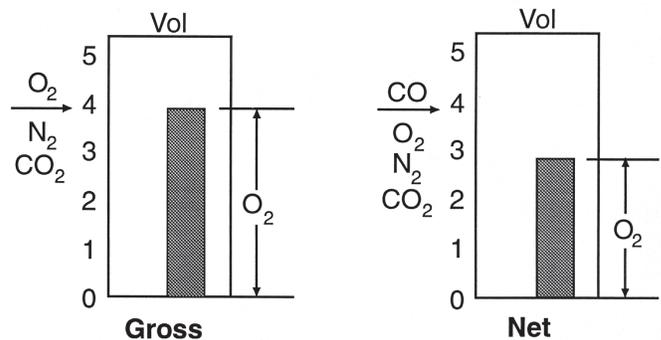


Figure 1 - Net vs. Gross O₂ Measurement

WET/DRY

The definition of oxygen measurement on a “wet” or “total” basis is based on the assumption that the moisture content in a flue stream is not removed and is an element included when the oxygen content is measured. The Model 6888 O₂ Analyzer, along with other in situ oxygen probes, provides a “wet” oxygen measurement.

The definition of oxygen measurement on a “dry” basis is based on the assumption that the moisture content in a flue stream is removed before the oxygen content is measured. Portable oxygen analyzers provide a “dry” oxygen measurement.

There will be a difference in the two methods of measuring oxygen. The assumption is that this difference is due solely to moisture (H₂O). The following relationship holds:

$$O_2 \text{ dry} = O_2 \text{ wet} (1/1-H_2O)$$

As H₂O appears in the flue stream, O₂ dry measures higher than O₂ wet.

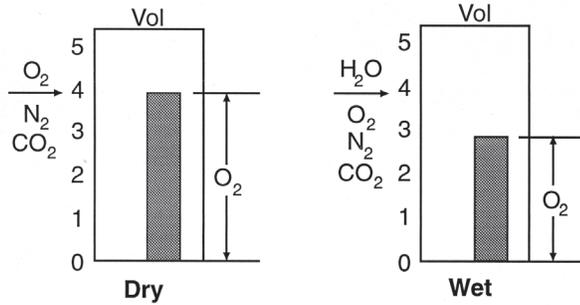


Figure 2 - Wet vs. Dry O₂ Measurement

CONCLUSION

In situ oxygen analyzers measure oxygen content on a “net” and “wet” basis. Portable oxygen analyzers provide oxygen measurements on a “gross” and “dry” basis. Consequently, the two may provide different readings. Generally, if the measurements from the portable analyzer are slightly higher than the measurements from the in situ analyzer, the in situ analyzer is considered to be properly calibrated. However, if the oxygen measurements from the in situ analyzer are higher than the readings from the portable analyzer, then it is likely that a problem exists. A known test gas can be used to verify the accuracy of both the portable and in situ analyzers.

VERIFICATION

In order to verify that the in situ analyzer is properly calibrated, a known oxygen balance nitrogen test gas can be injected into both the in situ analyzer calibration port and the portable analyzer’s input port. In this case, because no combustibles or moisture are present in the known test gas, the readings should be identical. This verification can be completed using a Rosemount Analytical Portable O₂ Test Gas Kit.

Notes

Emerson Process Management
Rosemount Analytical
Gas Chromatograph Center of Excellence
5650 Brittmoore Road
Houston, TX 77041 USA
T +1 713 827 6380
T 866 422 3683
F +1 713 827 3865
gc.csc@emerson.com
www.raihome.com

LATIN AMERICA

Emerson Process Management
Rosemount Analytical
11100 Brittmoore Park Drive
Houston, TX 77041 USA
T +1 713 467 6000
F +1 713 827 3328
www.raihome.com

Emerson Process Management
Rosemount Analytical Inc.
Gas Analyzer Service Center
6565P Davis Industrial Parkway
Solon, OH 44139 USA
T +1 440 914 1261
Toll Free in US and Canada 800 433 6076
F +1 440 914 1262
US Response Center 800 654 7768
gas.csc@emerson.com

EUROPE

Emerson Process Management
Shared Services Limited
Heath Place, Bognor Regis
West Sussex PO22 9SH England
T +44 1243 863121
F +44 1243 845354
www.EmersonProcess.com

MIDDLE EAST AND AFRICA

Emerson Process Management
Emerson FZE
Jebel Ali Free Zone
Dubai, United Arab Emirates, P.O. Box 17033
T +971 4 811 8100
F +971 4 886 5465
www.EmersonProcess.com

ASIA-PACIFIC

Emerson Process Management
Asia Pacific Private Limited
1 Pandan Crescent
Singapore 128461
Republic of Singapore
T +65 6 777 8211
F +65 6 777 0947
analytical@ap.emersonprocess.com

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