ANALOX O2EII® Oxygen Analyser

Humidity Compensation

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Introduction

Analox recommend in the O_2EII® User Manual that account is taken for the humidity in the atmosphere at the time of calibration.

This document attempts to explain the reasoning behind the O_2 compensation chart.

Any users still unsure should contact Analox for further advice.

Discussion

The earth's atmosphere consists of nitrogen (78.1%) and oxygen (20.9%), with small amounts of argon (0.9%), carbon dioxide (variable, but around 0.035%), water vapour, and other gases.

Humidity is the amount of water vapour in the air. Relative humidity is defined as the ratio of the partial pressure of water vapour in a parcel of air to the saturated vapour pressure of water vapour at a prescribed temperature.

Increasing levels of humidity are caused by an increase in the number of water molecules in the atmosphere. In a given sample of the atmosphere, the presence of these molecules effectively displaces the other gases.

The Analox O_2EII® is sensitive to the partial pressure of oxygen in the sample of gas that it is measuring.

If we were to enclose an O_2EII® in a sealed chamber, with a specific amount of oxygen present, then the reading of oxygen would remain constant even if we then pumped water vapour into the chamber. This is because we have not changed the number of oxygen molecules present; hence the partial pressure of oxygen has remained constant. This would prove that the sensor itself is not affected by the presence of water vapour.

However in a localised area of high humidity (ie not in our sealed chamber), the presence of extra water vapour displaces the other gas molecules, which are re-distributed in the remainder of the earth's atmosphere. This means that local to the sensor itself, there are now fewer oxygen molecules than before, and hence the reading on the analyser will fall.

The Analox compensation chart aims to account for this variation. It starts with the known percentage of water vapour in the atmosphere at 100% Relative Humidity at a number of temperatures. It then applies straightforward ratios for how much oxygen is displaced at relative humidity ranging from 10 to 100%.

As can be seen in the chart below, the fall in oxygen is gradual as either the temperature or the Relative Humidity increases. The green shaded area indicates where compensation is required if we want to maintain less than a 0.5% error of oxygen In other words, where the table colour is yellow, the reading is only slightly affected, and hence no compensation is considered necessary if up to a 0.5% oxygen error is deemed acceptable.

Oxygen compensation chart for moisture in the atmosphere

ATMOSPHERE OXYGEN PERCENT IN RELATION TO TEMPERATURE AND RELATIVE HUMIDITY										
TEMP F TEMP C	32 0	40 4	50 10	60 16	70 21	80 27	90 32	100 38	110 43	120 49
RELATIVE HUMIDITY	ATMOSPHERIC OXYGEN PERCENT									
10	20.9	20.9	20.9	20.9	20.8	20.8	20.8	20.8	20.7	20.7
20	20.9	20.9	20.8	20.8	20.8	20.8	20.7	20.6	20.5	20.4
30	20.9	20.8	20.8	20.8	20.7	20.7	20.6	20.5	20.4	20.2
40	20.8	20.8	20.8	20.7	20.7	20.6	20.5	20.4	20.2	19.9
50	20.8	20.8	20.8	20.7	20.6	20.5	20.4	20.2	20.0	19.7
60	20.8	20.8	20.7	20.7	20.6	20.5	20.3	20.1	19.8	19.5
70	20.8	20.8	20.7	20.6	20.5	20.4	20.2	19.9	19.6	19.2
80	20.8	20.8	20.7	20.6	20.5	20.3	20.1	19.8	19.5	19.0
90	20.8	20.7	20.7	20.6	20.4	20.3	20.0	19.7	19.3	18.7
100	20.8	20.7	20.6	20.5	20.4	20.2	19.9	19.5	19.1	18.5
H_20 at 100% RH	0.6	0.8	1.2	1.8	2.5	3.4	4.7	6.5	8.6	11.5

If the temperature and RH axis meet in this part of the chart, calibrate to the chart O_2 level or with dry air to maintain 0.5% O_2 accuracy in NITROX.