General Information

Gas concentration levels in ambient air are often expressed in Parts per Million (ppm) or Parts per Billion (ppb). These two common ways of expressing readings sound similar but in reality they are very different, by a factor of 1000 to be exact.

1 ppm = 1,000 ppb

Therefore as an example, a gas concentration reading of 5 ppm is the same as 5,000 ppb or a reading of 5 ppb is the same as 0.005 ppm

As a result, readings from a sensor may drift by as much as +/- 100 ppb. This means that one should not place too much emphasis on any specific reading. For the most part, we are better served by viewing averages and trends when using sensor based monitors.

Sensor units have the advantage of being small and portable in addition to lower cost.

Air Pollution

Polluted air is defined as air containing harmful substances that are persistent, in high concentrations and can cause health problems to humans, plants or animals or result in damage to property.

Polluted air may contain particulate matters or gases. The oil and gas industry is generally concerned with gases such as Hydrogen Sulfide (H2S), Sulfur Dioxide (SO2), Nitrogen Dioxide (NO2) and flammable gases (LEL).

Hydrogen Sulfide (H2S)

Hydrogen Sulfide or sour gas is a flammable, colorless gas that is toxic at low concentrations. It is classified as a chemical asphyxiant, which would be the same classification as carbon monoxide for example. It is heavier than air and may accumulate in low-lying areas. It smells like rotten eggs at low concentrations and quickly deadens a person's sense of smell at higher concentrations. H2S is soluble in water and oil. It burns with a clear blue flame and produces Sulfur Dioxide (SO2) as one product of combustion.

Sulfur Dioxide (SO2)

Sulfur Dioxide is a colorless, non-flammable gas with a sharp, pungent odor similar to a struck match. Because SO2 is less toxic than H2S, it is a common safety precaution to flare gases containing H2S rather than vent them to atmosphere. The flaring process produces SO2 (among other gases). Operators are required to ensure that SO2 emissions during flaring are kept within government guidelines. SO2 can cause respiratory problems. It can also displace breathing air if it accumulates in low-lying areas and it can be detrimental to vegetation.

Nitrogen Dioxide (NO2)

Nitrides of Oxygen (NOx) are the total of Nitrogen Dioxide (NO2) and Nitric Oxide (NO). NO is produced during flaring and will generally combine with Ozone (O3) to form NO2. Nitrogen Dioxide is a reddish-brown gas with a pungent odor and is partially responsible for the brown haze associated with smog. NO2 is classified as toxic and can cause respiratory problems - it can also be detrimental to vegetation in some circumstances.

ALBERTA'S AMBIENT AIR QUALITY OBJECTIVES

The Alberta Environmental Protection and Enhancement Act allows Alberta Environment to develop ambient air quality objectives. They have consulted with stakeholders, other government departments, industry, environmental organizations and the scientific community to develop the following standards.

H2S

- 1 hour average 10 ppb
- 24 hour average 3 ppb

The above noted recommended maximum concentrations for H2S are based on "odor perception". In other words, the intention is to minimize objectionable odor, not necessarily to avoid health issues. For example, when the objective is to avoid an unhealthy work environment, workers in Alberta are allowed exposure to the following concentrations:

- up to 8 hours exposure 10 ppm
- up to 15 minute exposure 15 ppm
- never more than 20 ppm

One might then conclude that the Alberta Ambient Air Quality Objectives have a factor of safety of more than 1000 if health concerns are the issue as opposed to avoidance of nuisance odors.

SO2

- 1 hour average 172 ppb
- 24 hour average 57 ppb

The SO2 recommendations are based on avoiding respiratory problems and/or damage to vegetation.

NO2

- 1 hour average 212 ppb
- 24 hour average 106 ppb

NO2 recommendations are based on odor perception, i.e. minimizing objectionable smells - see H2S notes above.

Gas Sensors

The sensors used by Eagle Technologies are electrochemical cells that generate an electrical current proportional to the fractional volume of gas being measured.

They use 3 electrodes and an electrolyte reservoir to generate and balance the current being measured. The composition of the electrodes and electrolyte are specific to the gas being monitored. The working electrode either oxidizes or reduces the target gas and the counter electrode tries to balance the current generated by this reaction. The reference electrode keeps the current within a limited range to enable accurate measurement.

Interfering Gases

Gas sensors are built for optimum response to a specific target gas - they may however be affected by other gases that might be present. For example, NO_2 is an interfering gas for H_2S sensors. NO_2 has the effect of lowering the signal from H_2S gas and will result in a lower than actual reading of H_2S concentrations. This is one of the reasons that Eagle EYE monitors have NO_2 sensors - they allow for analysis of situations when high NO_2 concentrations might have resulted in lower than actual H_2S readings.

Sensors have a shelf life of about 2 years. Their useful lifespan can also be shortened by overexposure to target or interfering gases. Eagle Technologies technicians test and replace sensors on a scheduled basis to maximize accuracy and consistency when using Eagle EYE stand-alone air monitors.