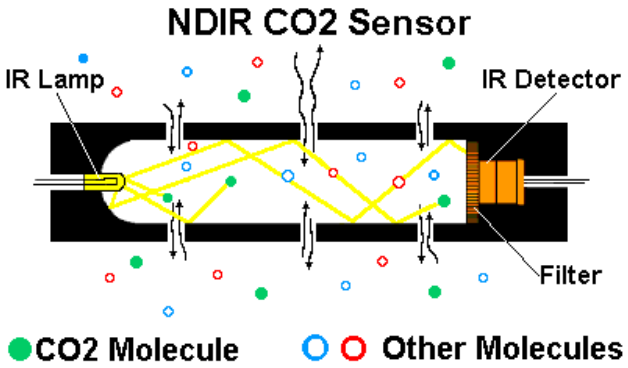
NDIR CO_2 SENSING TECHNOLOGY

APPLICATION NOTE TSI-037

TSI's IAQ instruments measure carbon dioxide concentration by relying on one of the natural properties of CO_2 molecules: CO_2 molecules absorb light at a specific wavelength of 4.26 µm. This wavelength is in the infrared (IR) range. High concentrations of CO_2 molecules absorb more light than low concentrations. This technique is called non-dispersive infrared (NDIR) detection. Refer to the schematic diagram, showing the major components of the NDIR CO_2 detector.



As shown in the figure, gas molecules diffuse into the sensing chamber. The IR light is directed through the sensing chamber towards the detector. The detector has a filter in front of it which eliminates all light except the 4.26 µm wavelength that CO_2 molecules can absorb. Since other gas molecules do not absorb light at this wavelength, only the CO_2 molecules affect the amount of light reaching the detector.

The intensity of 4.26 µm light that reaches the detector is inversely related to the concentration of CO_2 in the sensing chamber. When the concentration of CO_2 in the chamber is zero, the detector will "see" the full light intensity. As the concentration of CO_2 increases, the intensity of light striking the detector decreases. The exact relationship between IR light intensity and CO_2 concentration is determined when the instrument is calibrated using pure nitrogen (0 ppm CO_2) and a known concentration of CO_2 such as 1000 or 5000 ppm.

The intensity of light striking the detector is described by Beer's Law:

Beer's Law:

$$I = I_0 e^{kP}$$

Where:

I = the intensity of light striking the detector
I_0 = the measured signal with 0 ppm CO_2
k = a system dependent constant
P = the concentration of CO_2

The IR light source is pulsed on and off by the microprocessor. This allows background fluctuations to be subtracted during the off-period. If you look closely at the CO_2 chamber you may be able to see the light flash on and off.

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