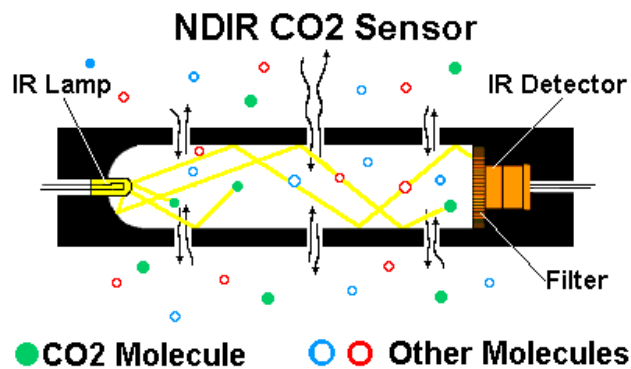


NDIR CO₂ Sensing Technology

Application Note TSI-037

TSI's IAQ instruments measure carbon dioxide concentration by relying on one of the natural properties of CO₂ molecules: CO₂ molecules absorb light at a specific wavelength of 4.26 μm . This wavelength is in the infrared (IR) range. High concentrations of CO₂ 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 CO₂ 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 CO₂ molecules can absorb. Since other gas molecules do not absorb light at this wavelength, only the CO₂ 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 CO₂ in the sensing chamber. When the concentration of CO₂ in the chamber is zero, the detector will "see" the full light intensity. As the concentration of CO₂ increases, the intensity of light striking the detector decreases. The exact relationship between IR light intensity and CO₂ concentration is determined when the instrument is calibrated using pure nitrogen (0 ppm CO₂) and a known concentration of CO₂ 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

I₀ = the measured signal with 0 ppm CO₂

k = a system dependent constant

P = the concentration of CO₂

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 CO₂ chamber you may be able to see the light flash on and off.

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