Keywords: Pathlength, Concentration, Absorbence, Beer's Law

Choice of Gas Cell for Pathlength/Concentration

In order to determine the pathlength of a gas cell for the concentration of gas to be measured, the measured absorbence (A) is related to the concentration of gas (C) by the usual Beer's Law relationship,

$$A = -\text{Log}10\ (I/Io) = a.C.L \qquad (1)$$

Where a is the (frequency dependent) absorption co-efficient, C is usually expressed in parts-per-million (ppm) partial pressure in the atmosphere, and L is the absorbing path, usually expressed in meters.

The relationship between A and C is linear, although there can be deviations from linearity at higher concentrations. Atmospheric concentrations are usually defined in C.L units of ppm.m , the number of molecules which would be encountered by the infrared beam in a one meter path. By this definition, an infrared beam passing through 100 meters of a 0.1 ppm gas cloud would exhibit the same absorbence as that of a beam passing through 10 meters of a 1 ppm cloud, or one meter of a 10 ppm cloud.

From equation (1), in order to maximize the measured absorbence for a given gas concentration, the largest absorbing path L should be used. Specac Cyclone™ and Tornado™ Gas Cells cover a range of path lengths, up to a maximum of 20m (Tornado™ Cell) which is a good compromise between the needs to maximize path length, and to fit it into a laboratory FTIR spectrometer, without sacrificing optical 'throughput'.

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