Differential Optical Absorption Spectroscopy (DOAS)

1. Brief description

Differential optical absorption spectroscopy (DOAS) measures gas concentrations based on the fact that the light of a wavelength that is absorbed depends on the type of gas. This method is used in open-path gas detectors.

Category	Detectable gas
Optical	Combustible

2. Structure and principles

[Structure]

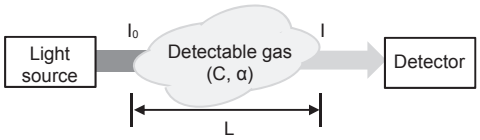
The sensor consists of a light source and detector unit to detect gas existing between them. The detector unit includes an optical filter and spectroscopes that allow only light of specific wavelengths to pass though it; the sensor thus detects only specific types of gases.

[Principles]

The light source emits light. Before it reaches the detector, gas absorbs a certain wavelength of the light, which is determined by the type of gas. The sensor determines the difference between the light in the presence and absence of the gas to calculate the gas concentration. The light intensities before and after the light absorption by gas are expressed by Lambert-Beer's equation:

$I = I_0 \exp(-\alpha CL)$ (1)

I_0 : Infrared intensity before light passes through gas
I : Infrared intensity after light has passed through gas
α : Gas-specific absorption coefficient
C : Gas concentration
L : Hume length: L



Based on the above, the sensor measures the infrared intensities before and after transmission of gas to detect a certain gas if the target gas is specific.

3. Features

According to Equation (1), for an open-path gas detector based on differential optical absorption spectroscopy, the following equation holds:

$$CL = (1/\alpha) \ln (I_0 / I) \quad (2)$$

The sensor outputs the product of the length of fume-like gas and gas concentration to detect gas.

Detector output (LEL.m) = length of fume-like gas (m) x gas concentration (% LEL)

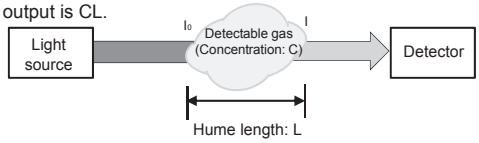
○ Gas concentration characteristics

When the length of the fume-like gas remains unchanged, the higher the gas concentration, the larger the detector output. Compared with (1) in the right figure, for (2), the fume length is the same but the gas concentration is twice and therefor the output is twice.

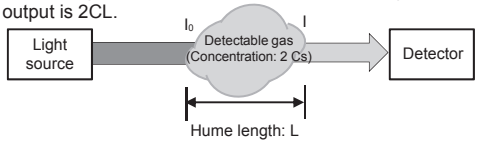
○ Gas range characteristics

When the gas concentration remains unchanged, the longer the fume-like gas length, the larger the detector output. Compared with (1) in the right figure, for (3), the gas concentration is the same but the fume length is twice, and therefor the output is twice.

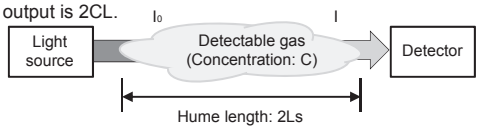
(1) When the gas concentration is C and fume length is L, the output is CL.



(2) When the gas concentration is 2C and fume length is L, the output is 2CL.



(3) When the gas concentration is C and fume length is 2L, the output is 2CL.



4. Detectable gas and detection range (example*)

Detectable gas	Detection range
Combustible gases in general (C1 to C8)	0-5 LEL-m (Methane and propane)

* The sensor SafEye™ Quaser is used as an example.

5. Products of this type (examples)

○Stationary products

... SafEye™ Quaser 900

SafEye™ Quaser 900