

## Principles of Operation for the CO<sub>2</sub> Coulometer

The CO<sub>2</sub> coulometer provides highly accurate, absolute determination of carbon in any CO<sub>2</sub>-containing gas stream. The coulometer is used as the detector in conjunction with different front end modules, detecting carbon in the range of 0.01 ug to 100 mg.

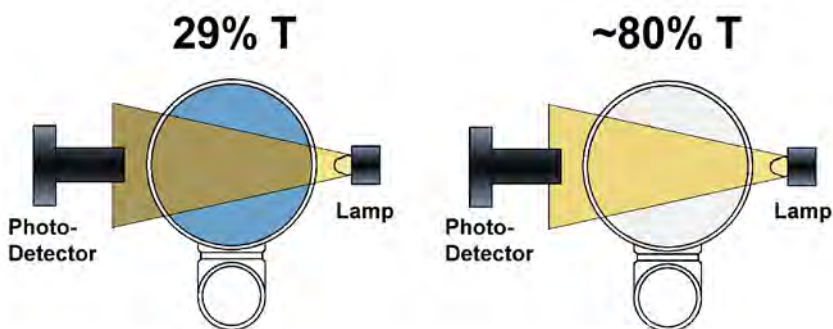
The coulometer cell is filled with a proprietary solution containing monoethanolamine and a colorimetric pH indicator. Platinum (cathode) and silver (anode) electrodes are positioned in the cell. The cell assembly is then placed in the coulometer cell compartment between a light source and a photodetector.

As a CO<sub>2</sub>-containing gas stream passes into the cell, the CO<sub>2</sub> is quantitatively absorbed, reacting with the monoethanolamine to form a titratable acid. This acid causes the color indicator to fade. Photodetection monitors the change in the color of the solution as a percent transmittance (%T). As the %T increases, the titration current is automatically activated to electrochemically generate base at a rate proportional to the %T

(with a maximum titration rate of approximately 1500 ugC/min.). When the solution returns to its original color (the endpoint), the current stops.

The titration current is measured continually and integrated to operator selected units on the sample screen. Since the current is, in effect, the titrant, there is no need for sample calibration.

Based on the principles of Faraday's Law (1 faraday of electricity will result in the alteration of 1 GEW (gram equivalent weight) of a substance during electrolysis each faraday of electricity expended is equivalent to 1 GEW of CO<sub>2</sub> titrated.



A summary of the chemical reactions occurring in the coulometer cell follows:

1. Absorption of CO<sub>2</sub> by cathode solution (cathode reaction)



2. Electrochemical generation of OH<sup>-</sup> (cathode reaction)



3. Neutralization of absorbed CO<sub>2</sub> reaction product by electrochemically generated OH<sup>-</sup>



4. Anode reaction

