

# SULFUR COULOMETER - PRINCIPLES OF OPERATION

## Principles of Operation for the Sulfur Coulometer

The Sulfur Coulometer provides highly accurate, absolute determinations of sulfur by coulometric titration of sulfur dioxide and hydrogen sulfide (SO<sub>2</sub> and H<sub>2</sub>S). The coulometer is used as the detector in conjunction with different front end modules, detecting sulfur in the range of 0.01 ug to 100 mg.

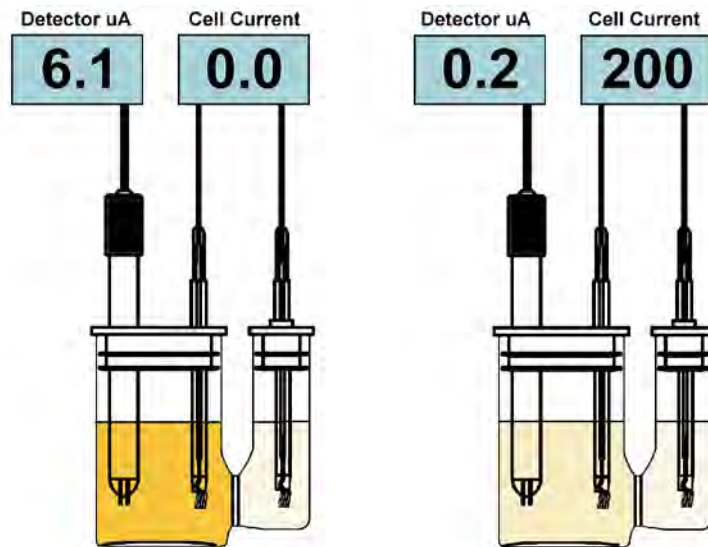
The anode compartment of the coulometer cell is filled with a proprietary solution containing methanol, pyridine, water and tetrabutyl ammonium iodide. Positioned in the anode compartment of the cell are a platinum anode (generating electrode) and a dual platinum detector electrode. The cathode compartment contains a buffered acidic solution and a platinum cathode.

When a gas stream passes through the anode solution, SO<sub>2</sub> (and H<sub>2</sub>S) is quantitatively absorbed and oxidized by free iodine (I<sub>2</sub>) in the solution. As the I<sub>2</sub> is consumed, the detector electrode becomes more polarized and the

detector current decreases. This detector current decrease is monitored by the Sulfur Detector Board, which in turn automatically activates the titration current. When the majority of the SO<sub>2</sub> (and H<sub>2</sub>S) has been titrated, the free iodine concentration increases, causing the detector electrode to become depolarized and detector current to increase. When the original I<sub>2</sub> concentration is reached, the detector current returns to its initial value and the titration 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 SO<sub>2</sub> (or H<sub>2</sub>S) titrated.



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

Anode Reactions:



Cathode Compartment:

