TYPES OF TOC DETECTORS

Total Organic Carbon (TOC), can be detected by using either the Non-Dispersive Infrared (NDIR) or the conductivity detector. The NDIR is more popular than the conductivity detector, due to stability and interference issues. NDIR detectors measure carbon, or more specifically CO_2 in the gas phase, while conductivity detectors measure CO_2 in the liquid or aqueous phase.

NDIR DETECTORS:

The NDIR detector consists of : light source, cell, and a detection portion (Figure 1). The older generation NDIR detectors used a diaphragm type detection system, and were named Luft detectors after the inventor. The Luft detectors utilize a movable diaphragm that is flexed with changes in CO_2 concentration. Light passes through the cell compartment and into the detector. Depending on the concentration of carbon dioxide generated from the sample and consequently the amount of light that passes through the quartz window, the movement of the trapped carbon dioxide within the detector compartment will flex the diaphragm. The flexing of the diaphragm creates electric signals which correspond to the concentration of TOC in the sample. The Luft detectors were nicknamed "microphone detectors" because they were susceptible to noise from the environment. If the table the detector was sitting on was disturbed, the diaphragm would flex without changes in CO_2 concentration, and as a result produces false signals.

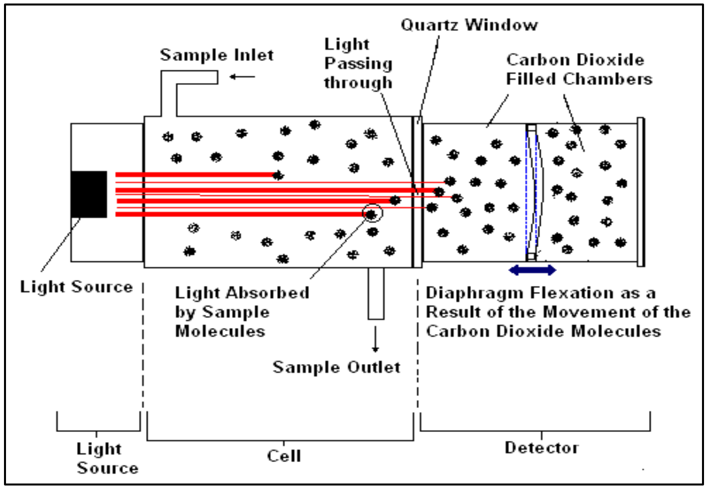

FIGURE 1: NDIR with Diaphragm Detector

Shimadzu's next generation NDIR detector solves the instability issue mentioned earlier and other issues with a Mircro Flow Sensor (MFS) as shown in Figure 2. The new detectors are utilized in the Shimadzu TOC-V and TOC-4110 Series instruments. The TOC instruments are very stable on boats under voyage, which create significant noise from both the motors and the "screws" or turning propellers. Thus accuracy is ensured because of no moving parts. As an added bonus the MFS is enclosed in a thermally stable compartment at 50 °C, to prevent any drift. Also, the detector is not sensitive to the temperature or pH of the sample, as with other detection methods described below.

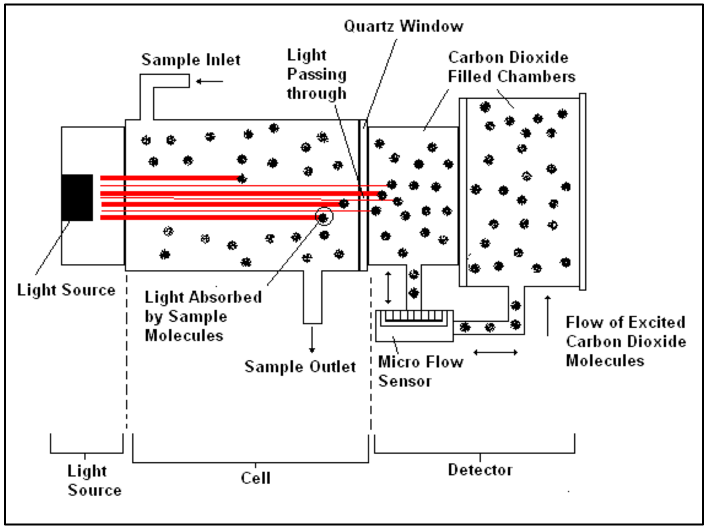

FIGURE 2: NDIR with MFS Detector

CONDUCTIVITY DETECTORS:

The conductivity detectors (not available from Shimadzu) are divided into two groups: direct and membrane conductivity. With the direct conductivity detector, interfering ions in the solution can cause high recoveries in the thousand percent ranges. Such ions include: Cl^-, HCO_3^-, SO_3^{-2}, H^+, etc. Both types of conductivity detectors are susceptible to interferences from changes in pH and temperature. Also all conductivity techniques suffer from interferences from gases such as chlorine, chlorine dioxide, sulfur dioxide, or other noxious gases and can cause false reading. In fact excess persulfate in the presence of UV light produces oxygen, which can lead to poor reproducibility, low TOC values, and TOC spikes. Excess oxygen bubbles can prevent the sample from flowing and can damage the instruments according to the manufacturer.