

TOTAL CARBON (TC) AND TOTAL ORGANIC CARBON (TOC) IN WATER USING HIGH TEMPERATURE COMBUSTION



Figure 1: Model CM130 TC/TOC Analyzer for liquid samples

PRINCIPLE OF OPERATION

Water samples are injected directly into a 950°C combustion zone. Oxygen carries the combustion product gases through a barium chromate catalyst/scrubber to ensure all of the carbon has been oxidized to CO₂. Interfering combustion gases such as HCl, SO₂ and SO₃ are removed by the barium chromate. Other scrubbers remove all potentially interfering gases, such as HBr, HI and NO_x, before the CO₂-containing gas stream is swept into the CO₂ Coulometer for detection. All scrubbers have sufficient capacity to allow for the analysis of mineral acids.

If Total Organic Carbon (TOC) is to be determined directly, dissolved CO₂ and inorganic forms of carbon must be removed from the sample prior to injection. Acidification and sparging of the sample is an effective pretreatment for removal of non-organic components. Alternately, TOC can be determined by difference between Total Carbon (TC) and Total Inorganic Carbon (TIC) determinations.

PROCEDURE

TOTAL CARBON ANALYSIS

1. Assemble and prepare the components for operation as described in the Instruction Manuals.
2. Determine the blank and run a standard to confirm proper operation of the complete system.

3. Fill the spring-loaded syringe with 200 µl of sample solution and insert the syringe into the sample introduction port.
4. Allow approximately one (1) minute for the system to purge any atmospheric CO₂.
5. Inject the sample and press Begin Analysis on the CM5017 Carbon Coulometer.
6. When all of the CO₂ has been evolved and titrated, the CM5017 automatically detects the endpoint, ends the analysis and prints the result to the printer and/or USB. Endpoint determination and result calculations are performed automatically based on user selectable settings entered into the CM5017 Carbon Coulometer.

TOTAL ORGANIC CARBON ANALYSIS

1. Assemble the components (including the purge accessory) and prepare them for operation as described in the Instruction Manuals.
2. Determine the blank and run a standard to confirm proper operation of the system.
3. Fill a test tube (or some other appropriate container) with about 5ml of sample.
4. Acidify the sample to approximately pH 2.
5. Purge the acidified sample for 6 to 12 minutes on the purge accessory with the oxygen flow at 50-100 ml/min.
6. Fill the syringe and inject the sample as described in "Total Carbon Analysis" above.

For samples containing low to medium salt concentrations, it is advisable to mix WO₃ in the loosely packed quartz wool placed in the combustion tube before the barium chromate.

NOTE 1: If the samples contain large amounts of salts or particulates, it may be desirable to use the Ladle Introduction Components which permit the introduction of samples in boats or capillary tubes. Direct injection of samples is simpler and faster, but allows salts to attack the quartz combustion tube. Placing the samples in boats permits mixing of the sample with tungsten trioxide (WO₃) which minimizes the salts' contact with the combustion tube. WO₃ also eliminates the formation of carbonates that can lengthen the analysis time and increase the instrument blank.

RESULTS

When 200 µl of sample is injected, up to 20,000 mg C/L may be determined without requiring dilution. Accuracy is typically +/-0.5% relative for samples containing more than 500 ppm C. For low concentrations, the accuracy is limited by the blank consistency. Accuracy can be as good as +/-0.5 mg C/L for potable waters. At elevated levels, accuracy is limited by the volume measurement and may be improved by weighing the syringe before and after the injection. Analysis times vary with the concentrations being determined and the accuracy sought with 3 to 5 minutes being typical.

OTHER INFORMATION

Additional details about this method are included in the ASTM D 4129-88 "Standard Test Method for Total and Organic Carbon in Water Oxidation by Coulometric Detection". The method is under jurisdiction of Committee D19.06 and is available from ASTM.

For additional information about the instrument's capabilities for specific types of samples, contact the UIC, Inc. Applications Laboratory.