

ChemScan[®]

PROCESS ANALYZERS

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ChemScan[®] Method Summary #126 TOC Estimation

Organics Analysis Classifications

Organic compounds in water are present in a variety of particle sizes and oxidation states. Some organic and inorganic compounds found in water or wastewater can be oxidized by biological or chemical processes, with analytical methods such as the biochemical oxygen demand (BOD) or chemical oxygen demand (COD) used as the measurement standard. Total organic carbon (TOC) is sometimes considered a more direct expression of total organic content than either BOD or COD because TOC does not measure the inorganic elements that can contribute to BOD or COD.

Standard TOC measurement techniques involve either the measurement of total carbon with a subtraction of inorganic carbon or the stripping of inorganic carbon with the measurement of residual organic carbon. In either case the methods require the conversion of carbonaceous material to CO₂ using heat, ultraviolet irradiation and/or chemical oxidation with a measurement of the resulting CO₂ using infrared spectroscopy.

Alternatively, many organic compounds are known to absorb light in a unique pattern over portions of the ultraviolet wavelength range. 254 nm is a common absorbance wavelength for these compounds which include many of the dissolved organic halogens (including certain THMs, organic solvents, pesticides, PCBs and chlorinated aromatics) and aquatic humic substances (particularly humic acid and fulvic acid) that are of interest for control of disinfection byproducts at water treatment facilities. Because organic substances have different absorbance intensity at 254 nm and because numerous inorganic substances also absorb light in the ultraviolet range and have the potential to influence absorbance intensity at 254 nm, analysis at this one wavelength will not always produce a reliable correlation with traditional TOC values, but is an effective and economical surrogate for many applications.

ChemScan Analytical Method

On-line organics analysis using ultraviolet light absorbance can be performed using ChemScan Process Analyzers. The ChemScan UV-0254 provides measurement of certain dissolved organics at 254 nm and a subtraction of turbidity at a second wavelength. This is an effective and economical method of analysis at locations where organics are the dominant constituent. Other ChemScan analyzers provide a measurement of light intensity at 256 increments across the 200 nm to 450 nm wavelength range including the 254 nm wavelength. These full spectrum analyzers are capable of compensating for the presence of inorganic chemicals that might otherwise interfere with organics analysis. On-line direct analysis of dissolved organics can be used to estimate TOC in waters where the dissolved organic fraction is the predominant TOC component or where the dissolved organic fraction is a constant percentage of TOC.

Because no two chemical substances absorb light in exactly the same pattern over the same wavelength range, a multiple wavelength analysis is used to accurately measure multiple organic constituents and to compensate for the effects of inorganic constituents in the sample such as nutrient, metal and free halogen ions. This compensation is not possible in an analyzer that only detects one wavelength such as UV₂₅₄ but may not be necessary in samples where dissolved organic matter is the predominant contaminant. ChemScan uses a visible wavelength to compensate for turbidity variations in the sample.

Monitoring System Requirements - Water Plants

The Information Collection Rule (ICR) defined certain sample collection points for monthly UV₂₅₄ and TOC analysis. These same sample points are excellent candidate sample points for on-line direct monitoring of dissolved organics using the ChemScan[®] Process Analyzer. These points include:

- A. Treatment plant raw influent
- B. Before and after coagulation/flocculation
- C. Before and after sedimentation, filtration, or softening
- D. Prior to disinfection
- E. At the distribution system entry point

Monitoring System Requirements - Water or Wastewater

ChemScan[®] Process Analyzers can accommodate samples with up to 150 mg/l of total suspended solids and turbidity of up to 60 NTU. Samples that contain debris capable of plugging sample lines or that contain high solids and turbidity may require screening, settling or filtration prior to analysis. Most ground water plants and many surface water plants will not require any filtration prior to analysis. Plants with high influent solids and turbidity will generally not require any filtration for samples extracted from points in the treatment process after primary settling.