

Cost-effective monitoring of organic compounds in a wide array of water matrices



Flexibility in configuration

The standard configuration of the **AppliTOC®** is based on the TOC methodology by hot-aerosol phase UV/persulfate. The analytical mainframe can also be configured to:

- True Total Organic Carbon or
- Total Inorganic Carbon or
- Total Carbon

Advanced features

- Smart features and add-on units reduce down-time and unnecessary checks substantially
- Built-in carbon removal system for purifying instrument air
- Unique range-specific solid state IR detectors with automatic zero calibration
- Up to three (3) sampling points possible
- Incorporated industrial PC with AppliTek controller software

A wide array of applications

Continuous, on-line monitoring of organic carbon and carbon compounds in various environmental and industrial process applications:

- Surface water
- Boiler feed water
- Cooling water
- Waste water
- Industrial waste water

High analytical performance

- True continuous analysis principle
- Low limits of detection (LOD) thanks to high volume sampling and range-specific, sensitive NDIR
- Smart features: automatic calibration, validation and cleaning
- High sensitivity and selectivity
- Samples with salt content up to 2% possible
- Factory configured, tested and calibrated

Introduction

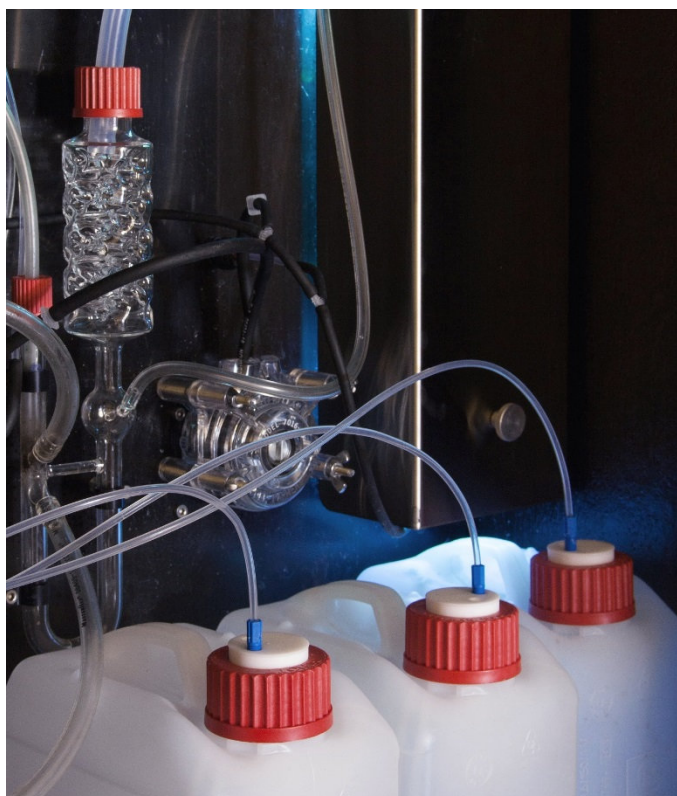
Total Organic Carbon analysis has been classified as a non-specific analysis method to determine the organic compounds in water. Its inherent accuracy and speed, combined with a low cost of ownership make it a preferred (standard) analysis method in many countries and industries.

AppliTek has taken this concept a step further with the development of the **AppliTOC®** Series of On-line TOC Analyzers. have been field-tested for many years in a wide range of applications and environments. A high sample flow rate not only assures low levels of detection (range 0 - 5 mg/l) but also that this sample is highly representative of the process or source from where it is sampled. The so-called "True TOC" is a special configuration of the **AppliTOC®** which is a 100% measure of all organic carbon in the sample, and applicable when the ordinary TOC configuration does not satisfy your needs.

For hazardous areas, a special enclosure in stainless steel is available with all necessary connections, special analytics and control units, designed and certified to fully meet ATEX or NEC 500 directives.

Application fields

- Production of demineralized water
- Waste water treatment (influent or effluent)
- Ground water reclamation
- Water recycling in manufacturing sites
- Boiler feed water



Containers with zero, span and cleaning solutions inside the ergonomic wet part of the AppliTOC®.

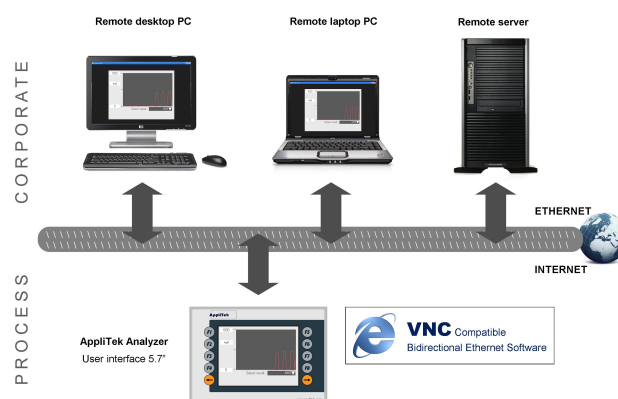
Smart functions

Auto-cleaning, auto-calibration, auto-validation

With smart features developed for easy and reliable operation, the **AppliTOC®** Series of On-line TOC Analyzers take the hassle out of repetitive and sometimes unnecessary actions just to keep the analyzer running. The results are self-evident: enhanced performance, reduced down-time and negligible operator intervention.

Users can program the sequence and interval of the analysis and the validation/calibration cycles. Validation or calibration can be carried out with a standard solution with a known concentration, in order to check the analysis program and analyzer functionality. Last but not least, automatic cleaning cycles eliminate unnecessary cross interference in the analysis stage.

Data exchange and supervision



The built-in controllers of AppliTek analyzers make it easy to gain access and exchange information with your analyzer system. Conduct trouble-shooting before doing any physical intervention, grab cross-platform screenshots for reports or presentations, the possibilities are endless. The incorporated software flexibility minimizes physical operator intervention. The analyzer screen (the client) can remotely be taken over by means of LAN Ethernet software (such as VNC software). Authorized users can carry out all manual operations and settings from a remote PC. **AppliTOC®** Series of TOC Analyzers can be equipped with MODBUS interface enabling full integration and communication with distributed control systems.

Analysis of multiple streams

AppliTek's integrated multi-plexing unit **ModuPlex®** consists of extra solenoid valves in addition with a special valve control software. This option enables you to monitor up to 3 streams sequentially, reducing the cost per sampling point. Results of each stream can be communicated through individual analogue outputs.

Optimal oxidation efficiency

Although all UV/persulfate TOC analyzers employ similar basic techniques, AppliTek has challenged the boundaries of this technology. **AppliTOC®** uses an adapted version of the standard TOC method in accordance with standard methods USEPA 415.2, ISO 8245 and DIN-EN 1484, by finetuning the oxidation process and optimizing its core performance:

- Elevated reactor temperature
- Elevated UV light intensity
- Formation of an aerosol inside the reactor
- Instrument air serving as source of oxygen

Determination of Total Organic Carbon

The Total Organic Carbon configuration of the AppliTOC® is in fact a measure of the non purgeable organic carbon (NPOC), while the volatile carbon (VOC) and the purgeable carbon (POC) are stripped out and lost for analysis.

The sample is introduced to the inorganic carbon removal stage where acid is added to the sample, dropping to a pH of 2. At this pH the inorganic carbon is converted to carbon dioxide gas which is stripped out from the sample liquid using a sparge gas. This liquid is continuously pumped into the hot UV reactor together with a fixed flow of sodium persulfate and carbon free instrument air. Since the carbon free air will create a dilution effect inside the infrared detector, this gas flow is precisely mass flow controlled.

Inside the dual stage UV reactor, the organic carbon is oxidized into carbon dioxide (CO₂). Leaving the UV oxidation reactor, the liquid is condensed from the gas/liquid stream in the Gas/Liquid Separator. After drying by a PermaPure™ dryer, the CO₂ is measured in the gas phase by a non-dispersive infrared detector. The CO₂ concentration generated from the oxidation process is directly related to the TOC content of the liquid sample.

Determination of Total Carbon

The Total Carbon configuration of the AppliTOC® is a measure of all carbon compounds, inorganic or organic, as well as the volatile compounds.

Liquid sample is continuously pumped into the hot UV reactor together with a fixed flow of sodium persulfate and carbon free instrument air. Since the carbon free air will create a dilution effect inside the infrared detector, this gas flow is precisely mass flow controlled.

The Total Carbon configuration follows the same pathway to the dual stage UV reactor as described for TOC. After drying by a PermaPure™ dryer, the CO₂ is measured in the gas phase by a non-dispersive infrared detector. The CO₂ concentration generated from the oxidation process is directly related to the TC content of the liquid sample.

Determination of Total Inorganic Carbon

Total Inorganic Carbon (TIC) includes all compounds coming from the inorganic carbon removal stage, and includes the purgeable organic carbon (POC) and the volatile organic carbon (VOC). TIC can also be described as the sum of carbon dioxide (CO₂), carbonate (CO₃²⁻) and bicarbonate (HCO₃⁻).

Liquid sample is introduced to the inorganic carbon removal stage where acid is added to the sample, dropping to a pH of 2. At this pH the inorganic carbon is converted to carbon dioxide gas which is stripped out from the sample liquid using a sparge/ stripping gas. Where the TOC configuration will vent the sparged CO₂ gas, the TIC configuration will actually measure this flow with a non-dispersive infrared detector after drying. The CO₂ concentration generated from the inorganic carbon removal stage is directly related to the TIC content of the liquid sample. Since the carbon free air will create a dilution effect inside the infrared detector, the gas flow of the sparge gas is precisely mass flow controlled.

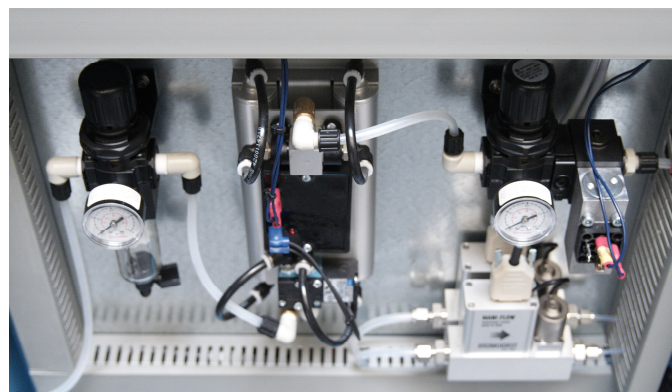
Organic Carbon and volatile compounds:

Determination of “True” TOC

The “True” Total Organic Carbon (True TOC) configuration of the AppliTOC® follows a differential measurement which truly takes into account the volatile (VOC) and the purgeable carbon (POC) in the end result.

Liquid sample is introduced into two separate pathways. The Total Carbon content is oxidized into the hot UV reactor together with a fixed flow of sodium persulfate and carbon free instrument air. As in the full TC analyzer configuration, this gas flow is precisely mass flow controlled. After drying by a PermaPure™ dryer, the CO₂ is measured in the gas phase by the first non-dispersive infrared detector.

At the same time, sample flows to a separate inorganic carbon removal stage where acid is added to the sample and all CO₂ content is stripped out. Again, the sparge gas is precisely mass flow controlled. After drying by a PermaPure™ dryer, the CO₂ is measured by a second non-dispersive infrared detector. The end result is then computed by the controller (TOC True = TC – TIC), reflecting the true, complete organic carbon level of the sample.



From left to right: pressure reducer, carbon removal unit and double mass flow control inside the AppliTOC® (True configuration).

Technical specifications

Analytical unit

Analysis method

Hot-aerosol UV / persulfate method

Measuring ranges

One single range, factory set:

0 – 5 mg C/L	0 – 500 mg C/L
0 – 10 mg C/L	0 – 1,000 mg C/L
0 – 20 mg C/L	0 – 5,000 mg C/L
0 – 100 mg C/L	0 – 10,000 mg C/L

Standard configuration

Total Organic Carbon as non purgeable organic carbon (NPOC)

Other configurations

Total Inorganic Carbon:

TIC + POC + VOC

Total Carbon:

TC = NPOC + POC + VOC + TIC

True TOC:

TOC = NPOC + POC + VOC – TIC

Cycle time

6 - 12 minutes (depending on range)

Calibration

Automatic, free adjustable sequence

Validation

Automatic, free adjustable sequence

Cleaning

Automatic, free adjustable sequence

Detection limit

Better than 250 µg/l (range 0 – 5 mg C/l)

Drift

1% full scale over 72 hours without calibration at 20°C by 100 mg C/l

Precision / Repeatability

Better than 2% full scale for standard solutions

Environmental data

Ambient operating conditions

10 °C – 30 °C +/- 4 °C deviation at 5 - 95% relative humidity non-condensing
(50 °F – 86 °F +/- 7.2 °F deviation)

Reagent temperature

Keep between 10 °C - 30 °C (50 °F - 86 °F)

Sample pressure

Atmospheric up to 0.1 bar (1.45 psi)

Note: higher sample pressures on request

Sample flow rate

10 - 30 ml per minute

Sample particulates

Maximum size 200 µm, < 0.1 g/l

Utilities

Power

220 - 240 VAC, 10 A, 50 Hz

Other voltages available on request

Instrument air

Dry and oil free according to ISA-S7.0.01-1996 quality standard for instrument air

Demineralized water

For rinsing, calibration and/or dilution

Drain

Atmospheric pressure, vented, min. Ø 64 mm

Earth connection

Dry and clean earth pole with low impedance (< 1 ohm) using an earth cable of > 2.5 mm²

Reagents

Number of containers

Inside: 3 (zero, span, cleaning)

Outside: 2 (acids)

Containers come with torqueless screw caps.

Acid reagent

≤ 10 L / 30 days (ranges up to 100 mg C/L)

≤ 20 L / 30 days (ranges up to 500 mg C/L)

≤ 30 L / 30 days (from 1,000 mg C/L and higher)

Sodium persulfate

Max. 20 L / 30 days (500 mg C/L and higher)

Calibration / validation solution

Consumption depends on pre-programmed sequence; at 1 cycle / week 0.3 - 0.6 L / 30 days

Cleaning solution

Consumption depends on pre-programmed sequence; this is determined empirically in accordance with your application

Mechanical data

Protection class

Analyzer cabinet: IP55

Touch screen/Industrial PC: IP65

Cabinet and materials, hinged part

25 % fiberglass reinforced polyester

Inside: chemically resistant, anti-static and easy to clean coating, bottom: leak detection

Cabinet and materials, wall section

Galvanized steel, powder coated

Dimensions

100 cm (39") x 60 cm (24") x 46.5 cm (18")
(H X W X D)

Total weight

65 kg (143 lbs.)

Control and communication

User interface / controller

Industrial PC with 5.7" TFT colour user interface, compact flash memory

Backlit touchscreen, brightness adjustable

Data handling, logging and security

- Standard Ethernet 10 M (RJ45) NE 2000 compatible
- Log files with 1000 values/result are stored
- Sealed USB port for data download/upload
- User interface with administrator access and menu keys activated/inactivated
- Data retention in case of power failure, initialization program for safe status after restart

Analogue outputs

Total: 3, active 4 –20 mA

Max. 500 Ohm load

RS232 / RS485 / MODBUS

Optional

Alarms (digital outputs)

- Malfunctioning alarm (potential free contact)
- Result alarm (potential free contact)

Digital outputs

Remote start/stop, leakage check, reagent check

Emergency stop (front side)

Mushroom type emergency stop button: stops all analysis methods except power supply

Options / add-on units

Carbon removal system

ZeroCarb® air purification system

CO₂ content after removal: < 2 ppm

Filtration

ModuSize® fast-loop filtration system with automatic blowback by solenoid controlled instrument air

Reagent level detection

Installed on reagent containers; alarms are generated by controller software

Multiple streams

ModuPlex® 2 or 3 streams

Ex-proof cabinet

ATEX or NEC 500 compliant

Certification

CE approval

Certified to CE approval

Factory Acceptance Test (FAT)

At AppliTek NV, Belgium.