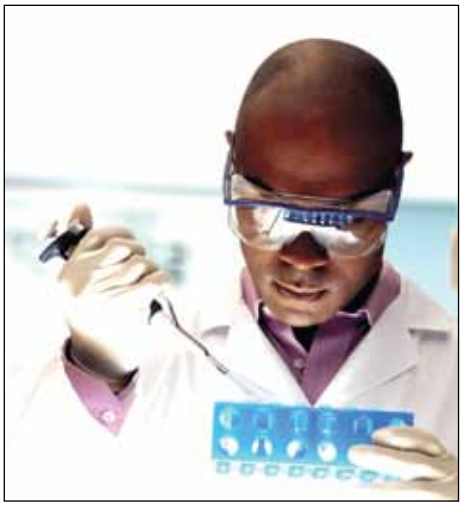
Generating CO_2 Free Compressed Air for Total Organic Carbon (TOC) Analyzers

Market Application Publication



Background:

Total Organic Carbon (TOC) analyzers are commonly used to determine the concentration of organic matter in water. Typical applications include the analysis of water for Clean in Place (CIP) procedures in the pharmaceutical industry, in the analysis of municipal water supplies and sewage. In addition, TOC is used to monitor water used in semiconductor manufacturing and nuclear power plants.

TOC analysis involves the acidification of the sample to remove inorganic carbonaceous material and purging to remove volatile organic compounds (e.g. methane). This is followed by oxidation of the organic matter in the sample (typically via persulfate in a heated quartz tube) to form CO_2 and subsequently by detection of the CO_2 (typically by non-dispersive infra-red spectroscopy.

High purity air is used to drive the CO_2 from the oxidation process to the detector and the purity of the air is a critical issue in the optimization of the sensitivity and operating range of the TOC system. The gas must be free of CO, CO_2 and hydrocarbons and is typically supplied to the analyzer at a pressure of 80-100 psig at a flow rate of 400-800 mL/min to provide a broad operating range. A typical TOC analyzer can detect organic carbon over a range of 4 to 25,000 mg/L. In addition to the analysis of organic carbon in water, a TOC analyzer can be coupled with a nitrogen analyzer (which converts organic nitrogenous compounds to NO and measures of the chemiluminescence of the NO) so that the level of both elements can be determined.

Features and benefits:

- Replaces high pressure gas tanks to supply hydrocarbon-free CO_2 - free gas. Purity exceeds gas purity requirements for TOC analyzers
- Eliminates acquisition and installation of bulky and hazardous compressed air tanks
- Prevents running out of gas during instrument operation
- Extremely low cost of operation, no hidden costs (demurrage, maintaining inventory)
- Minimum environmental impact, while transportation of tanks has a significant negative “green” impact
- Continuous operation with minimum maintenance

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Characteristics of the Air Required for TOC Analysis

The air used for a TOC analysis should contain a minimum of CO and CO_2 to maximize the sensitivity of the system. Parker Balston TOC gas generators can provide 0.625 lpm (Model TOC-625) or 1.25 lpm (Model TOC-1250) of air with a hydrocarbon concentration of <0.05 ppm (Model TOC-625) or <0.1 ppm (Model TOC-1250) of organic carbon (as methane), <1 ppm of CO, <1 ppm of CO_2 with a dew point of <-100°F (-73°C).

Generation of Air for TOC Analyzers

Prefiltration

Two high efficiency coalescing filters are integrated into the system to remove water, oil and particulate contamination from the compressed air supply. The inlet prefilters are equipped with automatic float drains to eliminate any liquids that have accumulated in the filter housings.

In addition, grade BX Parker Balston particulate filters are incorporated into the system to protect internal components from particulate contamination from both the catalyst tower and the Pressure Swing Adsorption (PSA) towers.

Catalytic Removal of Hydrocarbons

A proprietary catalyst is used to convert hydrocarbons and CO into CO_2 and H_2O. The catalyst is located upstream from the PSA towers to ensure that the production of ultra-high purity Nitrogen is not compromised. The catalyst is housed in a temperature-controlled assembly that maximizes the conversion of all hydrocarbons in the compressed air to less than 0.1 ppm.

Removal of O_2, H_2O and CO_2

Pressure Swing Adsorption (PSA) technology is used to reduce the concentration of oxygen, water and carbon dioxide in the compressed air. The PSA system utilizes two sets of adsorbent beds; as one set of beds adsorbs the gases to be removed from the air, the other set purges these contaminants to the atmosphere.

Final Filtration

The final filter is a Parker Balston Grade GS membrane filter that removes particulate contamination to 0.01 micron (absolute) and ensures that the outlet nitrogen is virtually particle-free.

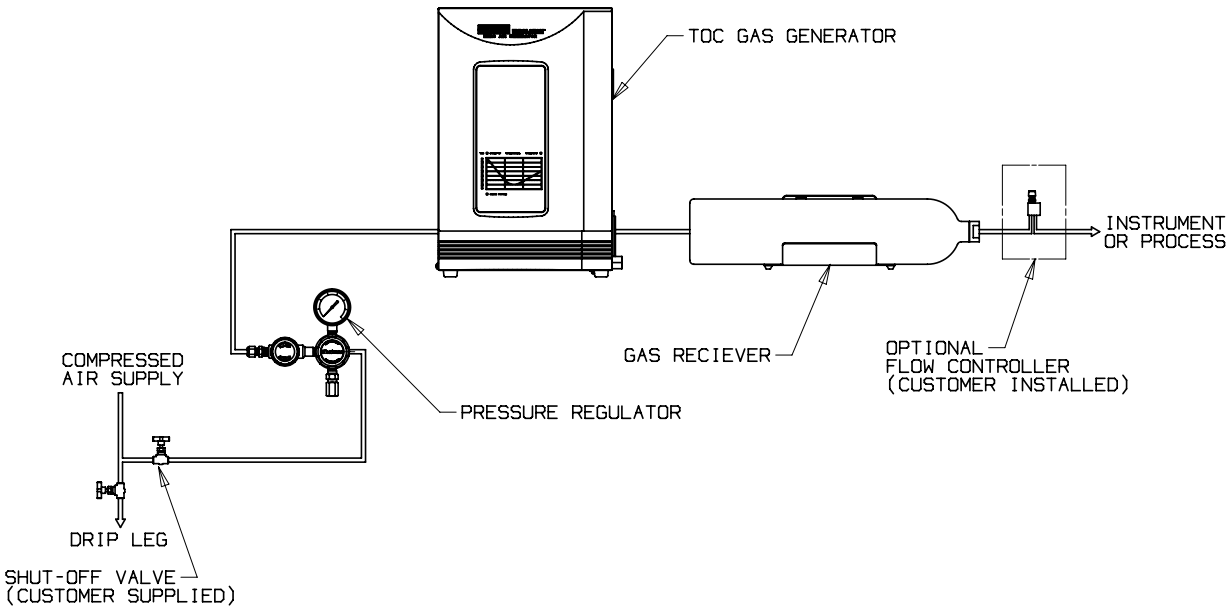

Figure: Schematic Diagram of an In-House Carrier Gas Generator for Total Organic Carbon Analyses

Benefits of In-House Generation of TOC Gas

Safety Considerations
In-house generation of TOC grade gas readily provides the required volume of sufficiently pure gas on demand at a lower pressure than the gas from a cylinder, so that a significantly greater degree of laboratory safety is provided. In addition, an in-house generator eliminates the need to transport cylinders. The Parker-Balston generators meet the requirements of a broad range of safety standards including NFPA and OSHA (1910.103) and regulatory agencies such as the IEC, CSA, UL, CUL and CE.

Convenience
When an in-house gas generator is employed, the TOC grade gas is readily available on a continuous (24/7) basis or can be generated as required with a short system warm-up. Very little maintenance is required; once the system is set up, gas is readily available with no effort on the part of the analyst for an extended period of time.

Elimination of Contamination
When a cylinder is used to deliver TOC gas, the connection between the source of the gas and the TOC analyzer must be broken when a cylinder is replaced. This can lead to the introduction of contaminants such as water vapor, O_2, CO_2 and other materials which may be present in the laboratory atmosphere into the system. These may have a deleterious effect on the TOC measurement. In contrast, when an “in-house” generator is employed, a permanent direct connection is made between the generator and the TOC system, thereby practically eliminating the possibility of contamination.

Cost
The total cost of operation of an in-house generator for high purity air is considerably lower than the use of a cylinder to provide the gas, as the only cost is for the electrical power and periodic maintenance.

Conclusion

A TOC gas generator supplies a continuous supply of hydrocarbon-free, CO_2 free compressed air for a TOC analyzer. An in-house generator is safer and more convenient than the use of bottled gas. In addition, the overall cost is lower and the generator eliminates the requirement for transporting heavy cylinders from the production facility to the end-use location, significant environmental benefits are obtained.

Principal Specifications

TOC Gas Generator	Specifications
Dimensions	TOC-625: 0.625 lpm (650 cc/min) TOC-1250: 1.25 lpm (1,250 cc/min
Outlet Hydrocarbon Concentration (as Methane)	TOC-625: <0.05ppm TOC-1250: <1ppm
Outlet CO Concentration	< 1 ppm
Outlet CO_2 Concentration	< 1 ppm
Dewpoint	< -100°F (-73°C)
Inlet and Outlet Port Connections	¼" NPT (female)
Min./Max. Inlet Air Pressure	TOC-625: 60/120 psig TOC-1250: 65-125 psig
Max. Inlet Air Temperature	78°F (25°C)
Min. Required Inlet Air Flow (at 100 psig)	TOC-625: 2 lpm (2000 cc) TOC-1250: 2.5 lpm (2500 cc)
Max. Inlet Hydrocarbon Concentration (as Methane)	100 ppm
Pressure Drop at Maximum Flow Rate	7 psig
Warm-up Time	TOC-625: 30 min TOC-1250: 45 min
Electrical Requirements (1)	120 VAC/60 Hz, 2.0 A
Dimensions	9 TOC-625:"w x 12.5 H x 16" D (23 cm x 32 cm x 41 cm) TOC-1250: 11 W x 17" H x 17" D (28 cm x 43 cm x 43 cm)
Shipping Weight	TOC-1250: 34 lbs (15.42 kg) TOC-1250: 48 lbs (22 kg)

NOTES
1 Refer to voltage appendix in catalog for electrical and plug configurations for outside North America

Ordering Information

Description	Part Number
TOC Gas Generator	TOC-625 TOC-1250
Maintenance Kit – 12 mo	TOC-625: MKTOC625-12 TOC-1250: MK7840
Maintenance Kit – 36 mo	TOC-625: MKTOC625-36 TOC-1250: Contact Factory
Installation Kit	IMK76803
Preventative Maintenance Plan	TOC-625-PM TOC-1250-PM
Extended Support with 24 Month warranty	TOC-625-DN2 TOC-1250-DN2

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