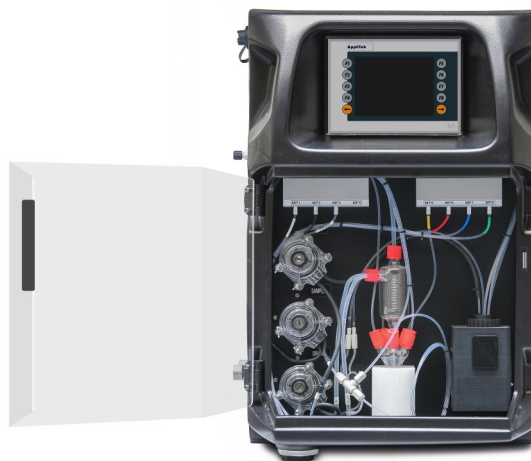


On-line, automatic monitoring of Total Nitrogen (TN) in water and waste water



Advanced features

- On-line, automatic colorimetric measurements conform standard method 4500-N
- Low temperature wet-chemical oxidation
- Second generation design with small footprint, shorter liquid pathways and simple maintenance
- Complete separation between electronics and wet part
- Multiplexing up to eight (8) sampling points possible
- Incorporated industrial PC with AppliTek controller software
- Extended data communication and exchange features

Application fields

- Industrial waste water
- Municipal waste water
- Surface water

High analytical performance

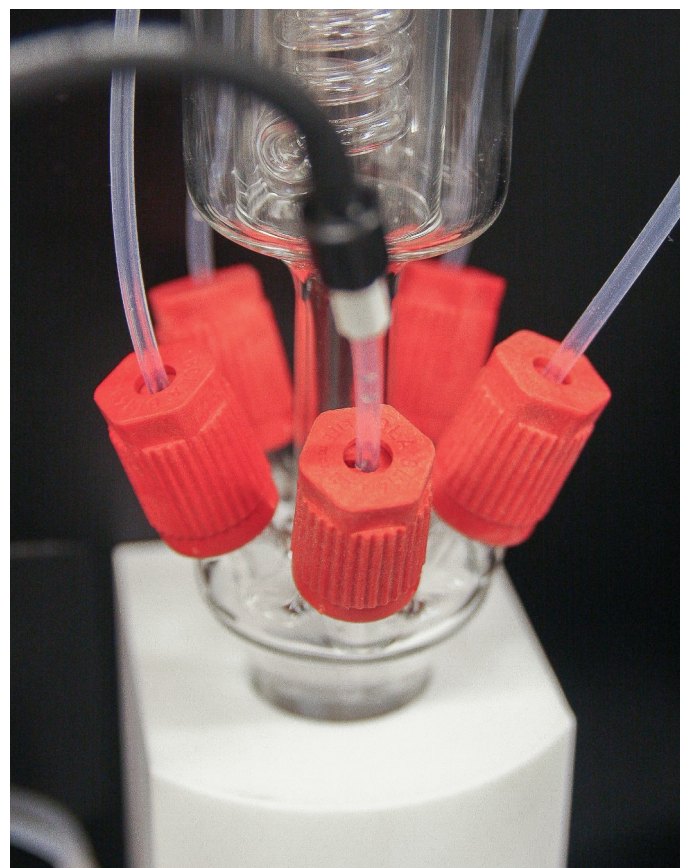
- Full oxidation of all nitrogen components without the need for matrix correction
- No influence from salts in the sample
- Smart features: automatic calibration, automatic validation and automatic cleaning
- Factory configured, tested and calibrated

Introduction

Decomposition of organic material in water produces dissolved and particulate organic nitrogen compounds. At this point, when the water is freshly polluted, nitrogen is originally present in the form of organic nitrogen and ammonia. Natural biochemical processes will slowly convert the organic nitrogen into ammonia, which is the ideal form of nitrogen to be utilized as a nutrient by microorganisms. Under aerobic conditions, the ammonia will further be oxidized to nitrite and nitrate.

While individual levels of ammonia, nitrate and nitrite provide operators of wastewater treatment plants insight in the biological processes, the determination of organic nitrogen is difficult due to the obligatory digestion of the sample. This is the main reason why the quantification of Total Nitrogen has traditionally been done by means of the time-consuming and complex (total) Kjeldahl method, developed primarily for organic nitrogen. Total Nitrogen, as measured by AppliTek, should not be confused with Total Kjeldahl Nitrogen since TN comprises all the components of the nitrogen cycle.

The **TONI®** On-line Total Nitrogen Analyzer, in conjunction with the development of the **TOPHO®** On-line Total Phosphorus Analyzer, was developed to meet the needs for fast and reliable monitoring of **regulatory sum parameters** in all sorts of water bodies. The analyzers share similar unique wet-chemical oxidation techniques in a compact and robust analyzer mainframe that harnesses the expertise from AppliTek's state of the art industrial analyzers.



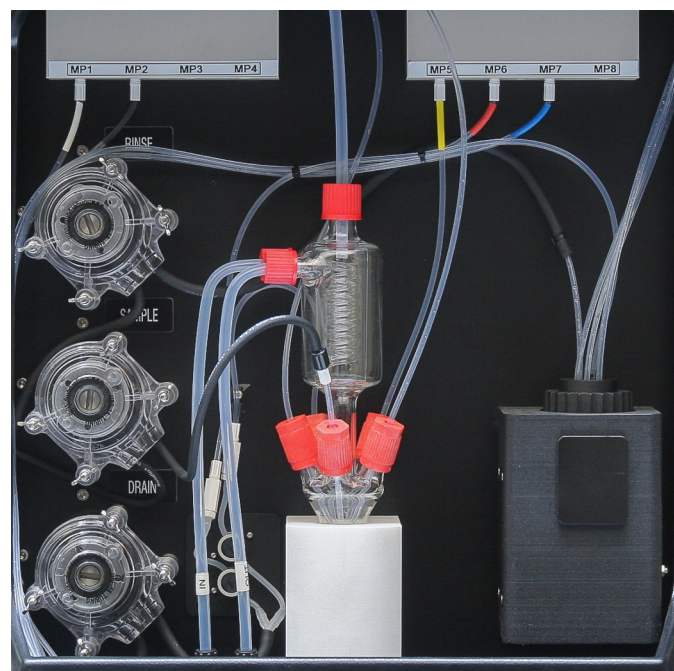
Second generation design

The second generation **TONI®** On-line Total Nitrogen Analyzer, originally introduced in 2001 as a research project, is equipped with a new analyzer enclosure consisting of a solid steel back, combined with an ergonomic ABS hinged part containing the actual wet part. Wet-chemical components are revised for optimal operation and low maintenance:

- Built-in smart automatic functions
- Shorter liquid pathways: reagents, cooling, drain
- Water-cooled reflux condenser for increased stability
- Transparent door allows instant 180° visual inspection
- Reduced environmental footprint (60% weight reduction)

At the heart of the on-line analyzer there is a compact photometer assembly developed by AppliTek and used in all of AppliTek's colorimeters. Consumption of reagents is reduced by low volume analysis, while a long optical path length assures high sensitivity. There is no direct contact between the optical parts and the sample (or reagents added), to avoid fouling or corrosion of the optics. A narrow-band optical filter avoids all influence from ambient light.

High quality components such as our robust precision micro pumps, used for addition of reagent solutions, are controlled by AppliTek's controller software running on the industrial panel PC. Pinch valves outside the analyzer cabinet control the distribution of cleaning, validation and/or calibration solutions.



Images - inside the wet part of the TONI®: close-up of the oxidation oven, micropump trains, long-life peristaltic pumps and photometer assembly.

On-line Analysis of Total Nitrogen

The **TONI®** On-line Total Nitrogen Analyzer runs a chemical analysis based on standard method 4500-N with hydrazine reduction and NEDD color solution after persulphate destruction, yet in a completely automated analyzer mainframe. The industrial panel PC controls all steps of the analysis procedure, including sampling, sample transfer, addition of reagents and reporting of the results.

Step 1: oxidation

The sample is mixed with the oxidation reagents **SuperOxi A®** and **SuperOxi B®** and heated at 120° C in a compact, built-in oven during 10 minutes (standard). During this oxidation/digestion process organic and inorganic nitrogen compounds are oxidized and converted to nitrate.



Step 2: reduction

Since nitrite is the only nitrogen compound that can be measured by means of spectrophotometric detection, the nitrate is reduced to nitrite by means of the reducing reagent (hydrazine sulphate).



Step 3: detection

Detection takes place in the photometer assembly where also the color complex is formed. In acidic medium, nitrite reacts with the color reagent to produce a violet azo complex. The absorption of the solution is measured at 540 nm with the photometer and is directly related to the Total Nitrogen level in the sample (based on Lambert-Beer law).



Smart functions

Auto-cleaning, auto-calibration, auto-validation

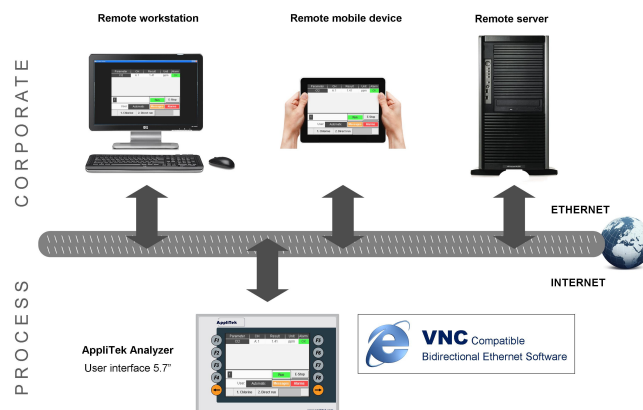
Enhanced analytical performance, minimized down-time and negligible operator intervention are essential when it comes to reliable and trouble-free on-line analysis. The **TONI®** On-line Total Nitrogen Analyzer comes standard with several possibilities, beginning with a cleaning cycle with demineralized water of the sample lines, oven and photometer, in order to eliminate cross interference.

Automatic calibration and validation cycles with standard solutions can be programmed in order to check the analysis program and analyzer functionality. AppliTek's controller software allows to program the sequence and interval of validation and cleaning, as well as the analysis cycle. The software can be set to generate alarms when calibration fails, results are out of range or when reagent containers are close to empty.

Data exchange and supervision

AppliTek on-line analyzers come with industrial 4-20 mA outputs, the most common analogue transmission standard available. Ethernet communication by means of the industry-standard TCP/IP protocol enables easy and reliable integration into existing corporate networks. MODBUS interfacing is possible to assure full integration and communication with distributed control systems (DCS).

All actions and logs of the **TONI®** On-line Total Nitrogen Analyzer are controlled by the incorporated high quality industrial panel PC. The flexibility of the controller software makes it easy to gain access to the analyzer system and 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, such as trouble-shooting before doing any physical intervention and capturing cross-platform screenshots for reports.



The solid state data logger of the panel PC allows to record a history of the records of the last 1,000 analysis results can be visualized in a chronological data table and equally be exported as Microsoft Excel files through the sealed USB port outside the analyzer cabinet.

The image shows two screenshots. The top one is a data table from the analyzer's interface, and the bottom one is an Excel spreadsheet showing the same data exported.

Nr	Date and time	Str	VFA (ppm)	BIC (mg/l)
1	Thu Mar 20 08:22:24 2014	1	582.39	28.03
2	Thu Mar 20 09:11:45 2014	1	582.39	28.04
3	Thu Mar 20 09:00:27 2014	1	583.62	28.03
4	Thu Mar 20 08:48:42 2014	1		
5	Thu Mar 20 08:38:01 2014	1		
6	Thu Mar 20 08:28:54 2014	1		
7	Tue Mar 18 17:08:54 2014	1		
8	Tue Mar 18 15:50:55 2014	1		
9	Tue Mar 18 18:29:07 2014	1		
10	Tue Mar 18 18:24:11 2014	1		
11	Tue Mar 18 18:10:05 2014	1		
12	Tue Mar 18 15:55:48 2014	1		
13	Tue Mar 18 15:41:27 2014	1		

The Excel spreadsheet below shows a 'STREAM STREAM STREAM' table with columns for 'Date and time', 'VFA (ppm)', and 'BIC (mg/l)'. It contains the same data points as the analyzer's table, including the date 'Tue Mar 18 15:41:27 2014'.

Technical specifications

Analytical data

Analysis method

Standard method 4500-N

Colorimetric measurement using hydrazine reduction and NEDD color solution after persulphate destruction in alkaline medium

Parameter

Total nitrogen

= Org N + NO₃-N + NO₂-N + NH₄-N

Standard measuring ranges

One single range, factory set:

0 - 5 mg/L N

0 - 20 mg/L N

Note: higher ranges available by sample dilution

Cycle time

30 minutes including oxidation of 10 minutes

Note: oxidation time can be set to 60 minutes for difficult samples

Calibration

Factory calibrated

Cleaning

Automatic, free adjustable sequence

Detection limit

Better than 0.2 mg/l (range 0 - 5 mg/L)

Precision / Repeatability

Better than 4% full scale for standard solutions

Utilities

Power

220 - 240 VAC, 2 A, 50 Hz

Max. power consumption: 120 VA

Other voltages available on request

Instrument air (purging)

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

Tap water

Cooling of the condenser

Demineralized water

Cleaning 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

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

By external overflow vessel

Sample flow rate

Fast loop sample supply required - minimal flow rate depends on application

Sample particulates

Maximum size 40 µm, < 0.1 g/l

Reagents

Reagent containers (included)

Outside cabinet: 6 (8 with calibration/validation)

Containers come with torqueless screw caps.

Oxidizing solutions

SuperOxi A® ≤ 10 L / 30 days *

SuperOxi B® ≤ 5 L / 30 days *

Other solutions

Buffer solution ≤ 2 L / 30 days *

Reducing solution ≤ 7 L / 30 days *

Color solution ≤ 2.5 L / 30 days *

* Based on 1 analysis result/120 min

Cleaning solution (recommended)

Demineralized water / specific chemical solution

Mechanical data

Protection class

Analyzer cabinet: IP55

Touch screen/Industrial PC: IP65

Cabinet and materials, hinged part

Thermoform ABS / Door: plexiglass

Cabinet and materials, wall section

Galvanized steel, powder coated

Wetted materials

PE / PTFE / PP / PFA

Dimensions (H X W X D)

69 cm (27.2") x 46.5 cm (18.3") x 33 cm (13")

Total weight

25 kg (55 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
- Communication ports supporting Ethernet connectivity to MODBUS TCP/IP
- Log files with 1,000 values/results are stored
- Easy export to spreadsheet files
- Sealed USB port for data or result graph download and program 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

Maximum 8, active 4 –20 mA

Max. 500 Ohm load

Alarms (digital outputs)

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

MODBUS TCP/IP, MODBUS-RS232 -RS485

Optional

Options / add-on units

Sample preconditioning I

EZ-Size® self-cleaning filtration unit, various pore sizes available, requiring fast loop

Sample preconditioning II

MicroSize® self-cleaning microfiltration unit, various pore sizes available

Reagent level detection

Installed on reagent containers; alarms are generated by controller software

Multiple streams

ModuPlex® 2 or 3 streams (8 on demand)

Certification

CE approval

Certified to CE approval

Factory Acceptance Test (FAT)

At AppliTek NV, Belgium.