



On-line waste water TOC-analyser Model Quick-TOC, with TN option

General description

The on-line TOC-analyser of LAR Process Analysers AG determines the Total Organic Carbon content of process water, waste water or cooling water. This analyser is designed and suitable for use in an industrial area.

The Quick-TOC uses a patented injection system. A precise volume of waste water is injected into the thermal oxidation reactor. At a temperature of 1200 degree Celsius all inorganic- and organic carbon will be fully oxidised (100% recovery). No catalyst is used. The amount of carbon dioxide, that is formed during the sample combustion, is linear proportional for the amount of TOC/TIC in the sample. Carbon dioxide is measured via a nondispersive infrared CO₂ analyser (NDIR). The peak area calculation method that is used, results in an excellent repeatability and long term stability. Furthermore the advantage of using the 1200 °C thermal oxidation technique is: no memory effects, a rapid response to big concentration changes and a fast analysis cycle time of 3 minutes (TC). An other advantage is that carry over effects are very low meaning that this analyser is very suitable for 2-stream, multi-stream and multi range applications. This analyser operated via a full programmable robot that controls the functions and positions of the robust injection needle. Only a few parts are in contact with the waste water: sample inlet tube, sample overflow vessel, sample outlet tube and an optional sample pump. After every waste water injection, the injection needle is flush with rinse water. This all results in a minimum of maintenance.

The injection volume is full programmable from 10 to 400 micro litre making the analyser very suitable for many applications from 1 to 100.000 mg/litre C.

For water with a low TOC-content, such as cooling water and effluent water, a high sample volume is injected or/and a more sensitive NDIR-sensor is used.

For very polluted water, such as process water and influent water, a low sample volume is injected and a less sensitive NDIR sensor is used.

The Quick TOC-analyser is available as a: Total Carbon Analyser (TC-analyser) or Total Organic Carbon analyser via the direct method (TOC-direct) or Total Organic Carbon Analyser via the differential method (TOC-differential).

Other models or combinations available are:

- TONb: Total Organic Carbon (TOC) + Total Nitrogen (TNb)
- TOC/COD: Total Organic Carbon (TOC) + fast Chemical Oxygen demand (fast COD method = Total Oxygen Demand)
- VOC: Volatile Organic Carbon Analyser
- POC = Purgeble Organic Carbon Analyser).

ODS delivered many Quick-TOC's to all kind of industries. They are used for "influent monitoring, spill detection, effluent monitoring, process control, monitoring of cool water streams. This TOC-analyser measures fast and accurate.



The Quick-TOC-analyser operates via advanced injection technique by use of a robot and thermal combustion at 1200 degree Celsius



On-site hands-on training



Export project: TOC at a Waste Water Treatment Installation



TOC-analyser with reagent cabinet



Big graphical LCD-display





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Features of the Quick-TOC

- Big graphical display and alpha numeric keyboard.
- The thermal oxidation technique at 1200 degree Celsius guarantees complete oxidation (100% recovery).
- Also organic particles (particulate organic carbon) will be oxidised completely.
- At 1200 degree C. memory effects are minimum resulting in a fast analyser response.
- Fast analyses time of 3 minutes (TC) and 5,5 minutes (TOC)
- Very stable analysing results due to the batch injection technique, auto zero technique and peak area calculation. Zero drift = 0 mg/litre C. per year.
- Programmable injection volume offers flexibility in optimising and setting the analyser range.
- Low reactor salt built up due to the low volume injection method & 1200 degree oxidation.
- Free programmable robot technique offers configuration flexibility such as
- Very low carry over effects making the analyser suitable for 2-stream analyser, multi-stream and multi range application
- Low maintenance because of a patented flush system that cleans the injection system (needle) after every sample injection.
- A sample inlet filtration or conditioning is normally not needed.
- Low consumption of a concentrated acid solution (only TOC-analyser use acid)
- Easy manual or automatic/daily calibration and easy validation due to internal robot selectable calibration vessel.
- Easy analyser inspection due to self diagnostic software and extra diagnostic sensors such as carrier gas inlet & outlet flow measurement, relative humidity sensor (option), circuit pressure measurement.
- Data presentation and data storage. internal memory and data logger. USB and RS-232 interface.
- Cabinet with a separate dry compartment for all electrical parts and a wet compartment for all analyses parts. Easy access for analyser maintenance.

Total Carbon:

Dry and CO₂-free carrier gas flows through the high temperature reaction tube (1200°C). Then the carrier gas flows through a gas/sample cooler and a gas scrubber. The dry and clean carrier gas then flows through the NDIR CO₂-analyser. Prior to injection the NDIR measures the base line zero value.

The robot controls the needle position and sample suction syringe. The needle is positioned into the sample overflow cup and is filled precisely with a programmed fresh sample volume.

Then the robot positions the needle into the injection inlet port. A needle sensor detects the needle and opens the inlet cock valve. Then the needle is positioned deep into the 1200 degree reaction tube and a precise volume of sample is injected.

Organic carbon and inorganic carbon is completely oxidized to CO₂ (and H₂O and NO_x etc.). No catalyst is used.

The carrier gas "transports" the CO₂ to the NDIR CO₂ gas analyser. Via peak area calculation the amount of CO₂ is determined. By comparing the outcome to wet calibrations, the Total Carbon concentration in the waste water is calculated.

Total Organic Carbon; direct:

The TOC-concentration is determined by pre treatment of the sample via acid, prior to injection of the sample into the thermal oxidation reaction tube.

The Carbonate Removal System:

The sample is mixed with a strong acid solution (for example 1% of HCl). The pH of the mixture is < 2,5. This acidified sample flows into a mixing vessel and during a specific period CO₂-free carrier gas bubbles through.

At a pH < 2,5 Inorganic Carbon (Carbonates) react as follows:
 $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) = \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

The (bi)carbonates and free CO₂ are stripped out of the sample as CO₂ gas.

Next the sample is sucked into the injection needle and injected into the high temperature reaction tube. All exactly as with the TC-method (described left).

The outcome is presented and stored as the TOC-concentration.

The TOC-direct method is also known as the Non Purgable Organic Carbon method (NPOC). It is less suitable for samples with organics that are Purgable or volatile because they can partially being stripped out during the carbonate removal step.

Total Organic Carbon; differential:

The TOC concentration is determined via two different analysing steps.

Step 1: The Total Carbon content (TC) of the sample is analysed. (same as TC).

Step 2: Then the Total Inorganic Carbon (TOC) content is analysed

The Total Organic Carbon content is then calculated via $\text{TOC} = \text{TC} - \text{TIC}$

Analysing total inorganic carbon (TIC):

An extra TIC-reaction vessel is used. Via a peristaltic pump a 1% phosphoric acid solution is pumped into this TIC-vessel. Via an overflow the solution level is kept constant. CO₂ free carrier gas bubbles through the acid solution. Then this carrier gas leaves the TIC-vessel and flows to the NDIR gas analyser. The CO₂-baseline is measured and stored.

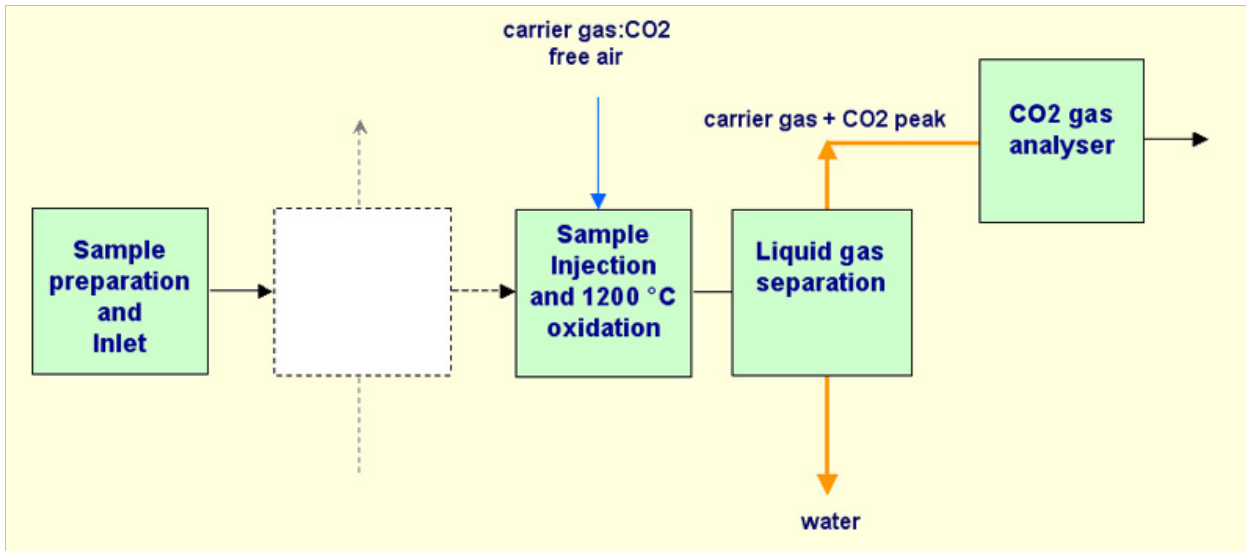
Now the robot positions the injection needle into the sample overflow vessel and sucks an exact volume of sample. The needle is moved and positioned into the TIC-vessel and this sample is injected into the acid solution. Inorganic carbon reacts with the acid (pH < 2,5) to CO₂ gas. The stripping gas, bubbling through the TIC-vessel, then transports the CO₂ gas to the NDIR-analyser, where the CO₂-peak is measured and the TOC-concentration is calculated.

The TOC-differential method presents TC, TIC and TOC-data.



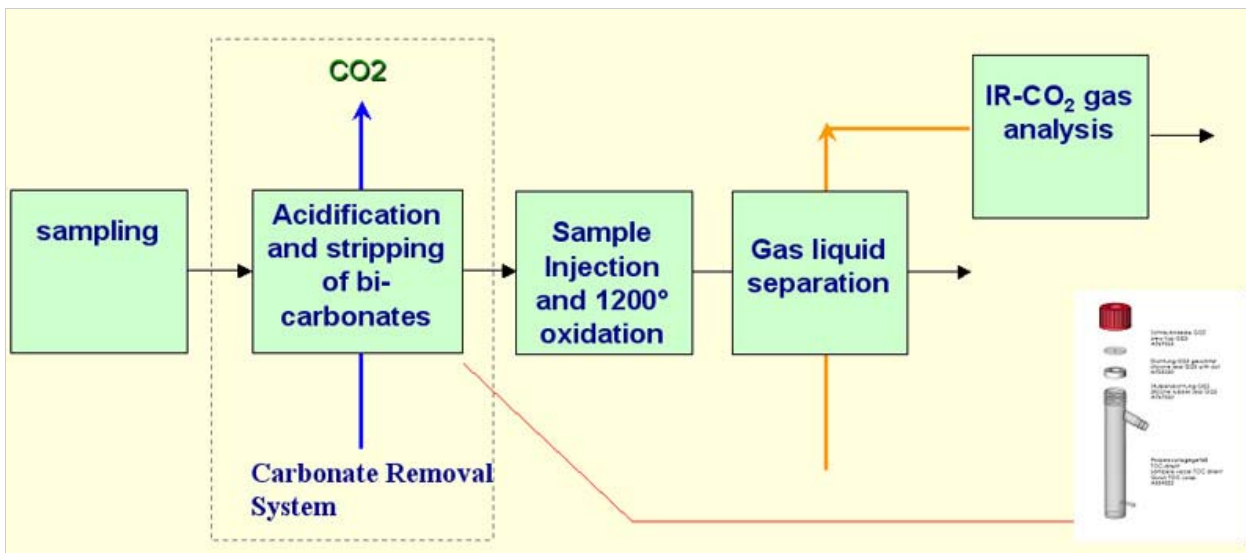


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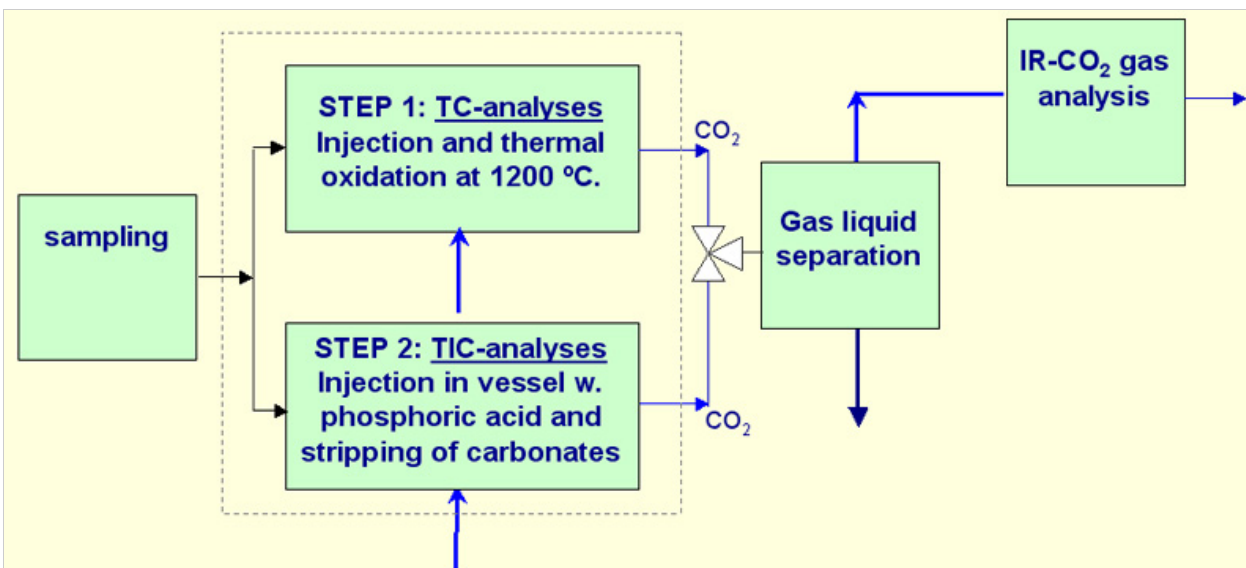
TC-method

Determination of total carbon content by thermal combustion and analyses of resulting CO₂.



TOC-direct method

Determination of the organic carbon content by thermal combustion and CO₂ analyses with removal of inorganic carbon compounds.



TOC differential method

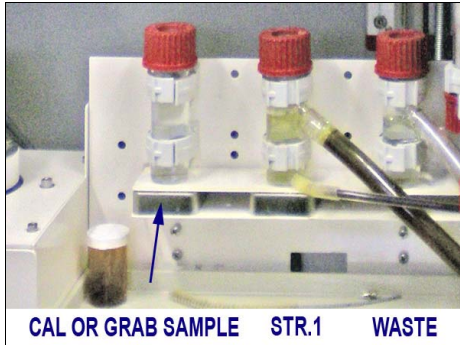
Determination of organic carbon content by thermal combustion and CO₂ analyses with correction of inorganic carbon compounds.
TOC = TC - TIC.





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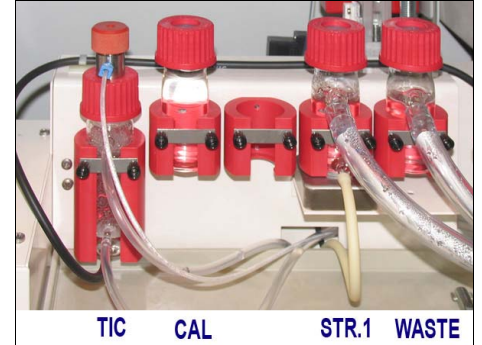
YOU NAME IT ... WE BUILT IT



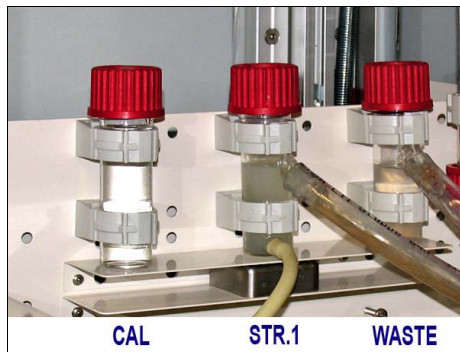
TC-analyser
1 stream



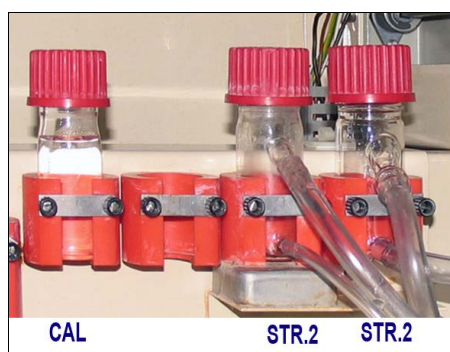
TOC-analyser, direct method
1 stream



TC, TIC & TOC-analyser differential
1 stream



TC + TNb-analyser
1 stream



TC & TNb-analyser
2 streams



TC, TIC & TOC-analyser differential
2 streams

The robot in combination with the free programmable software offers unique flexibility. Furthermore the hardware is designed and pre-constructed in such a way that it is easy to change an analyser functionality or measuring principle.

Examples of standard functionality:

- Flush the sample system during service or set-up,
- Do a single point measurements of a standard or a grab sample. Evaluate the repeatability and mark outliers.
- Automatically analyse samples, flush the sample system with water, flush the rest water to drain.
- Do a calibration routine on demand or automatically

Examples of hardware and measuring principle changes:

- Total Carbon; 1 stream or Total carbon 2-streams
- Total Organic (direct method); 1 stream or 2 streams
- Total Carbon, Total Inorganic Carbon, Total Organic Carbon (TOC-differential); 1 stream or 2 streams
- Total Carbon & Total Nitrogen; 1 stream or 2 streams
- Total Organic Carbon & Total Nitrogen; 1 stream of 2-streams
- Total Organic Carbon and fast Chemical Oxygen Demand (Total Oxygen demand); 1 stream or 2-streams

You name it, we built it.



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Total Nitrogen, Quick TNb option:

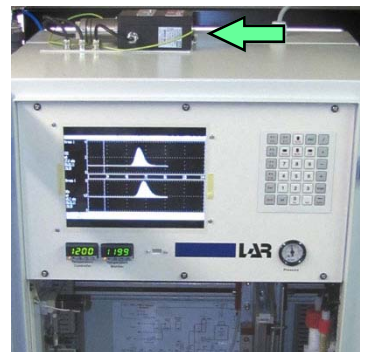
This unique Quick-TOC analyser can be offered with an additional Total Nitrogen measurement. This so called TNb option operates as follows:

- A NO(x) analyser or NO-sensor is mounted. It is measuring in series with the NDIR CO₂-analyser.
- The sample is injected into the 1200 degree Celsius reaction tube. Total organic nitrogen in the waste water will be oxidized to nitrogen oxide. Only for high ranges a Pt catalyst will be added. The amount of nitrogen oxide is measured via the NO(x)-analyser or NO-cell. The "NO-peak area" is measured and the TNb concentration is calculated. This all happens parallel, and at the same time, as the TOC-analyses takes place.

Two TNb options are available:

- Measurement via a NO-selective electrochemical cell. This option actually has an attractive price. The technique is simple, the size of the extra measuring box is small and maintenance is very low. Every year or one and a half year the NO-cell needs to be replaced. The measuring range and analytical performance depend on the sample injection volume and the cell that has been selected. Examples of available ranges are: 10 to 500 mg/litre TNb or 1 to 50 mg/litre TNb. The experiences with the electrochemical cell are pretty good and it gets to be the preferable method.
- Measurement via a chemiluminescence NOx analyser. The extra cabinet on top of the TOC is much bigger. It uses a more advanced measuring technique resulting in better analytical performance. Some periodic specialised maintenance is needed, for example to clean the optical reaction cell. The chemiluminescence analyser has a large dynamic range, for example: 1-50 or 10-500 mg/litre TNb.

ODS/LAR also offers a single Quick-TNb analyser.



Quick-TOC & TNb analyser with electrochemical NO-cell



Quick-TOC & TNb analyser with chemiluminescence Nox analyser

Hardware / analyser cabinet

The Quick-TOC-analyser is built in a rugged steel coated cabinet. It has two separate compartments with next features:

- Dry compartment (back) for the power supply, electronics, PCB's and microprocessor board, a big graphical display, membrane switch board.
- Wet compartment (front) for the robot, sample vessel, sample magnetic stirrer, injection system, reaction tube and heater, peristaltic pumps, cooler.
- Both compartments are easy accessible for maintenance.
- Suitable for wall, frame or strut mounting.
- Ex p cabinets for ATEX zone 2 or Atex zone 1 are available.

Projects

ODS offers also a system integration package consisting of know how and additional equipment and complete analyser packages: :

- Waste water pump system,
- Fast sample loop with anti-isokenetic sampling point,
- Utilities such as zero air supplies
- Complete walk in shelter

We offer:

- Engineering;
- A Factory Acceptance Test and Site Acceptance Test
- Documentation package, drawings and manuals
- Installation and commissioning & start-up
- Training



ODS project with walk in shelter and fast sample loop



Quick-TOC with zero air supply

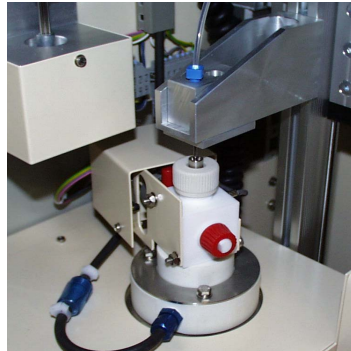




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Easy to operate and easy programming



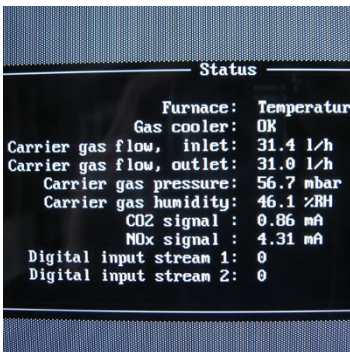
The injection port and robot with injection needle



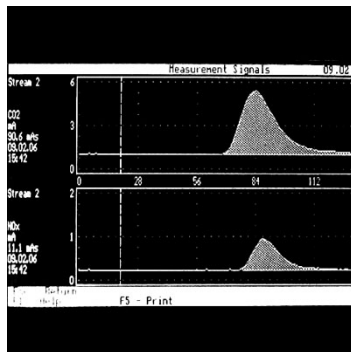
Quick-TOC-differential with TIC-reactor (left)



Easy access for service



Service menu with information screen: carrier gas flow etc.



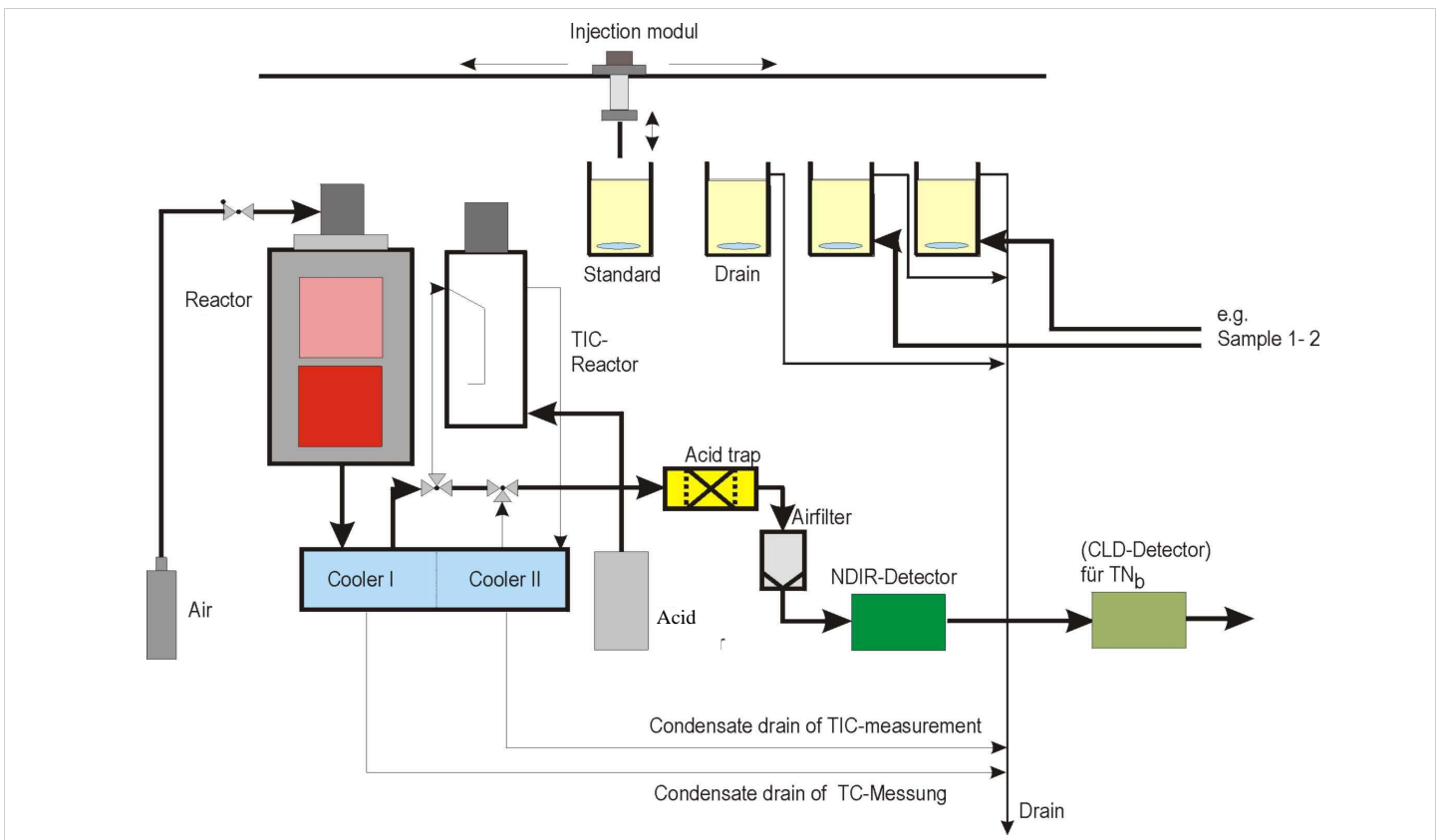
Peak area measurement with auto zero technique; TC + TN



A big graphical screen



Easy menu with alphanumeric membrane keyboard





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Total Organic Carbon Analyser, model Quick-TOC Specifications

| | |
|---|--|
| Type | Model Quick-TOC |
| Manufacturer | LAR Process Analysers AG, Germany, Berlin |
| Analytical Method: | Determination of the organic carbon content via thermal combustion of the sample at 1200 degree Celsius and the analyses of the resulting carbon dioxide. Conform DIN EN 1484, ISO 8254 en EPA 415.1 |
| Use | Stationary On-line |
| Typical applications | Influent & effluent of a WWTP, storm water monitoring ,cool water, spill detection, process water monitoring and control etc. |
| Ranges (milligram/litre C.) | 0 to 10 up to 0 to 100.000 (to be specified) |
| Repeatability, CV (% of measured value, 25 to 100% of scale) | Typical < 2 |
| Reproducibility (%) | Typical < 1%; drift : 0 mg/litre C. per year due to auto zero technique |
| Cycle time (minutes) | Typical TC: 3 ; TOC: 5,5 |
| Type of detector | NDIR infrared, no moving parts; maintenance free |
| Sample requirements: | |
| <ul style="list-style-type: none"> • Pressure (bar) • Flow (ml/min.) | <ul style="list-style-type: none"> • Slight overpressure; 0,05 tot 0,2 • Internal overflow sample vessel (no sample pump) 50 tot 500; with sample pump: 30 ml/min. during programmable sample time. • Up to 15 gram; higher salt or brine range by use of pre-dilution • 60 • Maximum 800; typical 500 |
| <ul style="list-style-type: none"> • Salt; as NaCl (gram/litre) • Temperature maximum • Organic Particles (micrometer) | |
| Sample conditioning: | |
| <ul style="list-style-type: none"> • Filtration • Fast sample loop | <ul style="list-style-type: none"> • No, not needed. • Yes, preferable. • We advise to use the anti-isokinetic sampling technique to separate big particles with high mass. |
| Analyser Cabinet | |
| <ul style="list-style-type: none"> • Type • Door • Dimensions; outside; h x b x d (mm) • IP class • Area | <ul style="list-style-type: none"> • Steel, coated, grey, dry and wet compartment, two sets of hinges • Door: with securit window • 1860 x 600 x 500 (plus glands, mounting brackets etc.) • IP 44 (to be mounted inside in a factory or analyser walk in shelter) • Non hazardous (optional Ex zone 2 or zone 1) |
| Preferable space needed for mounting the analyser, connecting inlets and outlets, maintaining and operating the analyser | <ul style="list-style-type: none"> • Floor: 1100 mm x 1100 mm (W x D) • Wall: 2000 mm x 1100 mm (H x W) |
| Weight (kg): | <ul style="list-style-type: none"> • 120 |
| Ambient conditions: | |
| <ul style="list-style-type: none"> • Temperature; (°C.); Relative Humidity (%) | <ul style="list-style-type: none"> • 10 to +40; max. 95% (non condensing) |
| Power; | |
| <ul style="list-style-type: none"> • Voltage / Frequency (V, Hz) • Fuse (A) • Power Dissipation, during start-up, typical (VA/ Watt) | <ul style="list-style-type: none"> • 230 / 50; (optional 110 / 60) • 16 • 1100, 800 |
| Carrier gas requirements: | |
| <ul style="list-style-type: none"> • Quality • Consumption (normal litres per hour) • Pressure (barg) | <ul style="list-style-type: none"> • Dry and free of particles, CO2 and hydrocarbons • Typical TC or TOC-differential: 30, TOC-direct: 45 • 1,5 to 6 |
| Acid solution; strength and consumption | <ul style="list-style-type: none"> • TC; not needed. • TOC-direct; 1% hydrochloric acid; 2 ltr/wk (or less when cycle time is longer) • TOC-differential; 1% phosphoric acid; 2,5 ltr/wk (or less when cycle time is longer) |
| Rinse water (litre/week) | 1 or 2; depends on cycle time |
| Certificering | CE |
| Electrical cables | Via Glands; top of cabinet |
| Signals: | |
| <ul style="list-style-type: none"> • Analogue outputs • Relays / alarms • Serial RS232 | <ul style="list-style-type: none"> • 2 each, 4-20 mA; isolated, active, max 500 ohm; free programmable • 4 each; contact closure; free programmable; fail safe • Can be used for serial data readout, a printer, auto sampler |
| Materials; wetted parts (sample) | Inlet tube, nylon, overflow vessel, (glass ; drain tube, PVC; injection needle, stainless steel 316; reactor. Ceramic; pump (TOC), viton |
| Mounting: | |
| <ul style="list-style-type: none"> • Wall • Hardware | <ul style="list-style-type: none"> • Solid, horizontal, for example concrete • 4 expender bolts; M8 (part of the delivery) |





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| <p>Extra diagnostic sensors:</p> <ul style="list-style-type: none"> • Thermal Mass Flow, carrier gas inlet • Thermal mass Flow; carrier gas outlet • Pressure sensor; reactor pressure and pressure pulse • Option: Relative Humidity sensor; after condensate cooler | <p>Measures status of:</p> <ul style="list-style-type: none"> • Carrier gas consumption, blocking of the oven outlet • Leakage in the gas circuit; differential inlet/outlet carrier gas flow • Blocking of the reactor output or gas circuit; checks sample injection via dP • Checks good operation of cooler, checks sample injection via delta RH |
| <p>Data and program settings: download/upload:</p> | <ul style="list-style-type: none"> • USB connection; internally; for service only. • Data transfer of 24-hour data profiles |
| <p>Service menu:</p> <ul style="list-style-type: none"> • Service • Calibrate • Status; tests • Test run • Setting of alarm parameters • Observe measured values of sensors | <ul style="list-style-type: none"> • Flush injection system or sample lines, Furnace on/off, Condensate pump on/off • Manual validate or calibrate, daily automatic calibration • Relays, signal outputs, oven, cooler etc. • Check settings and fine-tune robot positions. • Pressure, delta P, carrier gas flow balancing and limits, R.H. limits etc. • NDIR-signal, graphical curve, carrier gas inlet and outlet etc. |
| <p>Guaranty (year)</p> | <p>1 year after delivery; wearing parts and consumables excluded</p> |
| <p>Documentation: Manuals, drawings, spare part listing</p> | <ul style="list-style-type: none"> • User manual available in the English language; drawings, schematics included. • Technical training manuals on request |
| <p>Maintenance and routine service:</p> <ul style="list-style-type: none"> • Calibration • Cleaning of sample system • Inject-port • Outlet reactor • Pump tubes, condensate pump and sample pump • Scrubbers | <p>(depends on application and local conditions)</p> <ul style="list-style-type: none"> • 1x per 2 weeks • 1x per month / clean applications: 1x per 2 month • 1x per month / o-ring replacement • Depends on salt content and injection volume; 1x per 6 month; 1x per month • 4x per year; replace • 4x per year; replace content (brass and zinc) |
| Options | |
| <p>Options:</p> <ul style="list-style-type: none"> • 2-stream; 2x sample streams • Special cabinet for corrosive environment • Atex Zone 2 or Zone 1; special cabinet • TNb | <ul style="list-style-type: none"> • Includes: overflow vessel + stirrer, 2x 4-20 mA; sample & hold; software • Stainless Steel; hermetically closed, integrated air heat exchanger & fan • Type LAR; Ex p Günheimer; with integrated air cooler via heat exchanger • Via thermal or catalytical (Pt) combustion; Electrochemical NO-cell or chemiluminescence NOx analyser |
| <p>Options and utilities (outside the analyser):</p> <ul style="list-style-type: none"> • Dilution panel • Multi stream (> 2 streams) • Exp Zone 2 of Zone 1 • Sample pump, sample loop, sample probe • Zero air generator | <ul style="list-style-type: none"> • 1:2 to 1:50; Optional Ex • consult ODS • EX p cabinet with vortec coolers • ODS delivers complete analyser packages • Several types and models; low maintenance. Outlet CO₂ <1 ppm |



Specifications are subject to change by manufacturer or ODS without notice due to modifications or improvements

revision: 2012-01

