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dtli.

TECHNICAL DOCUMENTATION

NITRATE ANALYZER NT200

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1 Nitrate analysis – Principle and detailed description of the instrument

1.1 Main characteristics


1.1.1 Technology

The NT200 analyzer is a UV spectrometer tuned on the wavelength nitrates absorb at. It does perform a selective measurement taking into account the turbidity and the presence of interfering species if necessary.

The UV source of the analyzer is a xenon lamp which is ensured a very low energy consumption and a long life time (more than two years if a measurement is made every 15 minutes) thanks to a specially designed feeding mode. Many successive flashes are started for each analysis and the mean of all the results is calculated by the analyzer in order to ensure the perfect reproducibility of the measurements. Any electronic disturbance likely to affect the result of the analysis is detected by the analyzer and sets a default off.

The measurement is expressed in mg/L NO_3^- or in mg/L of nitrogen. The measurement unit is made by the user himself on the keyboard of the analyzer. The analyzer is calibrated at the factory and therefore requires no re-calibration. The use of UV spectrometry ensure the reliability of any measurement over long-termed periods.

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The measurement results can be remotely transmitted using a 4 - 20 mA output. The range of variation can also be set by the user.

Measurement principle
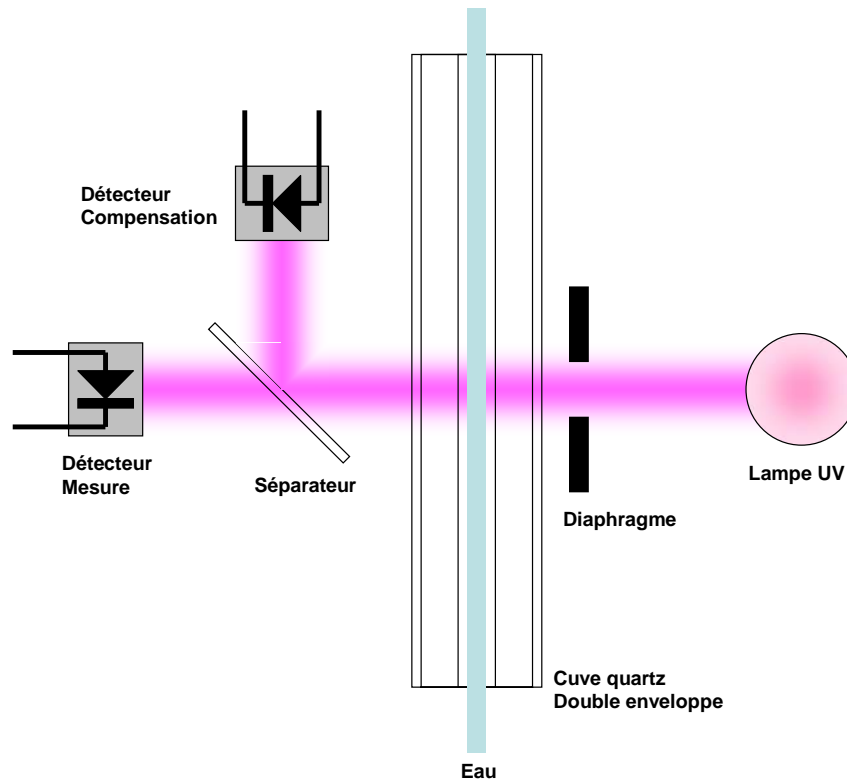
1.1.2 Range and accuracy

The NT200 analyzer measurement range is 0 to 250 mg/L NO_3^-

If no periodical zero calibration is performed, the zero drift of the analyzer is less than 4% of the measurement range over a year.

Measurements are still possible if the turbidity of water exceeds 100 NTU.

The accuracy of all measurements is about +/- 2% of the measured value on clear water in the 0 - 100 mg/L NO_3^- range. The resolution is better than 0.1 mg/L NO_3^-. Between 100 and 250 mg/L NO_3^-.the accuracy of the measurement decreases down to +/- 10% at the end of the range.

1.1.3 Measurement cycle and result values recording

The NT200 can make an analysis every minute . The delay between two measurements can be set from 1 minute up to 12 hours .
Measurements are systematically stored in the internal memory when the analyzer runs in automatic measurement mode. In manual measurement mode a recording may be performed using the memory key on the keyboard.
Each recording contains:

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✓ Date and time of the measurement
✓ The concentration of nitrates in mg/L NO_3^-.

Manual measurements can be carried out on sample without disconnecting the feeding pipes of the analyser, thanks to the automatic cleaning system pumping facility. In that case, neither 4-20mA output updating nor memory storing will take place.

1.1.4 Energy / power supply

The NT200 is a stand-alone analyzer and is provided energy from an internal 12 Volt battery. The built-in battery charger keeps the battery fully charged when connected to 120/240 V power supply.

1.1.5 Recorded values downloading

The memory stored measurements can be down loaded in a computer using two possibilities:

✓ Through a direct communication between a computer and the RS232 Input/Output of the analyser.
✓ Through a phone line, when using a dedicated modem option.

1.1.6 Alarm relays

The NT200 has two threshold alarm relays. The threshold value can be set by the user on the field.

A fault relay is switched when the analyser meets conditions making the measurement impossible.

1.2 Technical reliability

The measurement realized by NT200 analyzers is not based on a chemical or on a physicochemical reaction but on a physical principle. No reagent is required. No contact between the water which is analyzed and the measurement probe is required and therefore the measurement probe cannot be damaged by aggressive water. The only parts in contact with water are the feeding tubes (large diameter) and the quartz measurement cell the light goes through. Depositions that may occur on the walls of the measurement cell are the only obstacles to the light passing through. An automatic cleaning system which allows an acid solution to circulate through the measurement cell and keeps any deposition off is suggested in order to ensure the reliability of the measurements over long periods. An automatic adjustment of the zero can be set after each cleaning cycle.
This concept allows our analyzers to work in isolated sites with very high reliability and reproducibility whatever is the position. Other concepts which do not use a quartz measurement cell but are based on the free fall of water seem to be attractive but they require a calibrated hole which do not allow to perform reliable measurements neither on crude water because of clogging nor if the analyzer is too sloped.
The steel box is watertight, the measurement cell is protected by a quartz tube which prevents the measurement cell from being broken and allows measurement on very cool water without condensation.
Any unreliable measurement due to a failure of the measurement cycle produces an error message on the measurement frame and activates the default relay of the analyzer.

A journal of events which can be read on the PC records the date and the time of all events (excepting measurements) occurring on the analyzer: cleaning cycle, error measurements, potential communications or messages of the operator using the RS232 link or the modem board,....

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1.3 Measurement reliability

1.3.1 General purpose

NT200 analyzer has been subjected to different tests on testing bench. Those tests have pointed out that DATALINK INSTRUMENTS produced the most reliable analyzers on the market. The concept of the measurement using two wavelengths ensures the compromise between simplicity (synonym of solidity and reliability) and accuracy. The multi-channel technology using a barrette of photo-diodes coupled to a diffraction grating was tested for measurement of nitrates and comes out to be useless for two reasons:

- ✓ Sharp decrease of the signal because of the complexity of the optical path which causes the decrease of the ratio signal/noise and therefore the limitation of the measurement resolution,
- ✓ High cost of the detection parts.

The presence of interfering organic matter in water and the turbidity of water are efficiently compensated by a photo-diode tuned on 254 nm in the NT200 analyzer. Performing a recognition of recorded spectra is useless because the thickness of the water strip used for measurement of nitrates is too small for measurement of organic pollution. DATALINK INSTRUMENTS have chosen a global compensation at 254 nm.
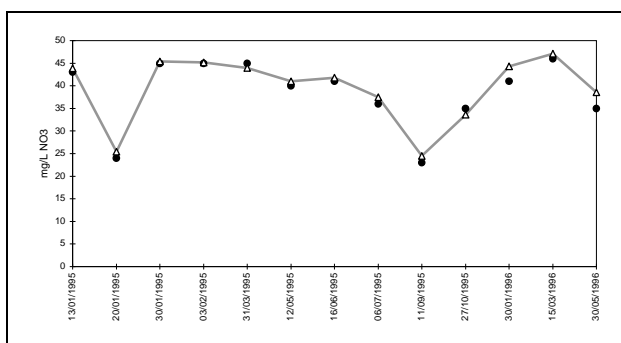
1.3.2 Application to waste water

NT200 analyzer keep on giving high performance results on waste water and on surface water even if it is turbid and heavy and requires no filtration.

The graph below shows the comparison between measurements performed by NT200 analyzer (grey area) and those performed using two standard measurement methods: colorimetric paper tape (Δ on the graph) and standard method using salicylate (• on the graph)
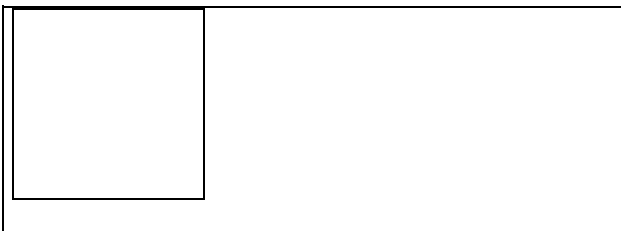
Application to surface water

NT200 is perfect to work on isolates sites. In the following example the analyzer has been settled in a shelter near a river close to a water reservoir. The operator monthly visit the analyzer in order to discharge its memory and to refill the cleaning solution container. The analyzer's zero is made only once a month at the same time as those visits. The following curve compares the measurements performed without any filtration by DATALINK's NT100-200 (Δ on the graph) and the measurements performed by an approved method (• on the graph) over more than one year.

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1.4 Operation cost

Our analyzers have been designed to perform the best results at the lowest price. Consequently we have been developing technologies allowing :

- ✓ A maintenance confined to adding cleaning solution and supervising that the device runs.
- ✓ Easy repairing operations thanks to the excellent accessibility of the different parts of the analyzer.
- ✓ A low energy consumption for applications in isolated sites.

Consumable

No reagent is required for the measurement. The only necessary consumable is the cleaning solution of the measurement cell. Using 250 mL of sulphuric acid in 5 L of distilled water every 30 days (making one cleaning a day) the annual consumption and cost will be:

Distilled water: 100 L

Sulphuric acid: 4 L d'H2SO4

Detectors, UV lamps or measurement cells have a life time which can be considered to be unlimited (more than 10 years); therefore it is useless to consider them as consumable.

Maintenance

The NT200 is maintenance free as it is automatically self cleaned.

The only required operation will consist in checking the correct operation of the analyser: Zero checking after cleaning solution tank refilling. This operation can be made by the analyser itself, using the automatic cleaning system. This only requires a few minutes.
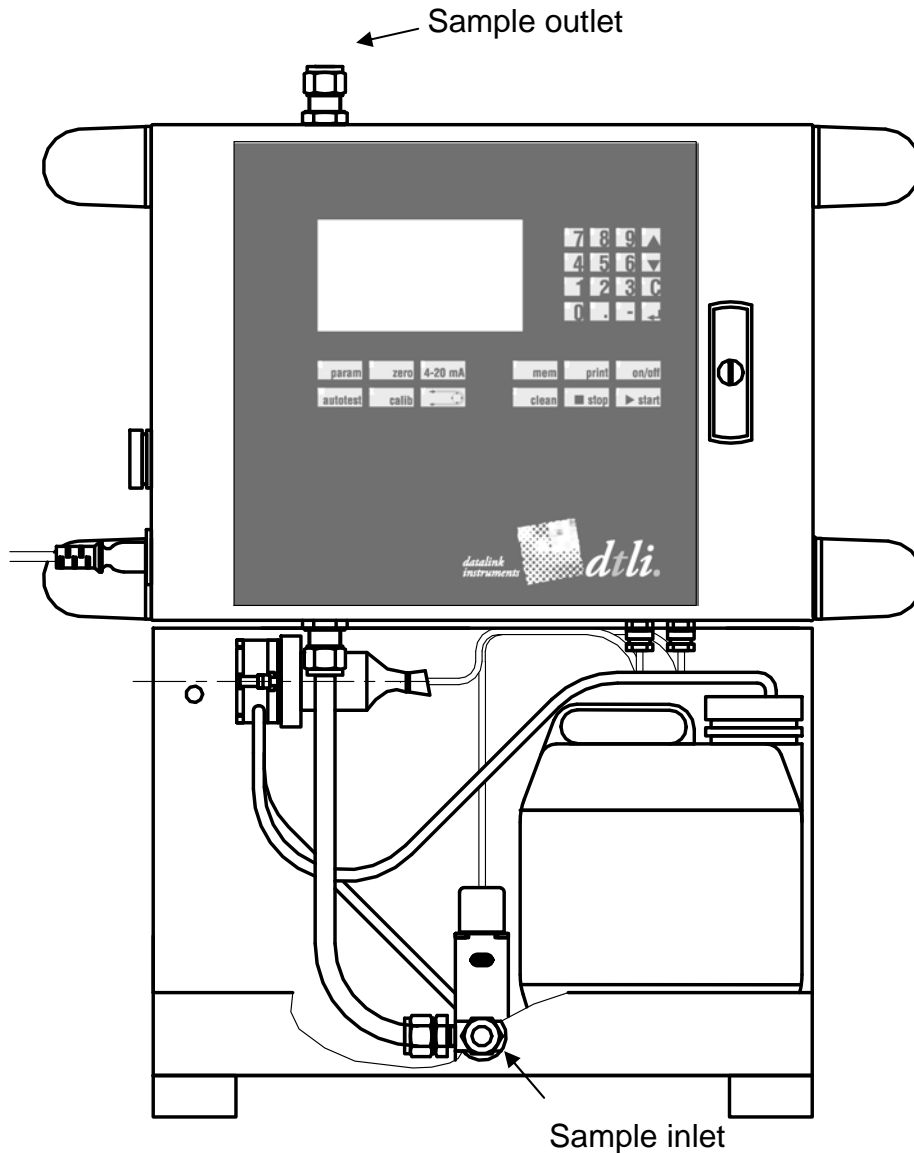
Any part is guaranteed for two years (except the pump for cleaning solution and battery) including spare parts and labor as defined in our standard guarantee conditions.

1.4.1 Installation

The water inlet and outlet fittings are double ring types for 12mm outer diameter tube.

A 120 or 240 VAC earthed mains plug should be available within 2 metres far from the analyser.

The freezing situation should be prohibited. Any freezing of water inside the measurement cell will lead to a failure.

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Sample outlet

Sample inlet

1.5 Autonomy

1.5.1 Memory capacity

The NT200 analyzer memory has a capacity allowing more than 10000 measurements. This gives 5 months autonomy in the case of one measurement every 15 minutes.

1.5.2 Energy capacity

The internal battery of the NT200 analyzer (2.8 Ah) allows 100 measurements, which corresponds to about 1 day if a measurement is performed every 15 minutes. An external battery of much higher capacity (12 Ah) may be used on request, it will improve four times the autonomy of the analyzer.

1.5.3 Cleaning solution capacity

For the cleaning procedure we recommend the use of a 5% sulfuric acid in distilled water solution. A 1% sulfuric acid solution can be sufficient if measurements are performed on drinking water.

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A 20 second pumping cycle uses about 0.15 L of solution. The 5 L acid solution tank gives to the analyzer a 30 days autonomy if the cleaning process is performed once a day (which is enough in most cases). A bigger solution tank may be provided for in order to increase the autonomy of the cleaning process.

1.6 Possible options on the nitrate analyzer NT200

1.6.1 Built in peristaltic pump

If the water is to be pumped from a natural source or a large container, an optional peristaltic pump can be used. It is supplied with power by the battery of the analyzer and can be either manually or automatically operated, using the keyboard of the analyzer.

The pump is delivered with a five meters silicone tube and a input strainer. The pumping rate is 0.5 L per minute and the pumping is efficient up to five meters high maximum.
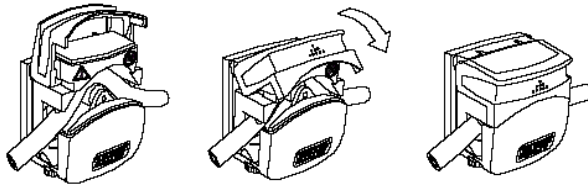
1.6.2 Built in modem board

Using this option, one can communicate with the analyzer through a phone line.
The user can call the analyzer and communicate using a Minitel (France only) or a PC equipped with a modem. All the settings and dialogue functions of the analyzer are available.
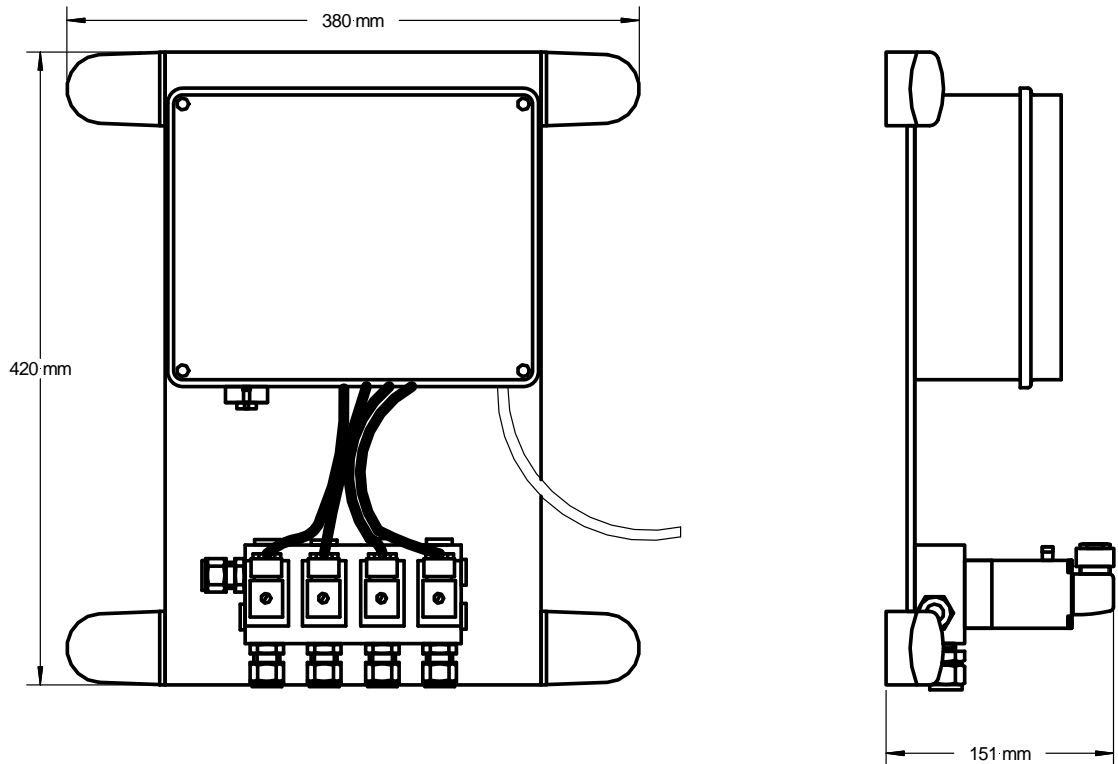If a threshold is exceeded, the analyzer will automatically call up to three phone numbers.

A phone line dedicated to this option is required.

1.6.3 Four channel multiplexing system

This option allows to analyze up to four different water networks with the same analyzer.

When a measurement cycle is started, all water channels are successively analyzed. The water flowing time must be programmed on each channel. As soon as a channel is started on the analyzer, the corresponding pump (or electric valve) is activated during the flowing time which has been previously programmed.

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1.6.4   Remote measurement command

This option allows to start a measurement cycle by activating an analog input with a voltage pulse. This is useful when the analyzer is integrated in a system monitored by a PLC.

An output contact is activated when the analyzer is ready for a measurement command. If the analyzer is not ready (cleaning cycle or previous measurement cycle still in process, keyboard being used) the output contact is disabled.

1.6.5   Water presence detector

Detect by conductivity the presence or not of water in the analyzer.

When the analyzer is fed under pressure with permanent circulation, the detector forbids all the automatic measurements if the presence of water is not detected. A device default message is produced.

Also, the autocalibration of the zero of the analyzer will be forbidden if the cleaning solution is not detected. This prevents an adjustment of the zero on an empty measurement cell or which would not have been cleaned for lack of solution.

1.6.6   pH measurement

A pH probe can be connected to the NT200 analyzer. In that case, the measurement benefits from assets of the NT200 that constitute the automatic cleaning (if the probe is placed on the channeling of exit) and of the storage of the measurement in the memory.

The temperature compensation is automatically made by the analyzer.

1.6.7   Conductivity measurement

It is the same for the conductivity measuement in the range of 0 – 2000 µS/cm.

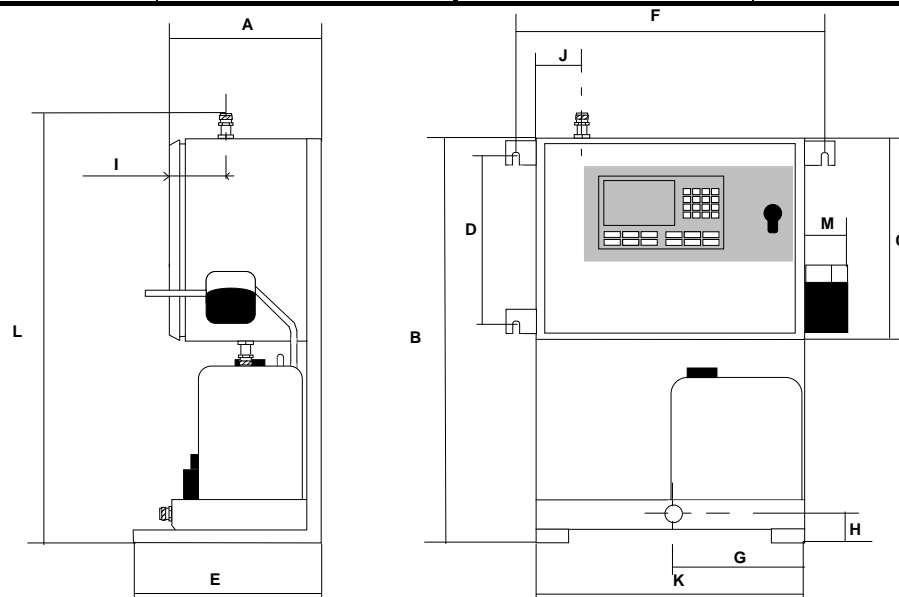DATALINK INSTRUMENTS DTLI
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1.7 Summary of analyser's characteristics

1.7.1 Technical data

Weight:	18 Kg
Inlet / Ooutlet fittings:	SWAGELOCK diamètre 12 mm
Range:	0-250 mg/L NO_3^- (0-50 mg/L NO_3^-) Other ranges on request
Mains power:	110-120 V/ 220-240V 50/60 Hz 60 W + internal battery 12 V
Outputs:	4-20 mA insulated, 12 bit resolution High and low threshold relays Default relay alarm
Casing:	Indice de protection IP559
Communication :	Port 1 :RS232 for PC, modem ou MODBUS Port2 : RS232 for on-line printer (on demand)
Inlet max pressure:	5 bar
Measurement cell volume :	100 mL
Sample temperature :	> 0 - 60°C

1.7.2 Dimensions

A	240 mm	H	55 mm
B	610 mm	I	95 mm
C	300 mm	J	105 mm
D	250 mm	K	400 mm
E	230 mm	L	640 mm
F	450 mm	M	65 mm
G	200 mm		

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2 Maintenance recommendation

2.1 Service operation

2.1.1 Low level check-up

Description

Any automatic analysis system requires a minimum checking operation even if it is not necessary to adjust any parameter. The automatic operation ensures the daily and repetitive measurements and cleaning, but a human control still remains necessary.

The NT200 analyzer has its own self checking facility which produces the fault relay switching in the case of a measurement problem.

The low level check-up of the analyser just consists in the control of correct measurement conditions:

- Visual control of feeding pipes dirtying, as well as measurement cell dirtying.
- Pumping Autoprene pipe replacement (external pump).
- Manual cleaning cycle in order to check that everything goes well.
- Manual measurement on a zero solution in order to detect any zero drift.
- Manual measurement on process water.
- Cleaning solution tank refilling.

Periodicity

Monthly.

Duration

15 minutes maximum.

Operator

Local operator.

2.1.2 Calibration checking

Description

This operation is to be added to the previous one. It consists in a manual measurement of a known sample or on a standard solution. In the case of difference between the measurement and the expected value, a calibration cycle should be run.

Periodicity

Every 6 months.

Duration

15 minutes maximum.

Operator

Local operator.

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2.1.3   Preventive maintenance

Description

This maintenance is not necessarily required but is strongly recommended. If the check-up operations described above are correctly made, the measurement performance of the analyser will be kept on long term. However, a dirtying of pipes and pumps can be observed. The replacement of these parts could be necessary depending on operation conditions.

From our experience, we observed that the analyzers that are yearly controlled give better reliability than others.

Periodicity (facultative)

Once a year.

Duration

One day for one analyser + travel time.

Operator

DTLI technician or any other habilitated operator.

2.2   Limits of use

2.2.1   Electromagnetic compliance

The NT200 design was improved and controlled in test bench. The alectromagnetic compliance was fully checked in industrial environment. The CE standards are met.

In order to comply with the CE standards, the 4-20mA and relays wiring should be made using shielded cables. The shield should be connected to the housing of the analyser.

2.2.2   Température

The analyser is designed for use on liquid water whose temperature is necessarily maintained in the 0.5 – 60°C range.

Freezing can destroy the measurement cell.

High temperature vapour circulation in the measurement cell can damage the sealing. In that case a DTLI or habilitated intervention would be necessary.

2.2.3   Interferences

The excess of salts of bromine, iodize (some hundreds of mg/L) or few quantity of phenol (some mg/L) produce a gap of the measure. These conditions are not present in the urban applications but can be met in industrial environment.

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