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Let's Solve Water

Application note

Operating experience with the NH_4-NO_3 IQ Sensor Net online measuring system

AT THE WASTEWATER TREATMENT PLANT MITTLERES PUSTERTAL

The ARA-Tobl wastewater treatment plant puts a lot of effort into the continuous improvement of the plant and procedure technique.
This also applies to the field of online measuring technique, where we are always looking for reliable and economic solutions for the control and regulation of our plant.
Our analyzing instruments to date are now already 11 years old and, therefore, no longer state of the art, though they still measure reliably. In addition, it is getting more and more difficult to find spare parts for these instruments. Thus the danger of a total instrument failure increases, which would affect the regulation and control of our wastewater treatment plant.
To be prepared for this, the first generation of the AmmoLyt® 700 IQ and NitraLyt® 700 IQ ammonium and nitrate sensors by Xylem Analytics was tested in the year 2005. After about one year, the evaluation and consultation with Xylem showed that the included manual compensation of potassium (for NH_4) and chloride (for NO_3) was not sufficient. After the end of this first testing period, Xylem Analytics provided us with the next generation of sensors for a test.
The VARiON®PLUS 700 IQ allows dynamic compensation of potassium or chloride due to additional electrodes and therefore provide even better results.

Instrument description

The nitrate and ammonium sensors were connected to an existing IQ Sensor Net system.
The used IQ Sensor Net system consists of:

1. MIQ/PS	Power supply module 100...240VAC
2. MIQ/MC(-PR)	Controller with Profibus interface
3. MIQ/T2020	Terminal
4. MIQ/CR3	Output module (3 current outputs and 3 relay outputs)
5. MIQ/CHV	Magnetic valve module for cleaning
6. AmmoLyt®PLUS 700 IQ	with electrodes for ammonium, potassium compensation and reference
7. NitraLyt® PLUS 700 IQ	with electrodes for nitrate, chloride compensation and reference
8. CH	Cleaning head with compressed air
9. SACIQ	Sensor connection cable

The IQ Sensor Net 2020 measuring system has a modular structure and can be equipped with up to 20 sensors. It covers the entire spectrum of online instrumentation (pH, O_2, NH_4, NO_3, PO_4, COD, turbidity etc.). Furthermore, there are various modules as additional options such as valve modules for compressed air cleaning.
The system provides analog signals (0/4...20 mA) or can be connected to the central control unit via an digital interface (RS232, Profibus-DP, Modbus and RS485).
Relays can be configured for various applications (malfunction, pre-alarm, etc.)
The system parameters (measuring range, cleaning interval etc.) are configured at the terminal, which is easy to operate due to the clear text display.

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Evaluation of NO3 measurement with the VARiON® NO3

In March 2006, the new chloride-compensated VARiON® PLUS 700 IQ sensor was installed in the outlet of the aeration tank of line 2 instead of the NitraLyt® 700 IQ sensor.
To check the reliability of the sensor, the sample was regularly counter-checked by photometer measurements in a laboratory. On site the samples were filtered immediately to keep the measured value falsification as low as possible (nitrate decomposition during transport from sampling point to lab). User-defined allowed measuring tolerance: +/-0.5 mg/l.

Comparison between VARiON® NO3 and lab measurement

Date	Amount of work in min	Measured value VARiON NO3	Lab counter measurement	Deviation from lab value	Evaluation of deviation
08.03.2006	15	2.8mg/l	2.610mg/l	0.190mg/l	Delta ok
14.03.2006	15	4.1mg/l	3.970mg/l	0.130mg/l	Delta ok
22.03.2006	15	3.5mg/l	3.610mg/l	0.110mg/l	Delta ok
29.03.2006	15	1.8mg/l	2.110mg/l	0.310mg/l	Delta ok
04.04.2006	15	0.9mg/l	1.090mg/l	0.190mg/l	Delta ok
12.04.2006	15	3.1mg/l	3.530mg/l	0.430mg/l	Delta ok
19.04.2006	15	4.7mg/l	4.580mg/l	0.120mg/l	Delta ok
26.04.2006	15	4.3mg/l	4.020mg/l	0.280mg/l	Delta ok
03.05.2006	15	5.9mg/l	6.120mg/l	0.220mg/l	Delta ok
10.05.2006	15	5.1mg/l	5.640mg/l	0.540mg/l	Delta not ok
17.05.2006	15	3.3mg/l	3.210mg/l	0.090mg/l	Delta ok
24.05.2006	15	1.7mg/l	1.840mg/l	0.140mg/l	Delta ok
31.05.2006	15	0.9mg/l	0.655mg/l	0.245mg/l	Delta ok
06.06.2006	15	1.2mg/l	1.380mg/l	0.180mg/l	Delta ok
13.06.2006	15	1.6mg/l	1.820mg/l	0.220mg/l	Delta ok
20.06.2006	15	1.3mg/l	1.210mg/l	0.090mg/l	Delta ok
27.06.2006	15	2.1mg/l	1.970mg/l	0.130mg/l	Delta ok
05.07.2006	15	1.8mg/l	1.600mg/l	0.200mg/l	Delta ok
12.07.2006	15	0.8mg/l	0.512mg/l	0.288mg/l	Delta ok
26.07.2006	15	1.1mg/l	0.586mg/l	0.514mg/l	Delta not ok
08.08.2006	15	3.7mg/l	4.120mg/l	0.420mg/l	Delta ok
22.08.2006	15	2.5mg/l	2.840mg/l	0.340mg/l	Delta ok
05.09.2006	15	3.3mg/l	3.510mg/l	0.210mg/l	Delta ok
19.09.2006	15	2.1mg/l	2.570mg/l	0.470mg/l	Delta ok
03.10.2006	15	1.6mg/l	2.010mg/l	0.410mg/l	Delta ok
17.10.2006	15	0.7mg/l	1.130mg/l	0.430mg/l	Delta ok
31.10.2006	15	2.6mg/l	1.400mg/l	1.200mg/l	Delta not ok
14.11.2006	15	1.8mg/l	1.620mg/l	0.180mg/l	Delta ok
28.11.2006	15	0.6mg/l	0.937mg/l	0.337mg/l	Delta ok
05.12.2006	15	1.3mg/l	1.160mg/l	0.140mg/l	Delta ok
12.12.2006	15	2.9mg/l	2.880mg/l	0.020mg/l	Delta ok
19.12.2006	15	3.7mg/l	4.120mg/l	0.420mg/l	Delta ok
	Average value:	**2.5mg/l**	**2.511mg/l**	**0.287mg/l**	

Greatest deviation: **1.200mg/l**
Smallest deviation: **0.020mg/l**

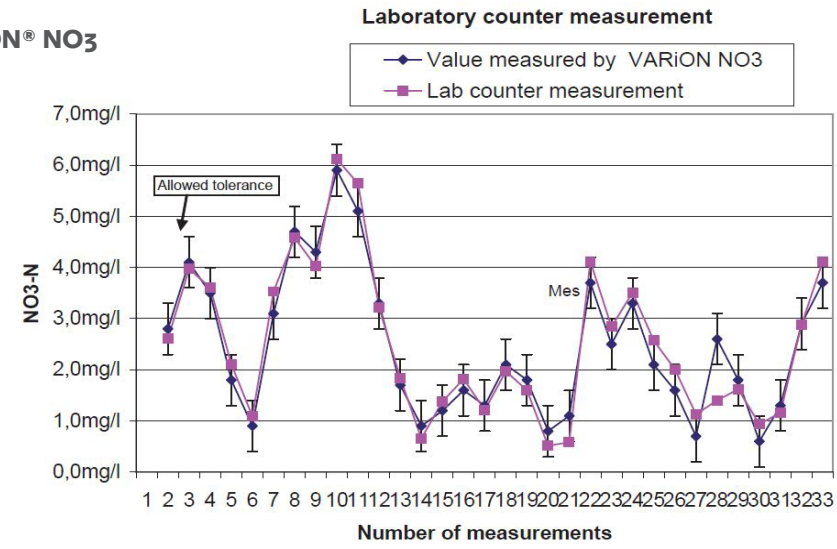
Number of measurements within the tolerance: **29**
Number of measurements outside the tolerance: **3**

Evaluation of the VARiON® NO3 sensor

The result of the test is that the VARiON® NO3 sensor is suitable for reliable regulation and control operation in the aeration tank. The average deviation compared to laboratory countereasurements is 0.287mg/l with 32 measured values; its average value is therefore within the allowed tolerance.
Three measurements that were counter-checked were outside the allowed tolerance, but only during a period of nine months. Therefore, we consider the stability of the sensor as good.

We regard the automatic cleaning function and the activities required for maintenance as very positive.
The automatic cleaning (every 6h) keeps the sensor completely dirt-free. If necessary, the cleaning interval can be changed at any time depending on the contamination.
At our plant, however, no manual cleaning or reduction of the cleaning intervals was required. With an average of 15 minutes, carrying out the adjustment does not take a great deal of time and can barely be compared with the time required for analyzers. We consider an calibration interval of one to two weeks as sufficient.
The costs are limited to one NO3 cuvette and one fluted filter per adjustment. Additionally required is a chloride cuvette to adjust the compensation electrode once a month.

Trend curve of the comparison between VARiON® NO3 and lab measurement



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Evaluation of NH4 measurement with the VARiON® NH4

In March 2006, the new potassium-compensated VARiON® PLUS 700 IQ sensor sensor was installed in the outlet of the aeration tank of line 2 instead of the AmmoLyt® 700 IQ sensor.
To check the reliability of the sensor, the sample was regularly counter-checked by photometer measurements in a laboratory. The samples were immediately filtered on site to keep the measured value falsification as low as possible (ammonium decomposition during transport from sampling point to lab). User-defined allowed measuring tolerance: +/-0.5 mg/l.

Comparison between VARiON® NH4 and lab measurement

Date	Amount of work in min	Measured value VARiON NH4	Lab counter measurement	Deviation from lab value	Evaluation of deviation
08.03.2006	15	1.1mg/l	0.930mg/l	0.170mg/l	Delta ok
14.03.2006	15	1.7mg/l	1.570mg/l	0.130mg/l	Delta ok
22.03.2006	15	1.4mg/l	1.320mg/l	0.080mg/l	Delta ok
29.03.2006	15	2.1mg/l	2.280mg/l	0.180mg/l	Delta ok
04.04.2006	15	1.6mg/l	1.890mg/l	0.290mg/l	Delta ok
12.04.2006	15	1.2mg/l	0.970mg/l	0.230mg/l	Delta ok
19.04.2006	15	1.0mg/l	1.010mg/l	0.010mg/l	Delta ok
26.04.2006	15	1.7mg/l	1.250mg/l	0.450mg/l	Delta ok
03.05.2006	15	1.3mg/l	1.120mg/l	0.180mg/l	Delta ok
10.05.2006	15	0.8mg/l	0.624mg/l	0.176mg/l	Delta ok
17.05.2006	15	1.3mg/l	1.120mg/l	0.180mg/l	Delta ok
24.05.2006	15	0.9mg/l	0.761mg/l	0.139mg/l	Delta ok
31.05.2006	15	0.7mg/l	0.573mg/l	0.127mg/l	Delta ok
06.06.2006	15	1.3mg/l	1.920mg/l	0.620mg/l	Delta not ok
13.06.2006	15	1.6mg/l	1.420mg/l	0.180mg/l	Delta ok
20.06.2006	15	1.2mg/l	0.980mg/l	0.220mg/l	Delta ok
27.06.2006	15	0.9mg/l	0.742mg/l	0.158mg/l	Delta ok
05.07.2006	15	0.8mg/l	0.529mg/l	0.271mg/l	Delta ok
12.07.2006	15	1.0mg/l	0.891mg/l	0.109mg/l	Delta ok
26.07.2006	15	1.5mg/l	0.831mg/l	0.669mg/l	Delta not ok
08.08.2006	15	1.1mg/l	1.020mg/l	0.080mg/l	Delta ok
22.08.2006	15	2.6mg/l	2.790mg/l	0.190mg/l	Delta ok
05.09.2006	15	1.9mg/l	2.080mg/l	0.180mg/l	Delta ok
19.09.2006	15	0.9mg/l	0.598mg/l	0.302mg/l	Delta ok
03.10.2006	15	0.7mg/l	1.050mg/l	0.350mg/l	Delta ok
17.10.2006	15	1.5mg/l	1.190mg/l	0.310mg/l	Delta ok
31.10.2006	15	2.3mg/l	1.720mg/l	0.580mg/l	Delta not ok
14.11.2006	15	1.3mg/l	1.410mg/l	0.110mg/l	Delta ok
28.11.2006	15	0.9mg/l	0.320mg/l	0.580mg/l	Delta not ok
05.12.2006	15	0.8mg/l	0.573mg/l	0.227mg/l	Delta ok
12.12.2006	15	1.0mg/l	0.876mg/l	0.124mg/l	Delta ok
19.12.2006	15	2.3mg/l	2.160mg/l	0.140mg/l	Delta ok
	Average value:	**1.3mg/l**	**1.204mg/l**	**0.242mg/l**	

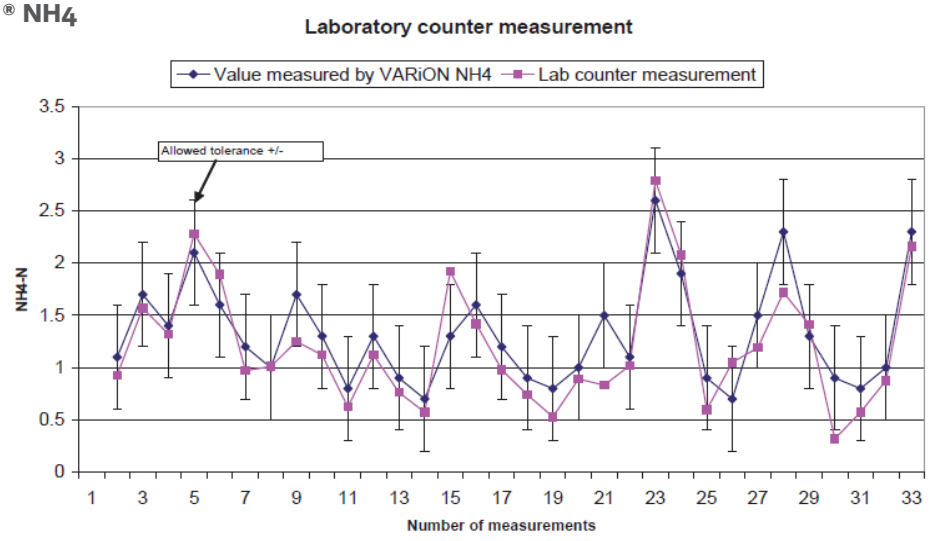
Greatest deviation:	**0.669mg/l**
Smallest deviation:	**0.010mg/l**
Number of measurements within the tolerance:	**28**
Number of measurements outside the tolerance:	**4**

Preliminary evaluation of the VARiON® NH4 sensor

The result of the test is that the VARiON NH4 sensor is suitable for reliable regulation and control operation in the aeration tank.
The average deviation compared to laboratory counter-measurements is 0.242mg/l with 32 measured values; its average value is therefore within the allowed tolerance.
Four measurements that were counter-checked were outside the allowed tolerance, but this was during a period of nine months. Therefore, we consider the stability of the sensor as good.

We regard the automatic cleaning function and the activities required for maintenance as very positive.
The automatic cleaning (every 6h) keeps the sensor completely dirt-free. If necessary, the cleaning interval can be changed at any time depending on the contamination.
At our plant, however, no manual cleaning or reduction of the cleaning intervals was required. With an average of 15 minutes, carrying out the adjustment does not take a great deal of time and can barely be compared with the time required for analyzers. We consider an calibration interval of one to two weeks as sufficient.
The costs are limited to one NO_4 cuvette and one fluted filter per adjustment.
Additionally required is a chloride cuvette to adjust the compensation electrode once a month.

Trend curve of the comparison between VARiON® NH4 and lab measurement



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Summary and prospects

Our experience from working with the Xylem Analytics sensors shows that

- The sensors provide reliable measured values
- The sensors are easy to operate
- Very little maintenance work is required
- The maintenance costs are very low
- The sensor carries out a real online measurement without any loss of time for sample preparation

Based on this test we decided that the sensors can without any doubts be used as a replacement for analyzing instruments in the aeration tank.

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Do you have further questions?
Please contact our
Customer Care Center:

Xylem Analytics Germany Sales
GmbH & Co. KG, WTW
Am Achalaich 11
82362 Weilheim, Germany
Phone +49 881 1830
Fax +49 881 183-420
Info.WTW@xylem.com

xylemanalytics.com

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