APPLICATION REPORT
PROCESS MEASUREMENT TECHNOLOGY
NITRATAX SC + AMTAX SC

Successful aeration control based on NH_4 measurement

Cost effective operation plays an important role at every sewage treatment plant. Not only is the level of investment in new equipment assessed but also the ➔ *energy costs* of aerators. At the same time, aspects such as the stabilisation of treatment processes and the reduction of ➔ *outflow concentrations* also have to be considered. The sewage treatment plant at Adelsdorf, south Germany (25,000 PE) demonstrates how successful the switch from pure time-based control to ammonium-based ➔ *aeration control* can be, with the integration of all process equipment in a ➔ *SC 1000 digital network*.

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Optimisation through targeted online analysis

- → **Reduced energy costs**
- → **Targeted nitrification/denitrification**
- → **Seamless online monitoring**
- → **Dynamic reaction to sudden surges**

From time based control to aeration control: with a network consisting of a SC 1000 digital controller, NITRATAX clear sc nitrate probe and AMTAX compact

TECHNICAL DATA

Plant size: 25,000 PE (Utilisation 16,000 PE) DWF = 1500 m^3/d
Start-up: 1975
Process technology: Combination tank with intermittent aeration, sludge age 15 days, switch from 50-60 minutes nitrification and 40-50 minutes denitrification to NH_4-based control, chemical precipitation of phosphorus in the aeration tank outflow.
Holding tank: 10,000 PE from industrial discharger, added through eccentric screw pump in accordance with the nitrate value in the denitrification phase.
Aeration: 3 blowers Basic load 35/50 kW; Frequency converter 68 kW; max. load 68 kW
Target value O_2: 1,5 mg/l
Limit values in outflow (mg/l): COD: 80 / 35-40; Total N: 16 / < 5; NH_4-N: 10 / ~ 0,1; Total-P: 2 / ~ 0,5
Participating companies: Planning: SRP Schneider u. Partner, Zeil am Main; Implementation: K. u. S. Richter GmbH, Kasendorf; Hermos Automatisierung GmbH Mistelgau

Where it all happens: The combination tank

In Adelsdorf, after passing through the screen and the grit chamber, the wastewater enters a combination tank (Fig. 1) with external aeration (2,900 m^3) and internal secondary settlement (2,550 m^3). The oxygen input used to be regulated by the clock: 50-60 minutes of aeration were followed by a break of 40-50 minutes without aeration, irrespective of the actual wastewater load.

Nevertheless, the consistently good outflow values, (see technical data left), testify to the impressive efficiency of this inflexible aeration method. A possible explanation for this is the holding tank containing readily biodegradable carbon compounds from an industrial discharger. The tank serves to even out the carbon load in the inflow.

Time based control is inflexible

Pure time based control takes no account of, for example, the regularly occurring ammonium surges associated with sludge dewatering (Fig. 2, right). In the worst case, NH_4 surges in the secondary settlement tank result in higher outflow values that exceed the permitted limits.

In periods when the load is low (NH_4-N < 1 mg/l), the longer –than necessary aeration times and lack of oxygen depletion cause the oxygen content to rise to 4 mg/l. Another consequence of such situations is unnecessarily high energy costs. At the same time the nitrate concentration increases to up to 4 mg/l, as the low level of carbon input to the denitrification stage makes longer non-aeration periods necessary. However the time based control system cannot, react to this.

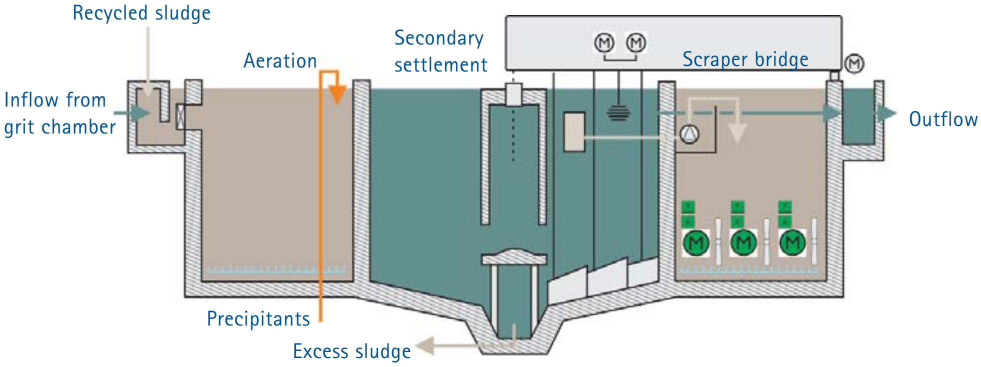


Fig. 1: The combination tank, shown in the process control system

Aeration control for variable loads

Ammonium based control of the aerators results in a total different picture. Ammonium concentrations of less than 5 mg/l cause the aerators to shut down for 80 minutes after 30 minutes of aeration in the period from 2 a.m. to 9 a.m. (Fig. 3). During this time the ammonium value falls from 5 mg/l to less than 2 mg/l.

From the start of the higher load period (Fig. 4, ammonium content > 5 mg/l) the control system increases the aeration time to 60 minutes followed by a 20-minute pause, so that the high ammonium values are reduced as quickly as possible. On a normal day without any ammonium surge (Fig. 5) the control system maintains the "low-load mode," thus saving energy costs and restricting the aeration time to a necessary minimum.

In practice this means that, with freely selectable ammonium and nitrate concentrations as switch points, in combination with variable aeration times, this control concept can cope with all future load peaks. The most economic setting is always given preference to ensure that the aeration is controlled both safely and cost-efficiently. An interesting secondary effect: at no time does the nitrate concentration exceed 2 mg/l.

Before: Time-based control

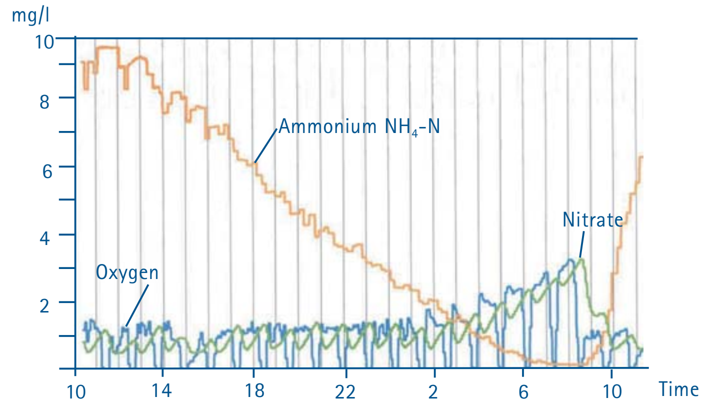


Fig. 2: Time course curves of ammonium/nitrate/oxygen in the aeration tank

After: Aeration control

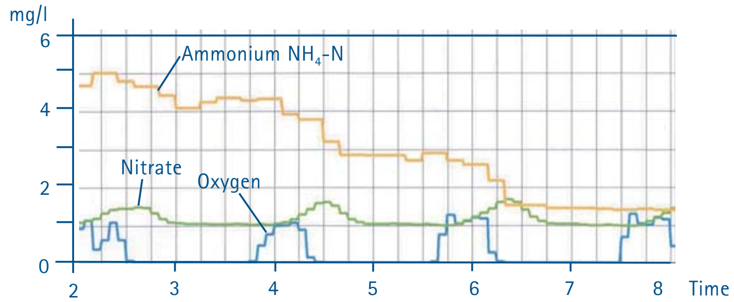


Fig. 3: Low-load phase (detail)

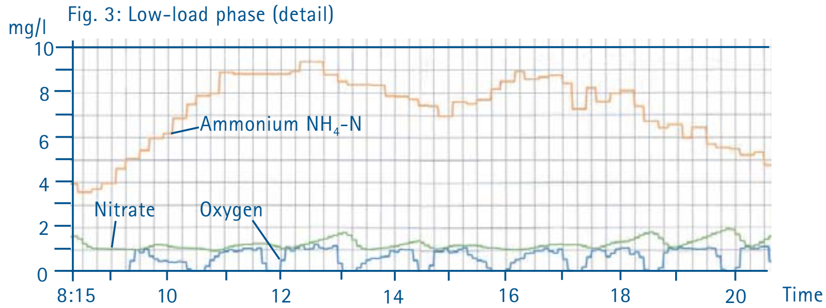


Fig. 4: High-load phase

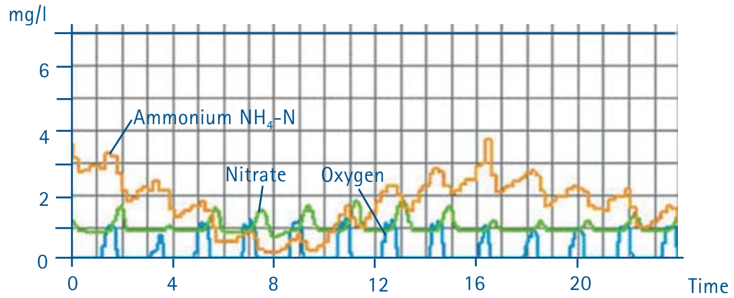


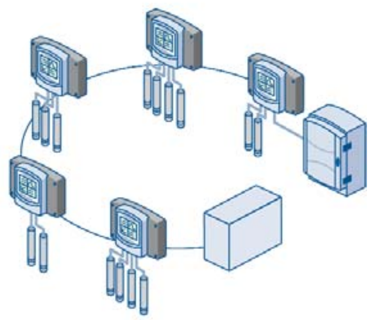
Fig. 5: Time course curve without surges

All dates June 2006

Investment costs halved with the SC network

Cost savings in Adelsdorf does not stop at efficient aeration control. All process instruments have been connected to a system of SC 1000 controllers through a Profibus network. The system consists of three probe modules and a display module (see Table 1). An alternative solution would have been to connect each measuring instrument (nitrate, oxygen, TS, turbidity, 2 × pH) to a separate SC 100 controller. This, however, would have exactly doubled the necessary level of investment (all prices include fastening material and Profibus connection). The older AMTAX compact instrument was connected directly to the Profibus and was not included in this calculation.

The new AMTAX sc analyser generation is available as an alternative to the AMTAX compact.



Modular design and easily upgradeable: the SC 1000 network.

HACH LANGE Services

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Process measurement instruments

DESCRIPTION	ART. NO.
SC 1000 Digital Controller Display module + probe module; a maximum of 8 digital sensors can be connected; networked with several probe modules in a SC 1000 network; upgradeable with measurement stations, sensors, inputs and outputs, bus interfaces	LXV400.99.2E021
NITRATAX clear sc nitrate probe in the bypass Process probe for reagent free measurement of nitrate and nitrite, self-cleaning, made of stainless steel (V4A). Alternative: NITRATAX eco sc in the tank.	LXV420.99.50001
AMTAX compact ammonium analyser Process photometer for continuous determination of the NH_4 concentration in water and wastewater with a low solids content. Alternative: AMTAX sc for on-site ammonium measurement at the side of the tank.	LPV368 SC-compatible: LXV421.99.1x001

Table 1: Installed process measurement instruments

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