HACH's answers to wastewater challenges

PART IX : Nitrogen treatment optimization

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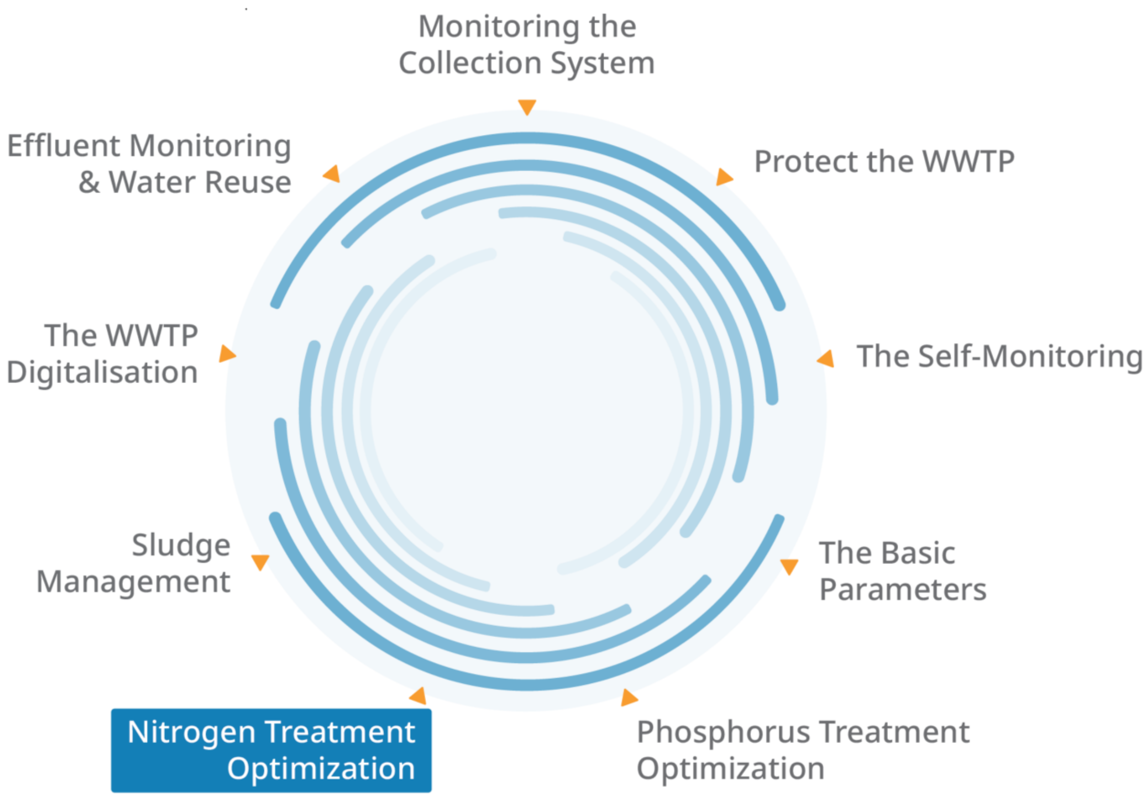
Hach'answers webinar series: Part IX: nitrogen treatment optimization



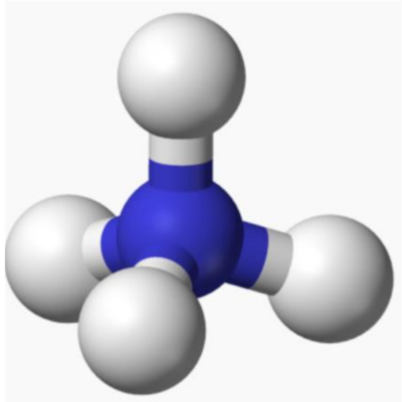
Agenda

Nitrogen treatment optimization

1. Introduction on nitrogen and its treatment
2. Tools to optimize nitrogen removal
3. Applying these tools to all plant configurations

Introduction on nitrogen and its treatment

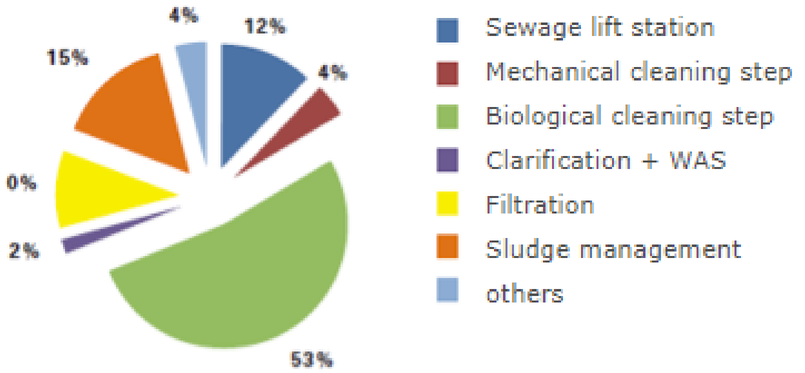
The challenges of nitrogen removal



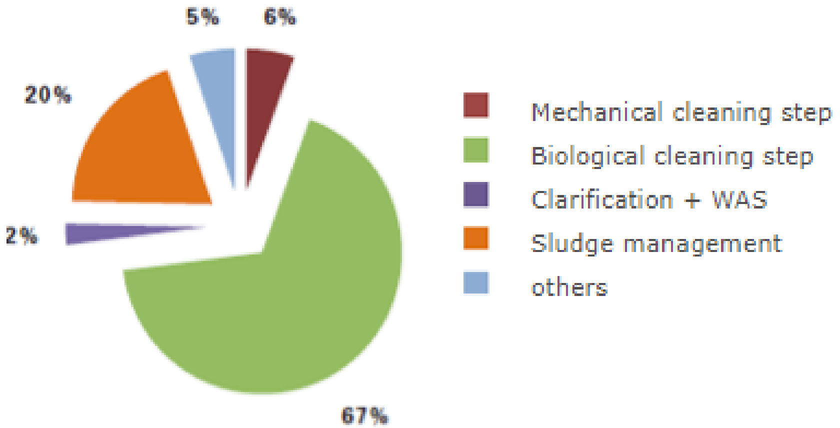
- Energy reduction
- Compliance
- Lack of on-line visibility for key parameters
- Adequate air supply
- Alkalinity availability
- Sludge age control
- Carbon availability for denit.
- Oxygen carry-over to denit.

The treatment of nitrogen in WWTP : the challenge of the energy consumption

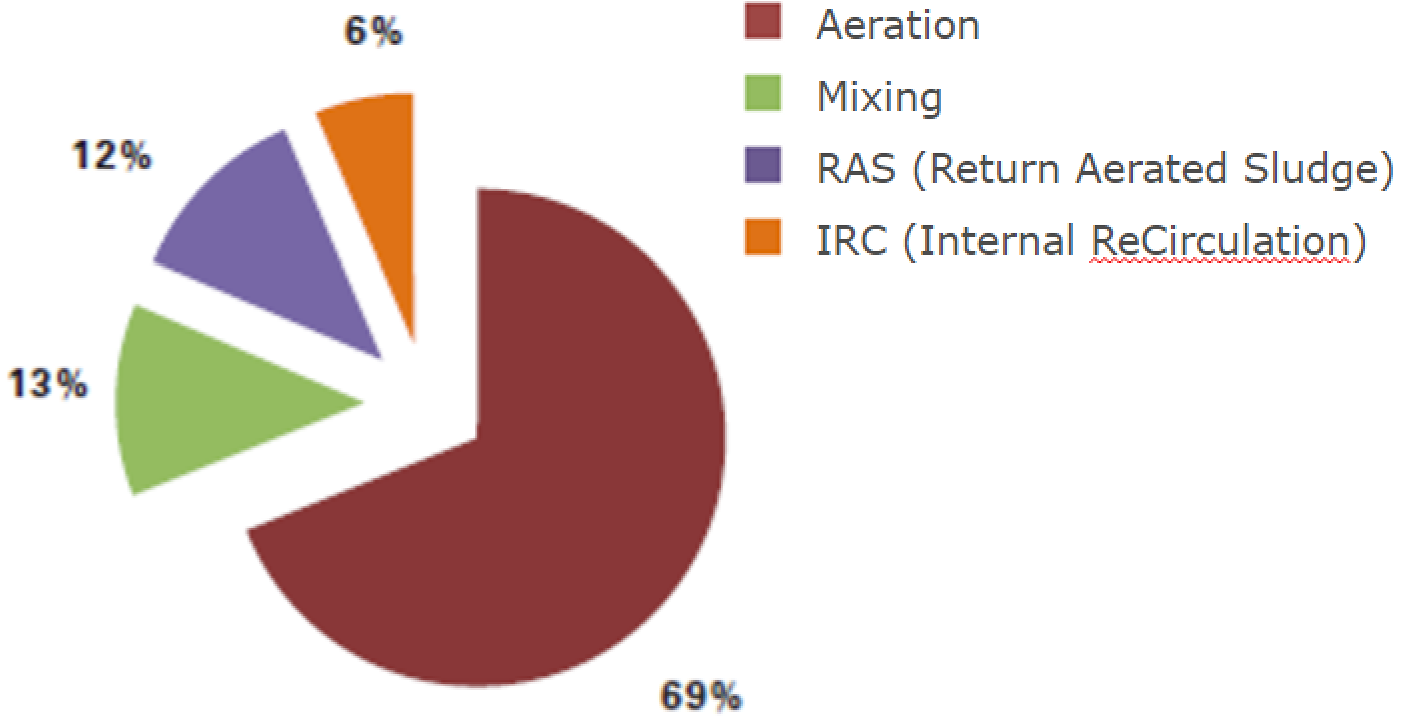
% electricity consumption of a WWTP in the activated sludge process with lifting unit and filtration



% electricity consumption of a WWTP in the activated sludge process *without* lifting station and filtration



Consumption in the Biological cleaning step



Poll

What is your biggest challenge in terms of nitrogen treatment?

1. Compliance with my current permit
2. Risk on future compliance with my future permit
3. Electricity consumption
4. Other

EU Foundation texts on nitrogen

The Urban Wastewater Treatment directive (UWWTD - 1991)

- ❑ Asks for an advanced treatment on nutrients for agglomerations > 10 000 PE
- ❑ Level of nitrogen required in sensitive area:
  - ✓ <100 000 PE: 15 mg/L TN
  - ✓ >100 000 PE: 10 mg/L TN

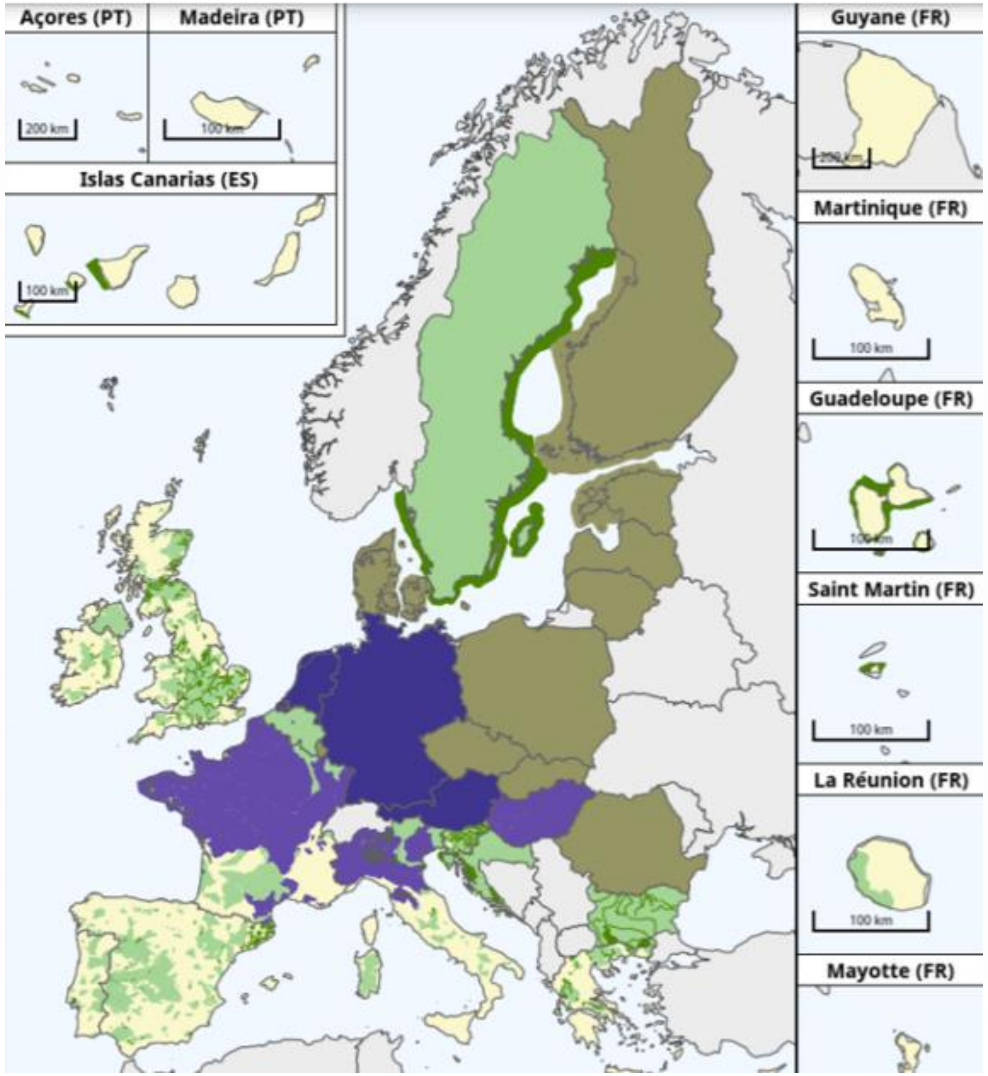
The Water framework directive (WFD - 2000)

- ❑ Aims at achieving “good status” for all waters
- ❑ High / good / moderate / poor water body quality: what does that mean?

Example of river nitrogen standard for France

PARAMÈTRES PAR ÉLÉMENT DE QUALITÉ (unités)	CODE	LIMITES DES CLASSES D'ÉTAT			
		Très bon / Bon	Bon / Moyen	Moyen / Médiocre	Médiocre / Mauvais
NH_4^+ (mg NH_4^+/l)	1335	0,1	0,5	2	5
NO_2^- (mg NO_2^-/l)	1339	0,1	0,3	0,5	1
NO_3^- (mg NO_3^-/l)	1340	10	50	*	*

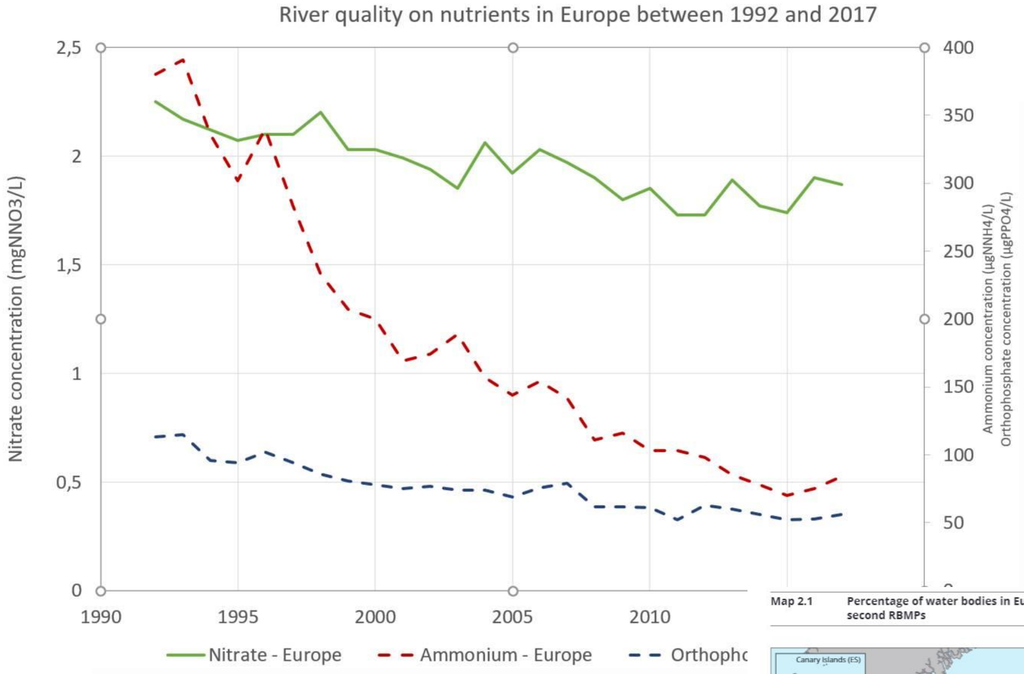
EU sensitive areas - UWWTD



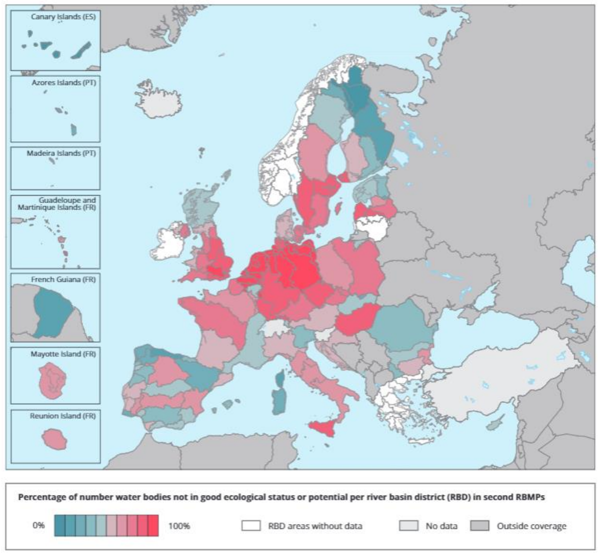
sensitive areas - UWWTD

- **A quarter (24%) of EU territory is not defined as sensitive area,** but some countries are 100% sensitive areas (AT, BE, CZ, DE, DK, EE, FI, LT, LU, LV, NL, PL, RO, SK, SE)
- Countries have to re-adjust or extend the sensitive areas **every four years**

30 years later



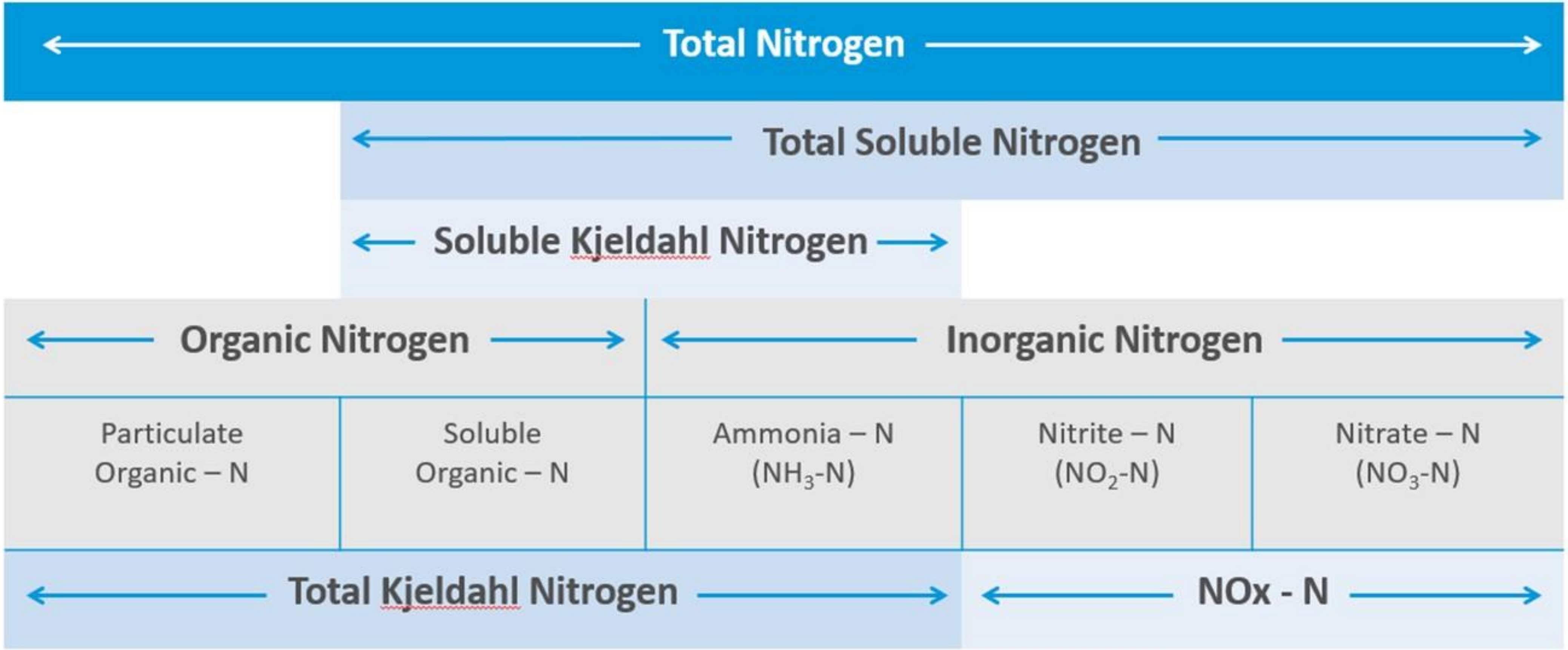
Map 2.1 Percentage of water bodies in Europe's RBDs that are not in good ecological status/potential: second RBMPs



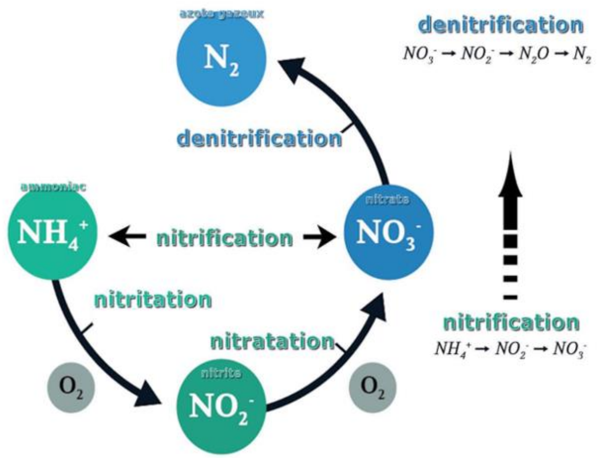
Source: Results are based on WISE-SoW database including data from 24 Member States (EU-28 except Greece, Ireland, Lithuania and Slovenia). Water bodies failing to achieve good status, by RBD; see also Surface water bodies: Ecological status or potential (group) and Surface water bodies failing to achieve good status by RBD .

- **Slight improvement** of nutrient concentrations in EU **in water bodies**
- But on an EU scale, **around 60%** of the surface water bodies are **not in good or high ecological status**
- Revision on UWWTD in process, potential new TN consent at 6mgTN/L

The different forms of Nitrogen



The treatment of nitrogen in WWTP : Nitrification / Denitrification



Aerobic

NITRIFICATION

consumes oxygen and alkalinity (inorganic carbon)

(NH_3) Ammonia / Ammonium (NH_4)

(NO_2) Nitrite

(NO_3) Nitrate

Anoxic

DENTRIFICATION

consumes organic carbon and creates alkalinity

(NO_2) Nitrite

(NO) Nitric Oxide

(N_2O) Nitrous Oxide

(N_2) Nitrogen gas

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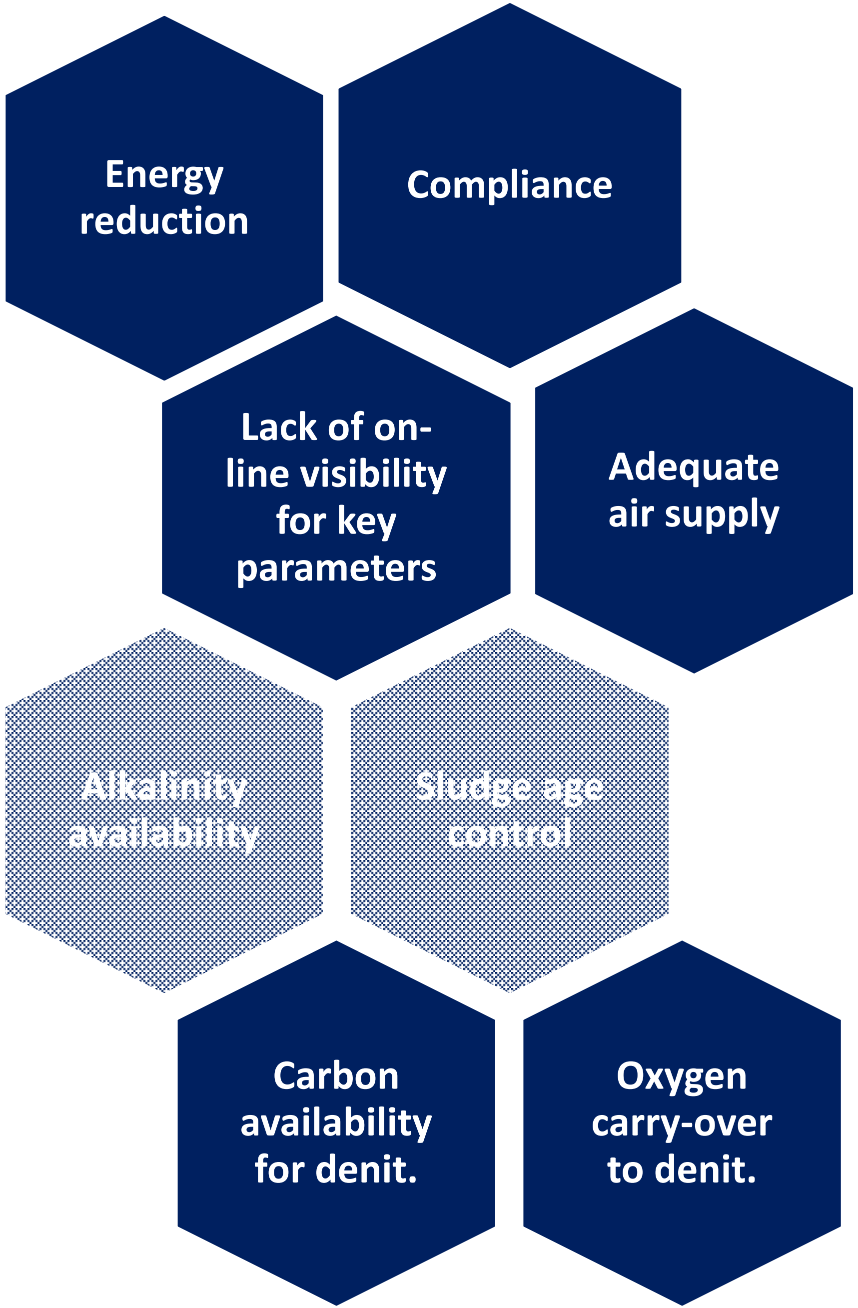
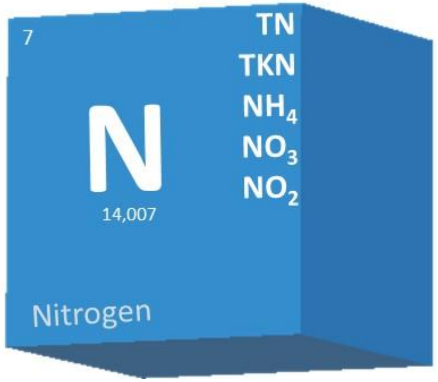
Parameters to answer nitrogen treatment optimisation





- **Ammonium** on-line measurement:
  - ✓ To monitor nitrification efficiency
  - ✓ To adjust at the needed level oxygen supply
- **Nitrate** on-line measurement:
  - ✓ To monitor denitrification efficiency
  - ✓ To adjust internal recirculation
  - ✓ To adapt external carbon dosing
- **Total nitrogen** on-line measurement:
  - ✓ To monitor inlet load
  - ✓ To check compliance

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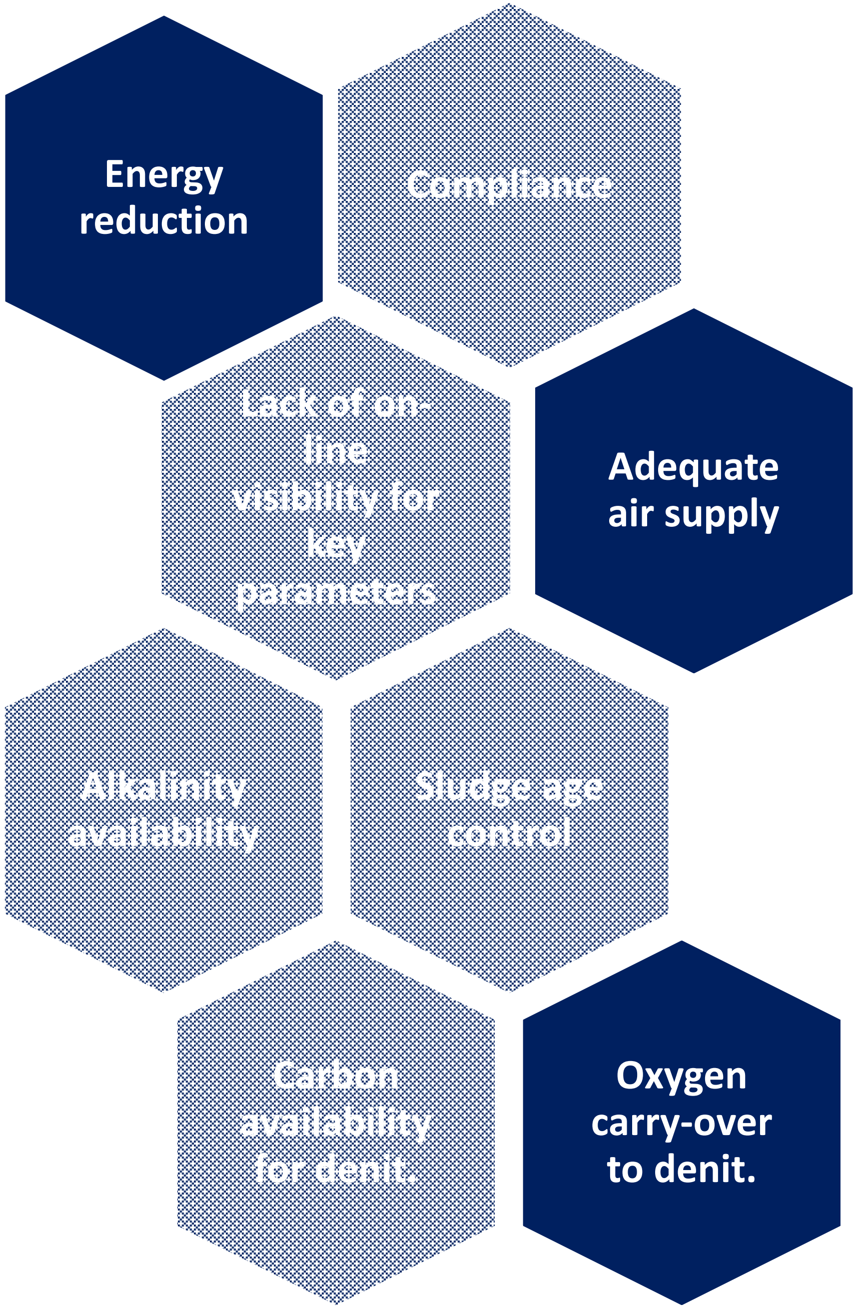
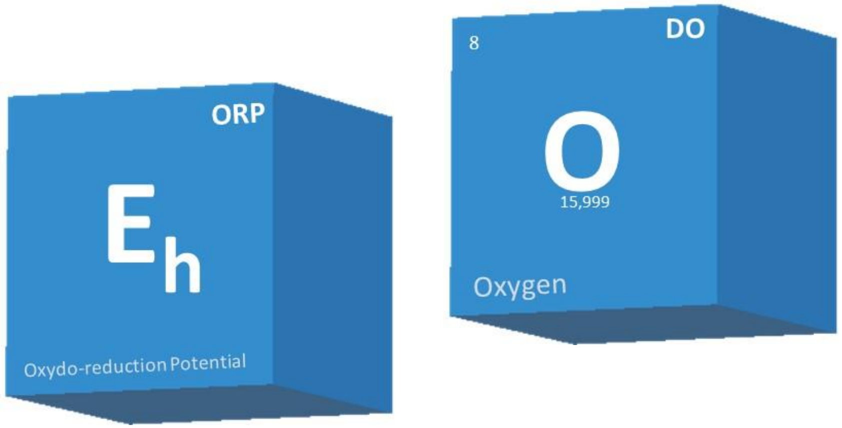
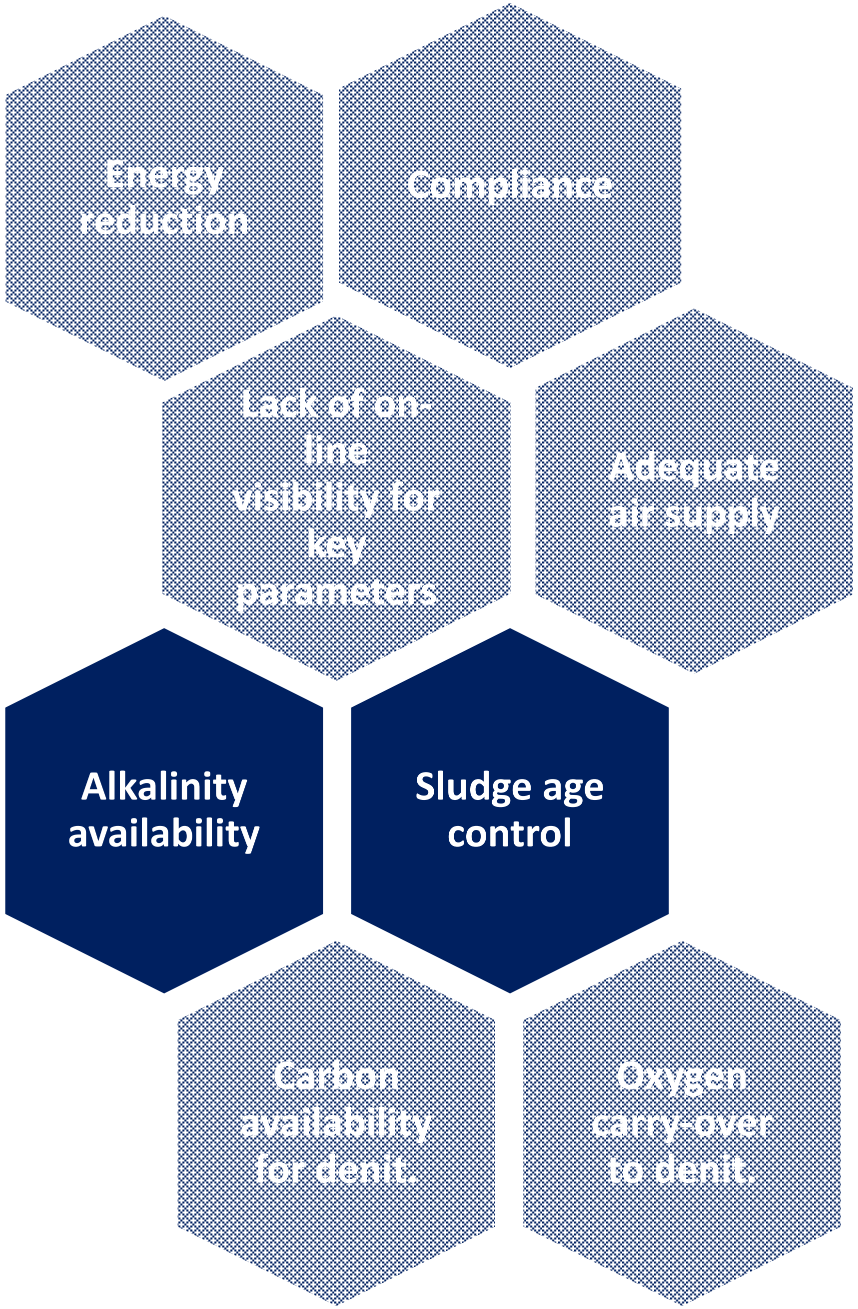
Parameters to answer nitrogen treatment optimisation

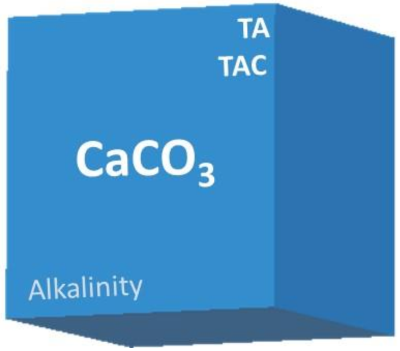




- On-line **dissolved oxygen** measurement:
  - ✓ To ensure enough air supply for carbon removal and nitrification
  - ✓ To avoid over-aeration
  - ✓ To check oxygen carry-over in the IRC to the anoxic zones
- On-line **ORP** measurement:
  - ✓ To monitor level of oxidation
  - ✓ Surrogate indicator of end of nitrification & denitrification to switch On/Off aeration for intermittent configurations

Parameters to answer nitrogen treatment optimisation





- **Sludge age**
  - ✓ Adequate sludge age in relation to the temperature is needed to allow nitrification
  - ✓ Too high sludge age = higher electrical consumption / lower methanogenic sludge/ potential growth of filamentous bacteria
- **Alkalinity**
  - ✓ Nitrification consumes alkalinity
  - ✓ A lack of alkalinity induce nitrification limitation and consequences on pH

Poll

What are the on-line parameter(s) installed on your secondary treatment stage to monitor nitrification and/or denitrification stage ?

1-Oxygen
2-Redox
3-Ammonium
4-Nitrate
5-Suspended solids
6-Alkalinity

Tools to optimize nitrogen removal

Solutions for Nitrogen in laboratory

Total Nitrogen
1 – 16 mg/l*

Heater HT200
Fast digestion

Nitrites
0,015- 0,6 mg/l
NO2-N*

Nitrates
0,23-13,5 mg/L
NO3-N*

Ammoium
0,015- 2 mg/l
1 – 12 mg/l
NH4-N*

* Examples of ranges for effluent

Total Nitrogen – LatoN

Ammonia + Nitrate + Nitrite + Organic Nitrogen

- ✓ 2,6 Dimethylphenol method
- ✓ 3 ranges from 1 to 100 mg/l N
- ✓ Compatible with HT200 for a fast digestion (35 mins)

Ammonium

- ✓ Indophenol blue method
- ✓ 4 ranges from 0,015 to 130 mg/l N

Nitrites

- ✓ Indophenol blue method
- ✓ 4 ranges from 0,015 to 130 mg/l N
- ✓ Low range from 0,005 to 0,1 mg/l N

Nitrates

- ✓ 2,6 Dimethylphenol method
- ✓ 2 ranges from 0,23 to 35 mg/l NO3-N

LCK cuvette tests according to ISO

Ammonium, nitrate, and total nitrogen Hach cuvette tests meet the stringent requirements of ISO standards

NEW !!

Hach LCK cuvette tests for ammonium, nitrate, and total nitrogen are now official ISO standard methods. .

- **Why ISO standardization?** Higher acceptance worldwide
- **Why higher acceptance?** ISO norms standardize processes/procedures improving quality
- **Where used? All** water labs **including ISO 171025 accredited laboratories**
- **Why used?** Simplifies process to include method in scope of the lab

LCK cuvette tests according ISO

Ammonium	Nitrate	Total Nitrogen	COD*
ISO 2369	ISO 23696	ISO 23697	ISO 15705
LCK302 (47 - 130 mg/L NH4-N)	LCK339 (0,23 - 13,5 mg/L NO3-N)	LCK138 (1 - 16 mg/L TN)	LCI400 (0 - 1000 mg/L O2)
LCK303 (2 - 47 mg/L NH4-N)	LCK340 (5 - 35 mg/L NO3-N)	LCK238 (5 - 40 mg/L TN)	LCI500 (0 - 150 mg/L O2)
LCK304 (0,015 - 2 mg/L NH4-N)	LCK540 (15 - 150 mg/L NO3-N)	LCK338 (20 - 100 mg/L TN)	APC400 (0 - 1000 mg/L O2)
LCK305 (1 - 12 mg/L NH4-N)	APC339 (0,23 - 13,5 mg/L NO3-N)	LCK438 (100 - 250 mg/L TN)	APC500 (0 - 150 mg/L O2)
LCK502 (100 - 1800 mg/L NH4-N)	APC340 (5 - 35 mg/L NO3-N)	APC138 (1 - 16 mg/L TN)	-
LCK503 (10 - 100 mg/L NH4-N))	-	APC238 (5 - 40 mg/L TN)	-
LCK504 (0,005 - 0,05 mg/L NH4-N)	-	APC338 (20 - 100 mg/L TN)	-
LCK505 (0,5 - 5 mg/L NH4-N)	-	-	-
APC303 (2 - 47 mg/L NH4-N)	-	-	-
APC304 (0,015 - 2 mg/L NH4-N)	-	-	-

APC cuvette tests can only be used in conjunction with the AP3900 Laboratory Robot.

** Hach LCI400, LCI500, APC400 and APC500 are unique. Using the original ISO 15705 formulation they follow exactly the ISO 15705 for COD.*

LCK according ISO
Ammonium / Nitrates / Total Nitrogen
+
COD

On-line solutions for nitrogen removal : ammonium, nitrate and nitrite

NT3 serie (NO_x ; NO_3; NO_2)

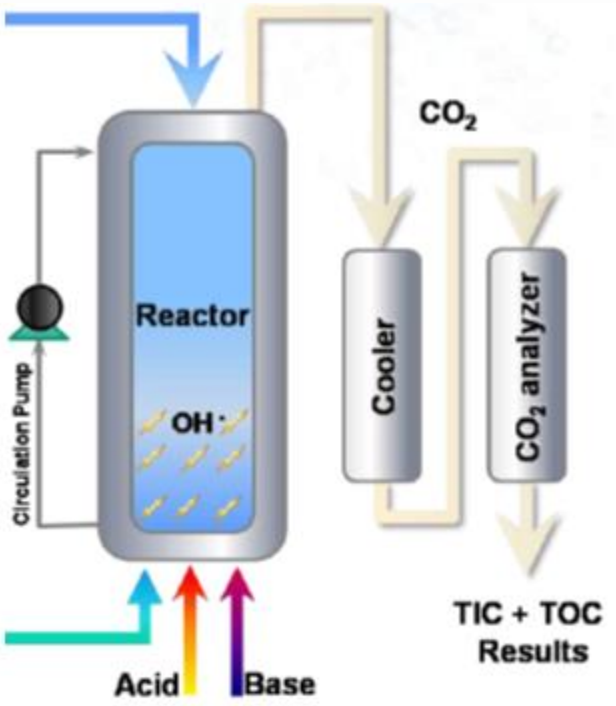
Amtax sc (NH_4)

AN-ISE sc (NH_4 /NO_3)

- **AMTAX**
  - ✓ Easy installation at the measurement point
  - ✓ Gas Selective Electrode method
  - ✓ 5 min response time
  - ✓ Associated to a filtration unit (Filtrax)
- **NT3 series**
  - ✓ UV absorption method
  - ✓ Self-cleaning & sludge compensation
  - ✓ NOx version or NO_2/NO_3 version
- **ANISE**
  - ✓ ISE probe for combined NO_3/NH_4 measurements

On-line solutions for nitrogen removal : TN for influent monitoring

Biotector



- **Biotector B7000 with combined TN**
  - ✓ Online measurement of Total Organic Carbon
  - ✓ Advanced oxidation thanks to hydroxyl radicals
  - ✓ Option of combined measurements with total nitrogen (total phosphorus also possible)
  - ✓ Accepts smooth particles up to 2mm
  - ✓ Up to 3 simultaneous measurement channels for TOC+TP+TN

On-line solutions for nitrogen removal : TN for effluent monitoring

EZ TN

- **EZ-TN (EZ7700)**
  - ✓ Colorimetric measurement after online sample digestion
  - ✓ Full oxidation of nitrogen species according to APHA method
  - ✓ 30 min response time
  - ✓ Upstream sample preparation option (e.g. homogenization with Sigmatax)
  - ✓ Automatic cleaning features

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On-line solutions for nitrogen removal : the basic parameters

LDO sc

pHd sc

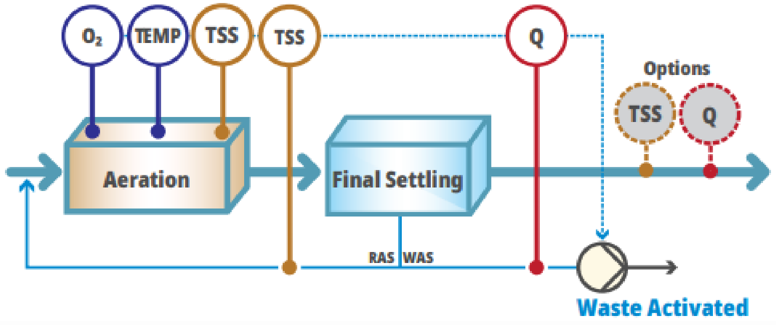
- **LDO**
  - ✓ Luminescent Dissolved Oxygen sensors (no membranes to replace)
  - ✓ No calibration needed
  - ✓ No drift & accurate measurements

- **pHd-ORP**
  - ✓ Differential Electrode measurement Technique
  - ✓ Ensure measurement accuracy and reduced downtime and maintenance

On-line solutions for nitrogen removal : additional parameters

EZ-Alkalinity

Solitax sc



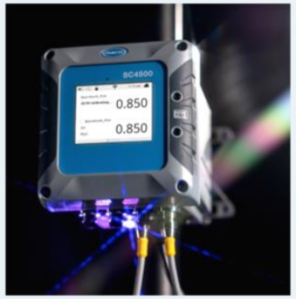
RTC-SRT

- **EZ-Alkalinity (EZ4000)**
  - ✓ Automatic titration / cycle time :10-15 min
  - ✓ Associated sample filtration unit & multiple stream analysis
  - ✓ To dose chemicals (ex: carbonate) in alignment with need
- **Solitax sc & RTC-SRT**
  - ✓ Monitor the solids content in AST / RAS / WAS with infrared on-line sensors
  - ✓ Adjustments of sludge retention time according to temperature
  - ✓ Automatic control of surplus activated sludge to waste to maintain correct amount of biomass

Control solutions for nitrogen removal

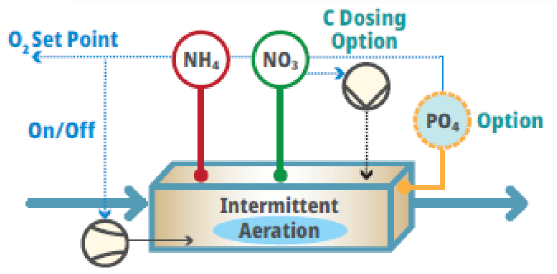
Claros Real Time Control for nitrogen treatment

- ✓ To improve performances at optimized operational costs
- ✓ 2 platforms available
- ✓ Many modules to control nitrogen removal : aeration, recirculation, carbon source dosing, alkalinity dosing…



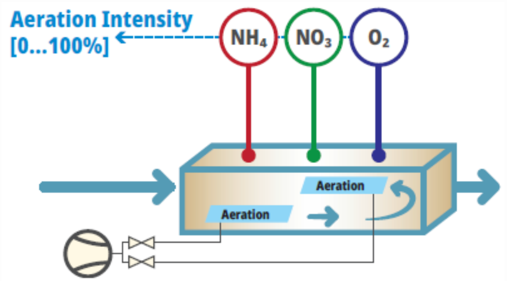
Applying these tools to all plant configurations

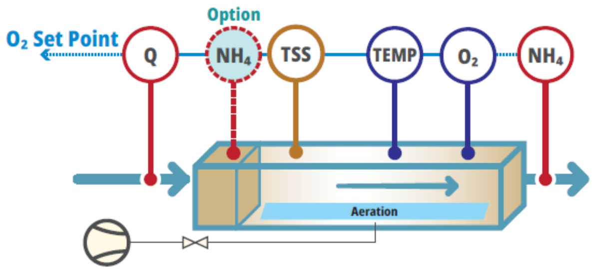
Nitogen-RTC
solutions for Nitrogen removal



Intermittend Denitrification
- Fast reaction regarding NH4-N & NO3-N measurement
- Activation signal for aeration
- Up to 6 stages (2 of tehm VFD controlled)
- DO setpoint
- Controler status signal
- Opt. External Carbon dosing rate
- Opt. Using P value effluent to avoid P redemption
- SBR-Version

Simultaneous Denitrification
- Typically carousel mixed (no plg flow), aerated and anaerated zones
- Optionally 6 digital and 2 analog signals
- Control by NO3-N and NH4-N allows to step away from DO setpoint





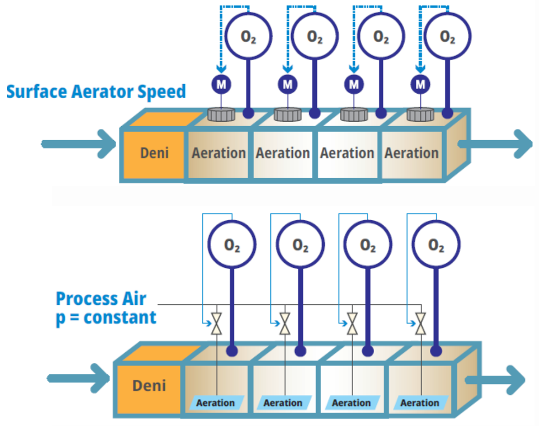
Nitrification Plug Flow
- Calculation required DO concentration
- Based on the NH4-N load
- DO setpoint
- Combining with DN-RTC (control denitrification)
- Combining with DO-RTC (oxygen control)
- Opt. External Carbon dosing

N/DN & N -RTC for all kind of treatment

- ✓ Based on the actually supplied load
- ✓ Consideration of events like shock loading
- ✓ savings energy during long low-load phases (longer rain events)
- ✓ Free adjustable fallback level integrated
- ✓ availability of all internal calculation variables (no black box)
- ✓ Integration in the existing infrastucture (nearly all kind of interfaces available)
- ✓ Possibility to use external measured values

Nitogen-RTC
solutionutions for Nitrogen removal

additional Options Dissolved Oxygen control

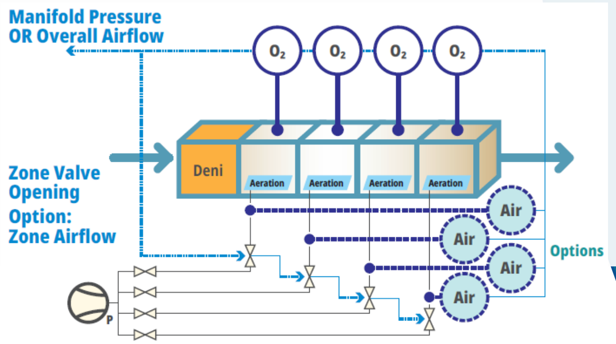


Dissolved Oxygen control

- Independent DO control in multiple zones of an aeration tank
- The RTC-DO can be combined with an RTC-N_4Z zone controller which provides up to 4 DO setpoints based on the current NH4-N loading of a lane
- Adjusted variable is the process air flow or surface aerator speed to the corresponding zone
- If diffused aeration is applied, air flow measurements and valve positions can be monitored if available.

Most open valve DO control

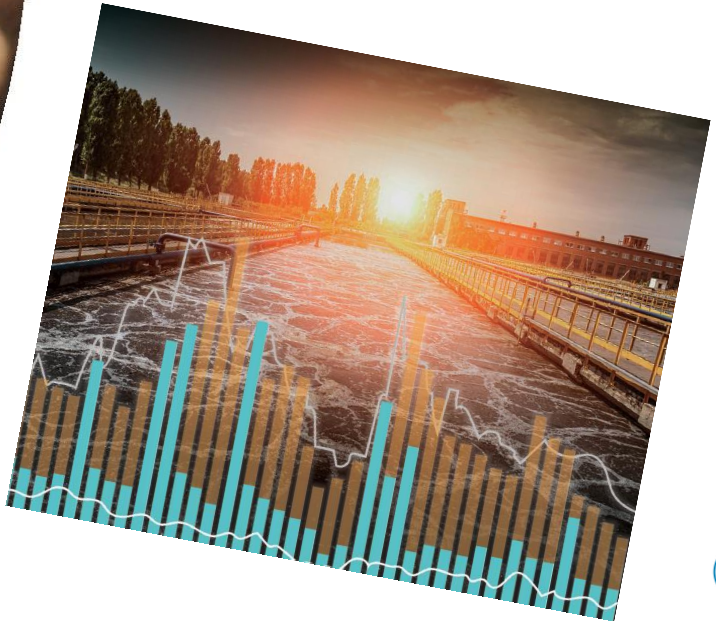
- The RTC-MOV independently controls up to 16 zones to a desired DO setpoint
- Adjusted variable opening degree of the air valves assigned to the corresponding zone
- Option to provide a common manifold air preasure ensuring that the valve assigned to the highest air demand has the highest opening degree



P-RTC for all kind of treatment

- ✓ Based on the actually supplied load
- ✓ Consideration of events like shock loading
- ✓ Adaption to daily and sudden load peaks
- ✓ Free adjustable fallback level integrated
- ✓ availability of all internal calculation variables (no black box)
- ✓ Integration in the existing infrastucture (nearly all kind of interfaces available)
- ✓ Possibility to use external measured values

Claros N/DN-RTC intermittent Denitrification



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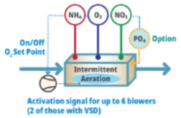


How does a N/DN-Module work?

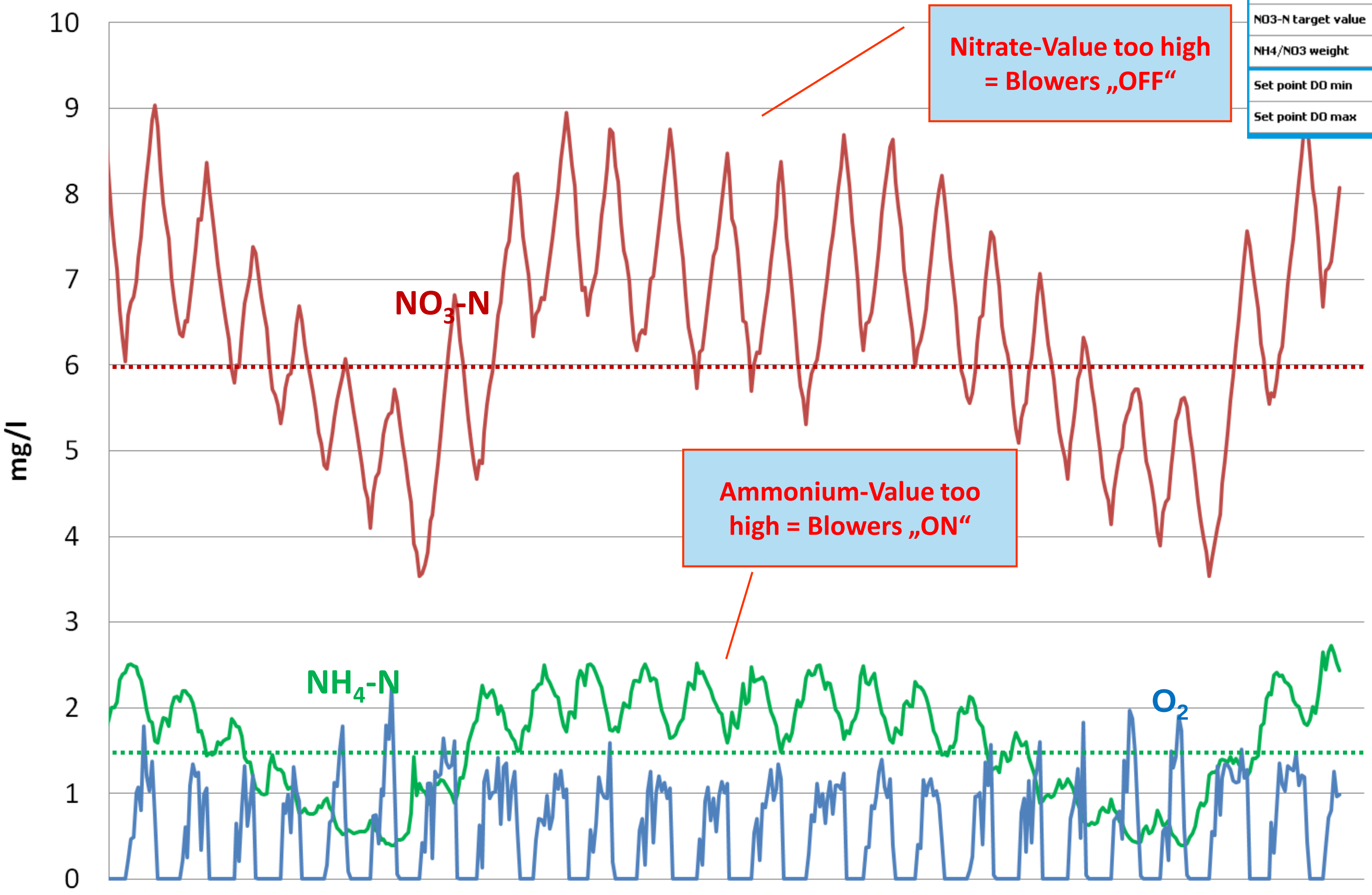
Controller parameter

Target values and limitation of controller result

	Unit	N/DN 1
NH4-N target value	mg/L	2.00
NO3-N target value	mg/L	6.00
NH4/NO3 weight	-	1.00
Set point DO min	mg/L	1.00
Set point DO max	mg/L	1.50

strictions

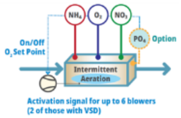
	Unit	N/DN 1
Nitri min	min	60
Nitri max	min	115
Denitri min	min	60
Denitri max	min	110



NO_3-N: 6 mg/l

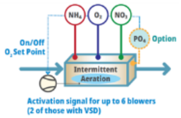
Limit Values

NH_4-N: 1,5 mg/l



N/DN-RTC: Software features

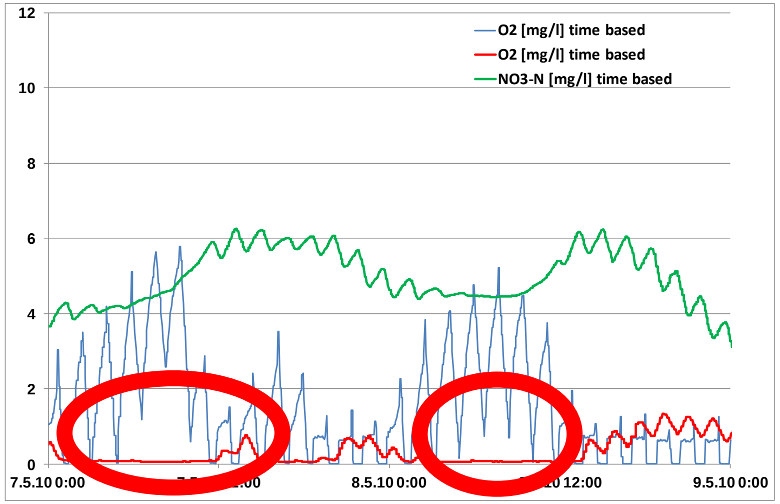
- Separate time frame for fallback strategy
- Impulse aeration
  - N/DN applicable in continuously aerated plants:
    - Ability to introduce anoxic intervals to improve denitrification / TN removal
    - No mixers needed in aeration tank
    - Programmable parameters: interval, pulse time, intensity
- CNP max (make active use of biological P-removal)
  - PO_4-P detector can be connected to N/DN-RTC and a PO_4-P upper limit can be chosen to start nitrification → overcome PO_4-P release
- NH_4-N min min (stopping Nitrification)
  - If NH_4-N decreases below a set minimum, aeration will be stopped to save aeration energy



N/DN-RTC: Increasing compliance and efficiency

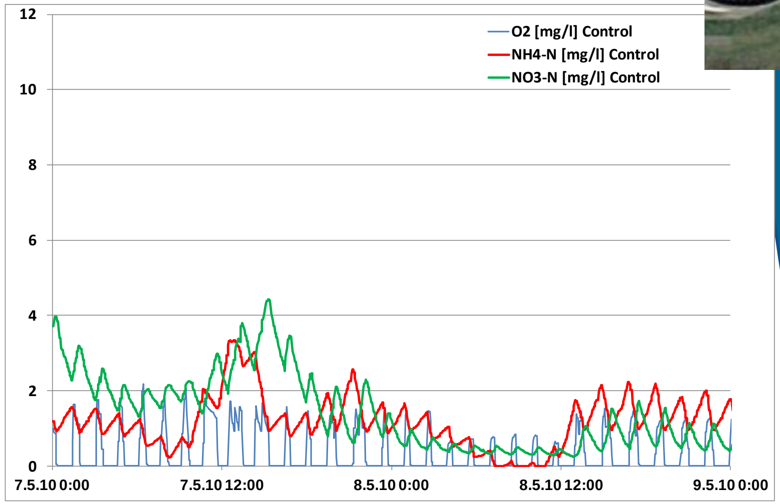
- Size: Approx. 8.000 PE
- Construction: 2 aeration tanks
- Strategy for tank 1: Time-controlled aeration
- Strategy for tank 2: N/DN Control of aeration with RTC
- Evaluation: 1 month of benchmark Time control

Time based control

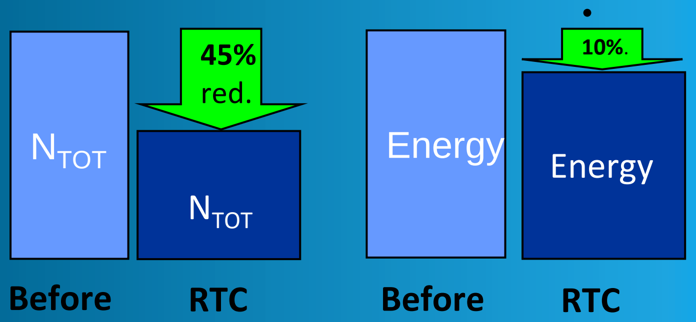


Fixed aeration intervals,
high DO → no denitrification during low load situations
High NO_3-N bzw. N_{TOT} –Concentration

N/DN control



Variable aeration intervals
Denitrification during low load situations
Low NO_3-N resp. N_{TOT} -Concentration



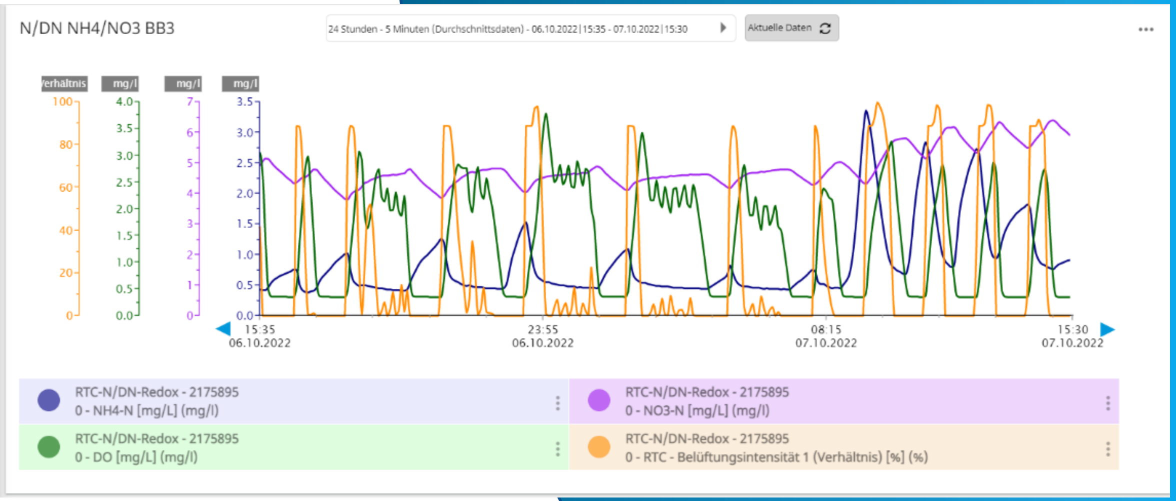
Process control: N/DN vs ORP

WWTP Germany, 15.000pe plant, 2 lanes

- Installation: RTC-N/DN hosted on sc4500
  Bio 3 in ORP mode, *Bio 2* in NH_4-N and NO_3-N mode
- **Ease of installation:** Installation done in less than one day (sc4500 RTC)
- **Customer ß-test feed back: Customer purchased** NH_4-N and NO_3-N solution for both lanes (process transparency)

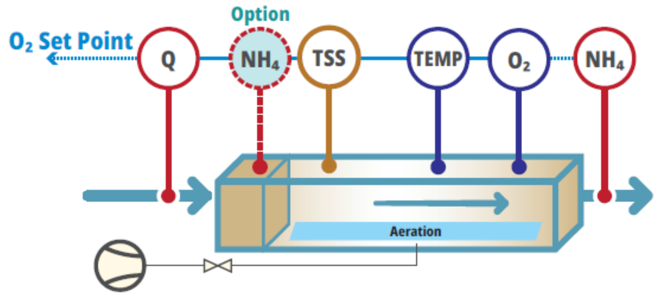
ORP control

NH4/NO3 control

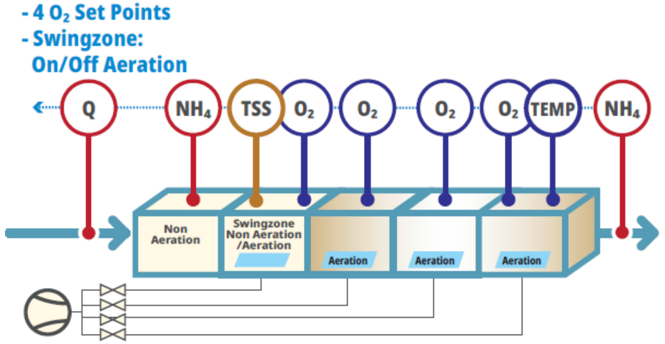


Claros N-RTC
Plug flow Nitrification

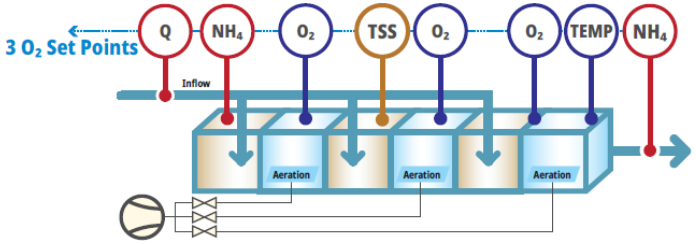
N-RTC solution



- DO setpoint
- Control Status Signal



- DO setpoint for up to 4 zones (one zone facultative aeration)
- Control Status Signal

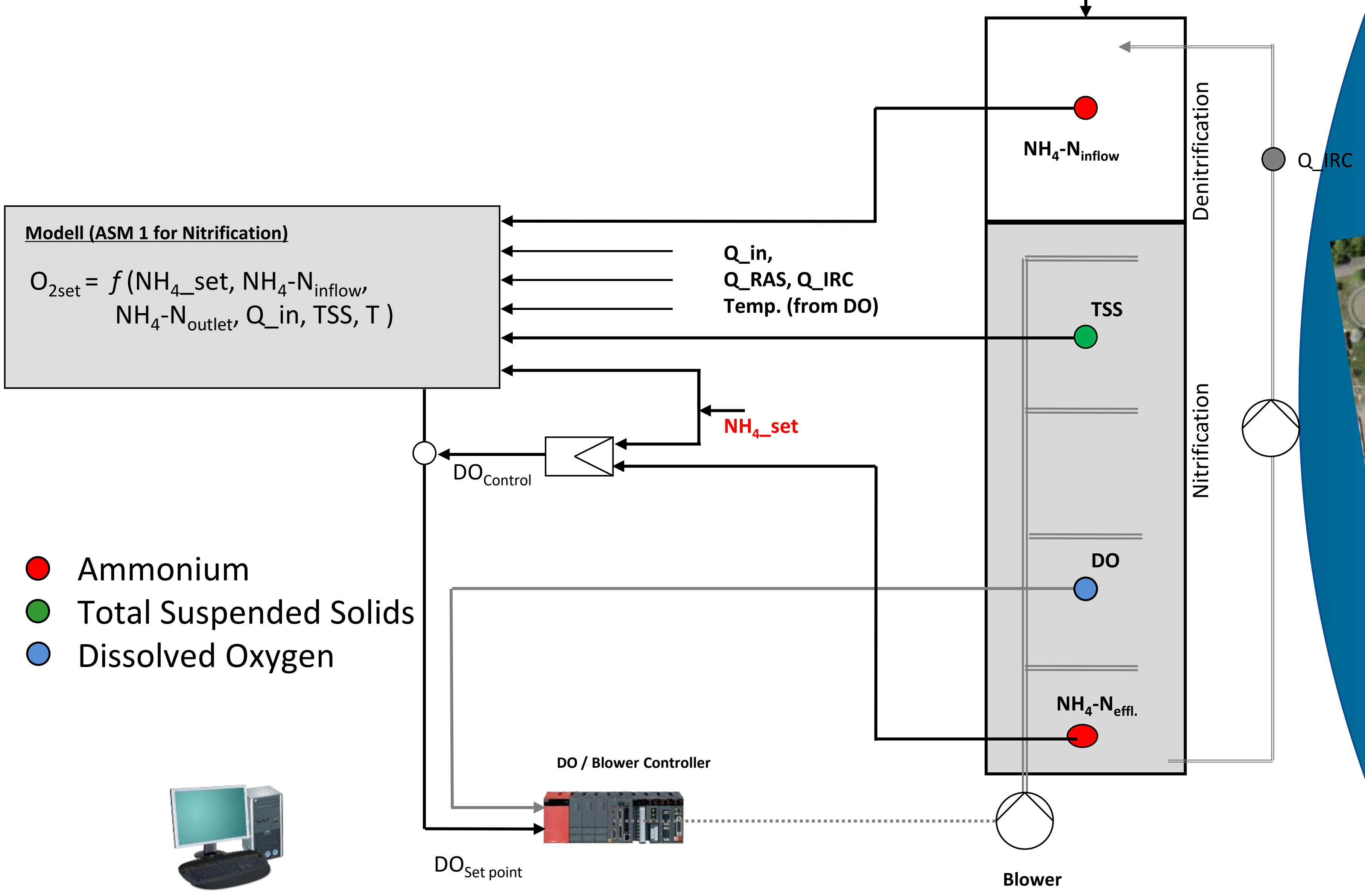


- DO set point for up to 3 zones
- Control Status Signal

N-RTC Plug flow Denitrification

- ✓ **Ensure compliance on NH4-N due to load based O2 set point adjustment**
- ✓ **Energy savings: 15%-30% due to lower DO concentration in aeration (compared to fixed O2 control on 1,5 mg/L…2,5 mg/L)**
- ✓ **Improved denitrification and compliance on N_TOT due to load based aeration (less O2 recirculated)**
- ✓ **Focused air supply to areas of highest requirement (RTC-N4Z)**
- ✓ **Improved denitrification capacity due to adjusted volume for nitrification (RTC-N4Z)**
- ✓ **Improved sludge settlement qualities through DO levels matching organic load and well maintained anoxic zones**

N-RTC: Operational principle



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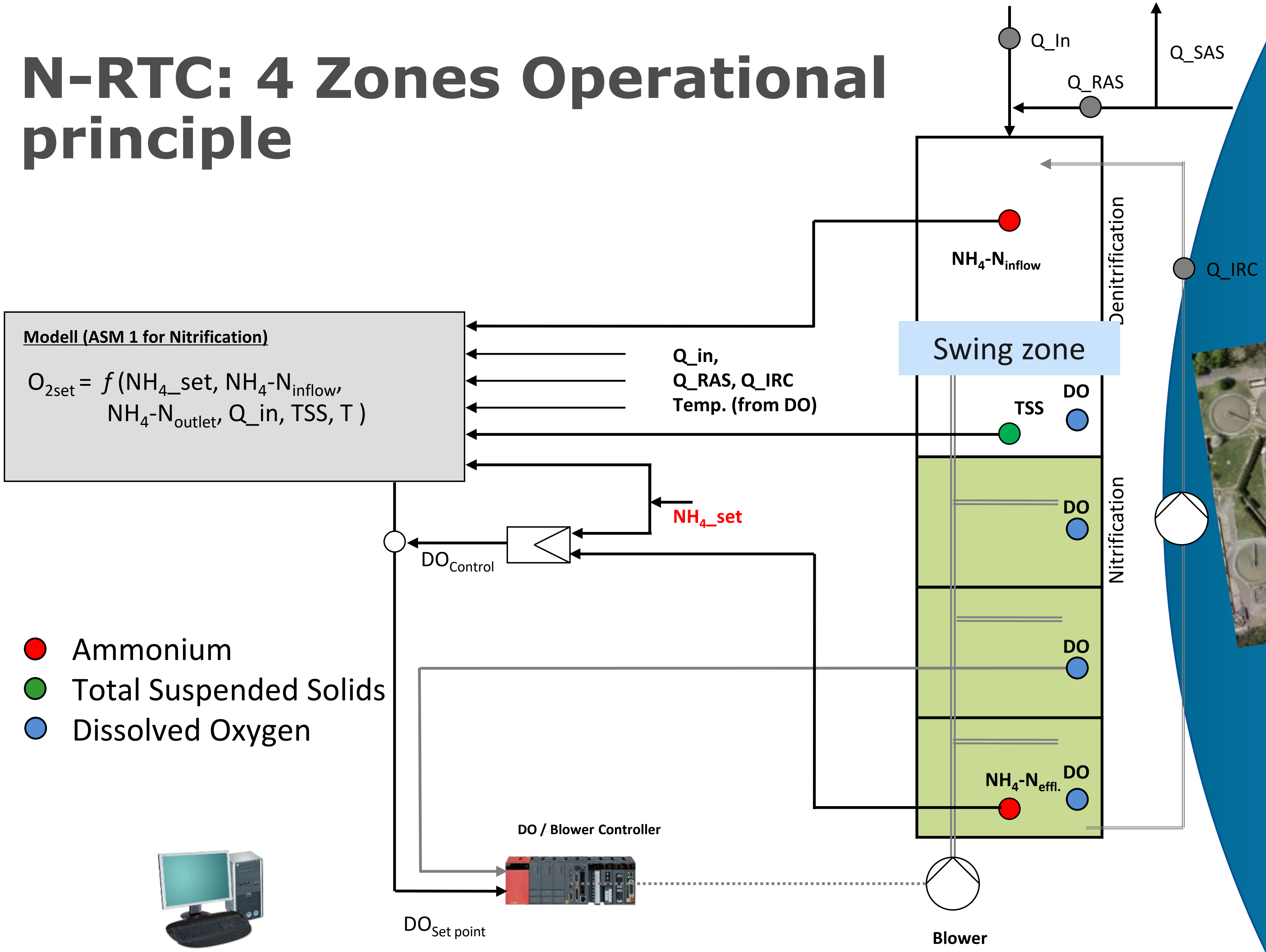
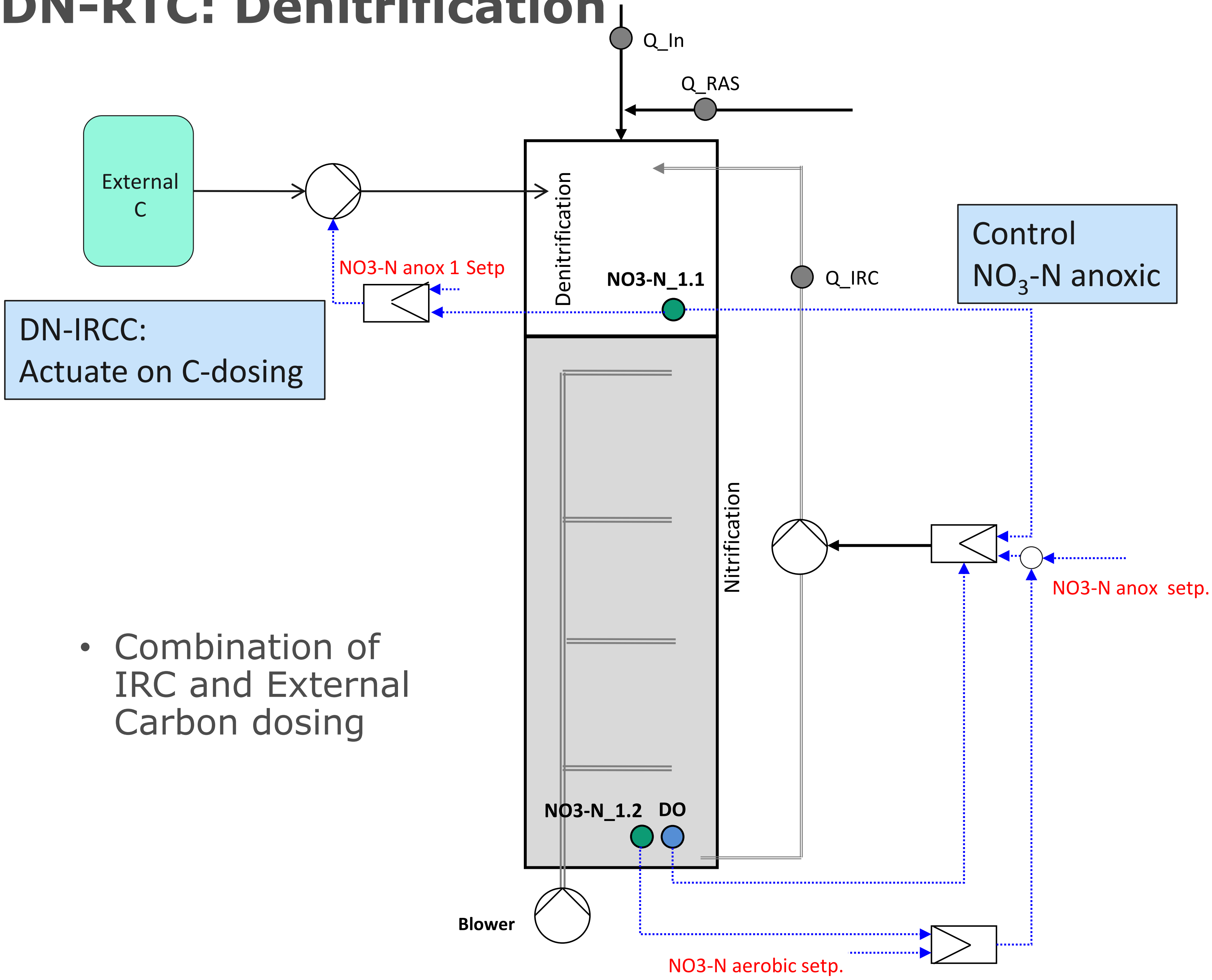
N-RTC: 4 Zones Operational principle



DN-RTC: Denitrification



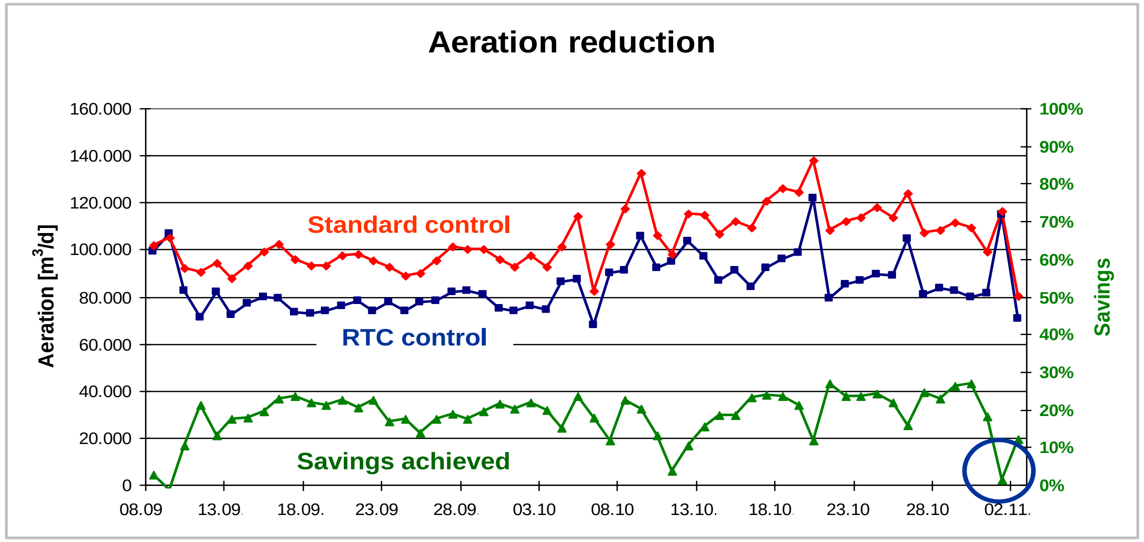
- Combination of IRC and External Carbon dosing

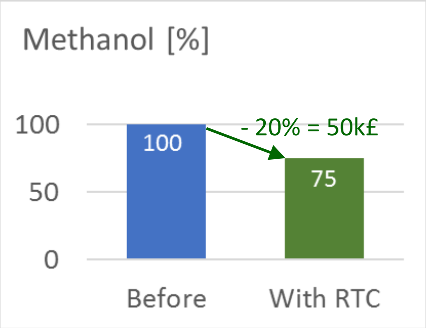
N-RTC: Southampton, Southern Water, UK

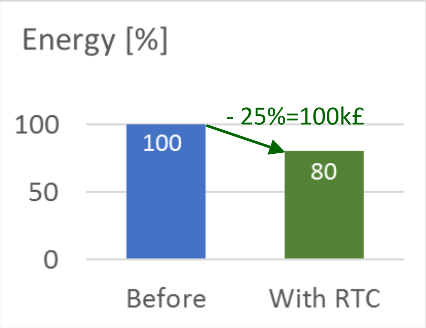
- Plant: - 250.000pe, 4+4 = 8 lanes, Bardenpho 4 stage
- Targets: - Improvement on Compliance
  - Less aeration energy and methanol consumption
  - Compare standard DO control to NH_4-N control
- Delivery: - N-RTC for load based aeration
  - DN-RTC for carbon dosing (meet TN compliance)
  - SRT-RTC for sludge age adjustment
- Results: - Improved compliance, ROI ~ 2 yr
  - 20% less airflow, 25% less methanol

Benchmark trail: 4 lanes of old plant (RTC) compared to 4 lanes of new plant

Benchmark test: Airflow comparison between existing control and RTC control

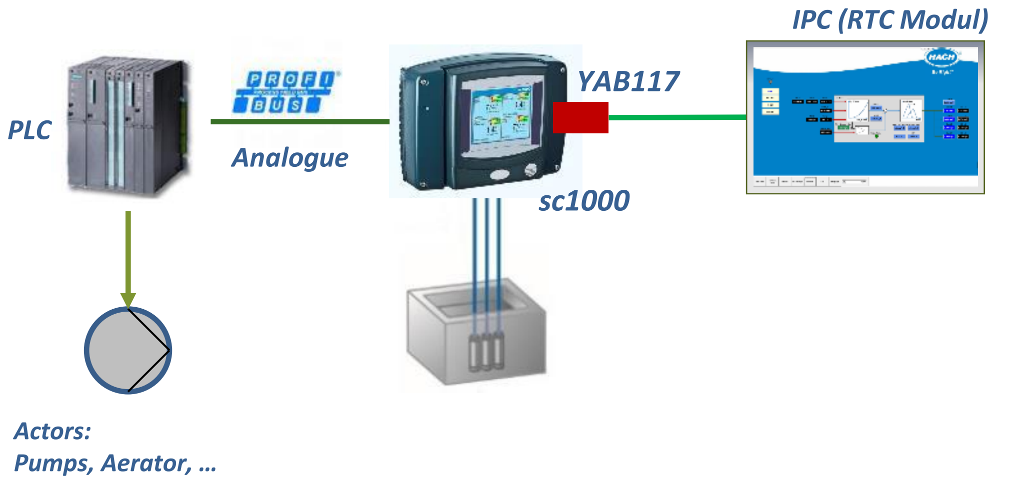






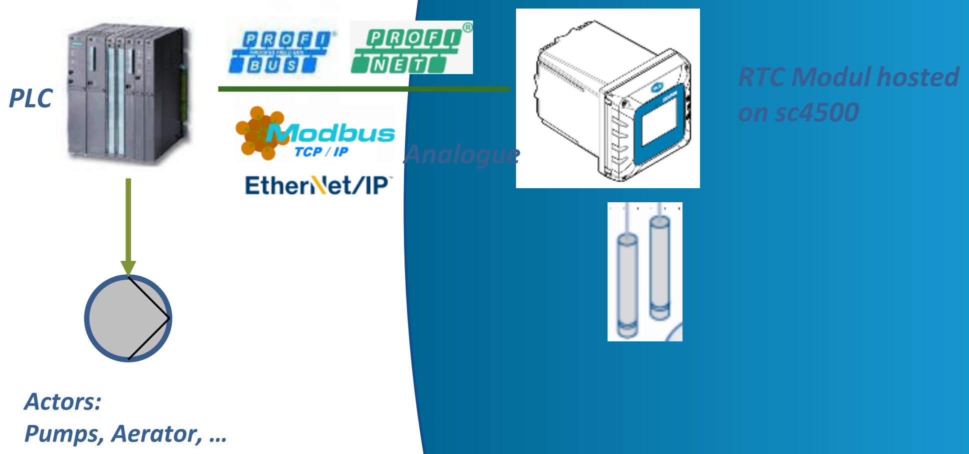
RTC hosted on SC4500: What is the concept?

- Existing std. combined



Cumbersome, but very flexible and effective solution for medium sized plants with a demand on multiple modules.

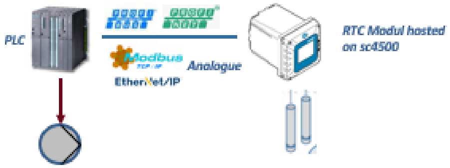
- RTC hosted on SC4500



Cost effective, but limited capabilities for
- small plants
- decentralized applications on larger plants with a single module demand

RTC hosted on SC4500
transforms a measurement transmitter into a process controller !!

RTC plattform different options



Intermittent denitrification (RTC-N/DN)	Intermittent aeration control, Output: Aeration on/off	1 Channel 2 Channel	RTC-N/DN (1C) RTC-N/DN (2C)
	Intermittent aeration & O_2 control, Output: Aeration on/off, 1 aeration stage, VSD	1 Channel 2 Channel	RTC-N/DN_DO (1C) RTC-N/DN_DO (2C)
	Intermittent aeration & O_2 control, Output: Aeration on/off, 6 aeration stages, 2 VSD	1 Channel 2 Channel	RTC-N/DN_DO 2VFD (1C) RTC-N/DN_DO 2VFD (2C)
	Intermittent aeration control incl. external Carbon addition, Output: Aeration on/off, external Carbon dosing	1 Channel 2 Channel	RTC-N/DN_C (1C) RTC-N/DN_C (2C)
	Intermittent aeration control incl. external Carbon addition, Output: Aeration on/off, 1 aeration stage, VSD external Carbon dosing	1 Channel 2 Channel	RTC-N/DN_DO_C (1C) RTC-N/DN_DO_C (2C)
	Intermittent aeration control incl. external Carbon addition, Output: Aeration on/off, 6 aeration stages, 2 VSD external Carbon dosing	1 Channel 2 Channel	RTC-N/DN_DO 2VFD_C (1C) RTC-N/DN_DO 2VFD_C (2C)
SBR (Intermittent denitrification) (RTC-N/DNSBR)	Intermittent aeration control (SBR), Output: Aeration on/off	1 Channel 2 Channel	RTC-N/DN SBR (1C) RTC-N/DN SBR (2C)
	Intermittent aeration & O_2 control (SBR), Output: Aeration on/off, 1 aeration stage, VSD	1 Channel 2 Channel	RTC-N/DN SBR_DO (1C) RTC-N/DN SBR_DO (2C)
	Intermittent aeration (SBR) & O_2 control, Output: Aeration on/off, 6 aeration stages, 2 VSD	1 Channel 2 Channel	RTC-N/DN SBR_DO 2 VFD (1C) RTC-N/DN SBR_DO 2VFD (2C)
Simultaneous denitrification (RTC-SND)	NH_4-N & NO_3-N control, Output: Aeration Intensity (0…100%)	1 Channel 2 Channel	RTC-SND (1C) RTC-SND (2C)
	NH_4-N & NO_3-N control, Output: Aeration Intensity (0…100%), Output: 6 stages, 2 VSD	1 Channel 2 Channel	RTC-SND (1C6Z) RTC-SND (2C6Z)
Nitrification, plug flow (RTC-N)	Combination open / closed loop NH_4-N control, Output: Dissolved Oxygen setpoint	1 Channel 2 Channel	RTC-N (1C) RTC-N (2C)
	Combination open / closed loop NH_4-N control, Output: Aeration on/off, 1 aeration stage, VSD	1 Channel 2 Channel	RTC-N_DO (1C) RTC-N_DO (2C)
	Combination open / closed loop NH_4-N control, with O_2 control, Output: O_2 setpoint, 6 aeration stages, 2 VSD)	1 Channel 2 Channel	RTC-N_DO 2VFD (1C) RTC-N_DO 2VFD (2C)
	Combination open / closed loop NH_4-N control, Output: O_2 setpoints for 4 zones, control of one swing zone	1 Channel 2 Channel	RTC-N_4Z (1C) RTC-N_4Z (2C)
	Combining open / closed loop NH_4-N control on Step Feed reactors, Output: O_2 set points for 3 zones	1 Channel 2 Channel	RTC-N_STEP (1C) RTC-N_STEP (2C)
DO control (RTC-DO)	Closed loop zone DO control. Output: Aeration intensity	4 Zones 8 Zones 12 Zones 16 Zones	RTC-DO (4C) RTC-DO (8C) RTC-DO (12C) RTC-DO (16C)
Most open valve DO control (RTC-MOV)	Closed loop zone DO control. Output: Air valve position, pressure on manifold or overall	4 Zones 8 Zones 12 Zones 16 Zones	RTC-MOV (4C) RTC-MOV (8C) RTC-MOV (12C) RTC-MOV (16C)
Denitrification (RTC-DN)	Closed loop control NO_3-N effluent anoxic or post-aeration. Output: Internal recirculation flow rate	1 Channel 2 Channel	RTC-DN_IRC (1C) RTC-DN_IRC(2C)
	Closed loop control NO_3-N effluent denitrification or effluent aeration. Output: Internal recirculation flow rate and external carbon addition.	1 Channel 2 Channel	RTC-DN_IRC_C (1C) RTC-DN_IRC_C (2C)
	Combination open / closed loop NO_3-N control. Output: External carbon addition	1 Channel 2 Channel	RTC-DN_C (1C) RTC-DN_C (2C)

Non-Cloud
Non-Cloud + Embeddged Prognosys
Cloud (Claros-enabled)
Claros, RTC N/DN-ORP
Claros, RTC N/DN-ORP(DO)
Claros, RTC N/DN
Claros, RTC N/DN(DO)

HACH®

HACH RTC-Modules for WW cleaning Experiences:

Installations

- more than 3.000 modules at over 2.000 WWTP
- Germany: München, Ingolstadt, Baden-Baden, Göppingen, Monsheim, …
- International: London, Pilsen, Bratislava, New York, Perth, Melbourne, …..
- 60% of all Installations in Europe
- Size of the plants between 3,5 Mio PE and 700 PE

London, Becktoon, Thames Water, 3,5 Mio EW, ASP3
8 Kanal N-RTC, SRT-RTC Installation

Southampton, Southern Water, 250.000EW
N-RTC, DN-RTC , SRT-RTC Installation

Flieden, Deutschland, 5.000 EW,
P-RTC Installation

Optimierung der Schlammentwässerung reduziert Entsorgungskosten

Modernisierungsmaßnahmen auf der Zentralkläranlage Ingolstadt führten zur Erhöhung des TS-Gehalts und zu einer Senkung des Polymerverbrauchs.

Ingolstadt, Deutschland, 275.000 EW,
ST-RTC Installation


thank you for your attention!
merci de votre attention!
grazie per l'attenzione!
vielen Dank für Ihre Aufmerksamkeit!
gracias por su atención!
HACH