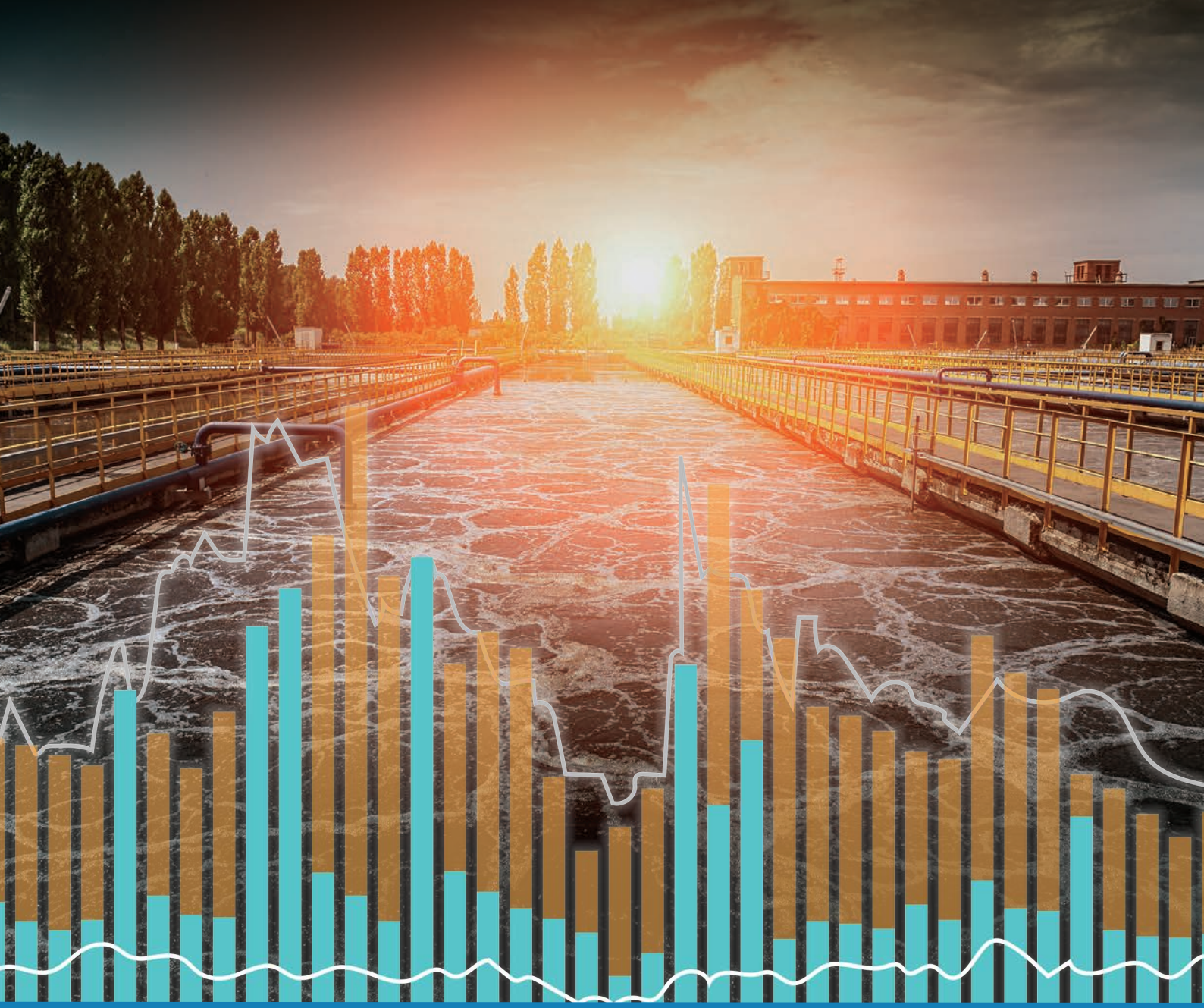
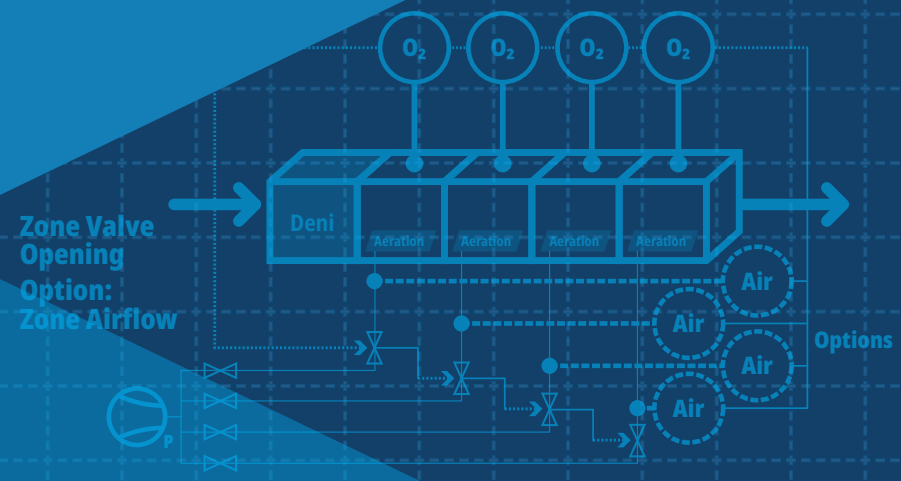


Claros Process Management

RTC Modules for Wastewater & Source Water Treatment

PRODUCT RANGE & DESCRIPTION

HACH®
Be Right™



Claros – Flexible solutions for your individual requirements

Claros combines instrument, data and process management into integrated solutions that are tailored to your business.

Claros Instrument Management

Thanks to predictive diagnostics, warning messages when maintenance is required, and step-by-step instructions, you can trust the accuracy of your measurements.

Claros Data Management

Using data visualization, you can record and access data, and share it with others. So you get a complete picture of yours water or sewage system—anytime, anywhere, and on any device.

Claros Process Management

Control your water and wastewater treatment processes in real time to ensure compliance with limit values and efficient operation around the clock.

Claros Process Management

Hach's RTC (Real Time Control) solutions are complete, off-the-shelf systems that adjust a treatment process in real time to keep your facility compliant while reducing treatment costs. Controlling your processes has never been so easy.

Standardized RTC modules can be combined and configured to provide a holistic optimization solution for water treatment processes. This is tailored to the plant-specific requirements, improves compliance with guidelines, and lowers operating costs.

- Ensure regulatory compliance
- Reduce operating costs
- Standardized, modular, and expandable
- Increase treatment capacity

HACH®

RTC Standardized Combined Product Range

Process	Product Description		Abbreviation	Article #
PO_4-P precipitation (RTC-P)	Closed loop control PO_4-P, Output: precipitant flowrate	1 Channel 2 Channel	RTC-P_CL (1C) RTC-P_CL (2C)	LXZ515.53.A1010 LXZ515.53.A1011
	Open loop control PO_4-P, Output: precipitant flowrate	1 Channel 2 Channel	RTC-P_OL (1C) RTC-P_OL (2C)	LXZ515.53.A1110 LXZ515.53.A1111
	Closed loop control PO_4-P considering P_tot / TSS in effluent, automatically compensating for total P or solids in final effluent. Output: precipitant flowrate	1 Channel	RTC-P_CLCL	LXZ515.53.A1210
	Combination open / closed loop control PO_4-P, Output: precipitant flowrate	1 Channel 2 Channel	RTC-P_OLCL (1C) RTC-P _OLCL (2C)	LXZ515.53.A1310 LXZ515.53.A1411
	Combination closed loop PO_4-P control with open loop PO_4-P control. Output 2 precipitant flow rates from 1 measurement point.	2 Channel	RTC-P_CLOL	LXZ515.53.A1311
PO_4-P precipitation (RTC-P, SBR version)	Open/Closed loop control PO_4, Output: precipitant flowrate for each SBR tank	1 Reactor 2 Reactor 3 Reactor 4 Reactor	RTC-P_SBR (1C) RTC-P _SBR (2C) RTC-P_SBR (3C) RTC-P _SBR (4C)	LXZ515.53.B1010 LXZ515.53.B1011 LXZ515.53.B1012 LXZ515.53.B1013
Intermittent denitrification (RTC-N/DN)	Intermittent aeration control, Output: Aeration on/off	1 Channel 2 Channel	RTC-N/DN (1C) RTC-N/DN (2C)	LXZ520.53.C0101 LXZ520.53.C0111
	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)	LXZ520.53.C3101 LXZ520.53.C3111
	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)	LXZ520.53.C2101 LXZ520.53.C2111
	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)	LXZ520.53.C0201 LXZ520.53.C0211
	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)	LXZ520.53.C3201 LXZ520.53.C3211
	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)	LXZ520.53.C2201 LXZ520.53.C2211
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)	LXZ520.53.D0101 LXZ520.53.D0111
	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)	LXZ520.53.D3101 LXZ520.53.D3111
	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)	LXZ520.53.D2101 LXZ520.53.D2111
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)	LXZ522.53.A0101 LXZ522.53.A0111
	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)	LXZ522.53.B0101 LXZ522.53.B0111
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)	LXZ519.53.B0101 LXZ519.53.B0111
	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)	LXZ519.53.B3101 LXZ519.53.B3111
	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)	LXZ519.53.B2101 LXZ519.53.B2111
	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)	LXZ519.53.D0101 LXZ519.53.D0111
	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)	LXZ519.53.D1101 LXZ519.53.D1111
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)	LXZ530.53.C0101 LXZ530.53.D0101 LXZ530.53.C0111 LXZ530.53.D0111
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)	LXZ530.53.A0101 LXZ530.53.B0101 LXZ530.53.A0111 LXZ530.53.B0111
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)	LXZ521.53.A0101 LXZ521.53.A0111
	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)	LXZ521.53.B0101 LXZ521.53.B0111
	Combination open / closed loop NO_3-N control. Output: External carbon addition	1 Channel 2 Channel	RTC-DN_C (1C) RTC-DN_C (2C)	LXZ521.53.D0101 LXZ521.53.D0111
Alkalinity (RTC-ALK)	Open closed loop control of Alkalinity, Output: Caustic dosing rate	1 Channel 2 Channel	RTC-ALK RTC-ALK	LXZ514.53.A0101 LXZ514.53.A0111
Nutrient dosing (RTC-C/N/P)	Nutrient dosing based on organic load. Considers both influent and effluent nutrient levels. Output: External Nitrogen and Phosphorous dosing rate	1 Channel 2 Channel	RTC-C/N/P (1C) RTC-C/N/P (2C)	LXZ514.53.B0101 LXZ514.53.B0111

RTC Standardized Combined Product Range *Part 2*

Process	Product Description		Abbreviation	Article #
Sludge retention time (RTC-SRT)	Adjustment of sludge retention time (sludge age) according to seasonal temperature. Output: Surplus activated sludge flow rate	1 Channel 2 Channel	RTC-SRT (1C) RTC-SRT (2C)	LXZ518.53.A0101 LXZ518.53.A0111
Chlor-Dechlor RTC-C/DC	Combined Open loop / Closed loop adjustment of Total Residual Chlorine (TRC) after waste/raw water disinfection. Output: CL_2 & de-Cl dosing rate.	1 Channel 2 Channel	RTC-CL_2 (1C) RTC-CL_2 (2C)	LXZ531.53.A1010 LXZ531.53.A1011
Return Activated Sludge (RTC-RAS)	Adjustment of RAS flow rate considering both TSS in the return activated sludge and sludge level in the final settling stage. Output: Return activated sludge flow rate	1 Channel 2 Channel	RTC-RAS (1C) RTC-RAS (2C)	LXZ518.53.C0101 LXZ518.53.C0111
Sludge Thickening (RTC-ST)	Open and closed loop control of TSS in thickened sludge and/or filtrate. Output: Polymer flow and/or sludge feed flow	1 Channel 2 Channel	RTC-ST (1C) RTC-ST (2C)	LXZ517.53.A0101 LXZ517.53.A0111
Sludge dewatering (RTC-SD)	Control of TSS in dewatered sludge or centrate. Output: Polymer flow or sludge feed flow	1 Channel 2 Channel	RTC-SD (1C) RTC-SD (2C)	LXZ516.53.A0101 LXZ516.53.A0111
Dissolved air flotation (RTC-DAF)	Control of TSS/COD in discharged water or TSS in flotated sludge. Output: Dosing of Coagulant and polymer, dosing of acid and or caustic	1 Channel 2 Channel	RTC-DAF (1C) RTC-DAF (2C)	LXZ517.53.B0101 LXZ517.53.B0111
	Control of TSS in flotated sludge and TSS in clear water. Output: Dosing of Coagulant and polymer (2 dosing points), 2 point dosing of acid and or caustic for pH control	1 Channel	RTC-DAF+ (1C)	LXZ517.53.B0201
Source Water coagulation (RTC-COAG)	Combination open/closed loop control effluent turbidity	Small Medium Large	RTC-COAG (Small) RTC-COAG (Medium) RTC-COAG (Large))	LXZ532.53.A1010 LXZ532.53.A1011 LXV532.53.A1012
Source Water pre-oxidation (RTC-PREOX)	Combination open/closed loop control of Mn and Fe in finished water	Small Medium Large	RTC-PREOX (Small) RTC-PREOX (Medium) RTC-PREOX (Large))	LXZ532.53.B1010 LXZ532.53.B1011 LXV532.53.B1012

System Integration	Hach Claros Network Bus communication (HCNB)		LXZ515.53.B0001
	ModBus TCP/IP		LXZ515.53.B0002
	PLC / RTC communication via 3rd party Software from Kepware for specific PLC communication protocol. Brand and type of PLC to be defined	Kepware SW	LXZ515.53.B0000

Accessories/Service	Product Description	Article #
Hardware	DIN Rail IPC with UI and Basic SW (SIEMENS IPC427E Microbox) 15" touch wide screen (SIEMENS IPC477E) 19" touch wide screen (SIEMENS IPC477E)	LXV515.53.0005C LXV515.53.0003C LXV515.53.0004C
	DIN Rail IPC with UI and Basic SW (CX5130 Beckhoff) 15,6" touch wide screen (CP2716, Beckhoff) 18,5" touch wide screen (CP2718, Beckhoff)	LXV515.53.0005B LXV515.53.0003B LXV515.53.0004B
	4G SIM Card Router with Power Supply	LZH371
	RTC upgrade from std. single to std. combined Std. combined extension RTC Software adoption / modfication / extension (after consultation with RTC BU)	LXZ515.53.00001 LXZ515.53.00002 LXZ515.53.00005

PO_4-P Precipitation (RTC-P)

RTC-P Application Area

- Plants with chemical P-removal
  (measurement point before or after the point of chemical application or any combination of those).
- Plants with varying phosphorus loads in their inflow
- Plants using Al, Fe, and combination products as precipitant

RTC-P Description

Control module for load-dependent precipitant dosage for chemical phosphate elimination.

The RTC-P (Phosphate Removal Real Time Controller) controls the PO_4-P (soluble phosphorus) concentration based on the continuously measured PO_4-P concentration and the waste water flow rate. The open loop RTC-P considers the biological phosphorous uptake and true chemical efficiency to ensure the minimum amount of precipitant is added to meet the PO_4-P setpoint. Closed loop control uses specialized PID loops to ensure very low set points can be used without problematic over reaction common in conventional PID loops. Combination of these advanced controls ensures a direct "fit" to almost any plant configuration and allows new strategies not previously available. Namely, dynamic PO_4-P set points to automatically react to solids loss events, or automated "policing" dosing to ensure separate dosing systems work in harmony to secure total P and where applicable metal ion compliance.

Robust fall back strategies are integral to Hach RTC. If input signals for inflow or ortho phosphate concentration are not available, the system automatically switches to a user defined fall back strategy choice.

Optionally, the RTC-P can also consider the residual ferric concentration measured in the plant effluent in order to also support ferric compliance.

RTC-P Benefit

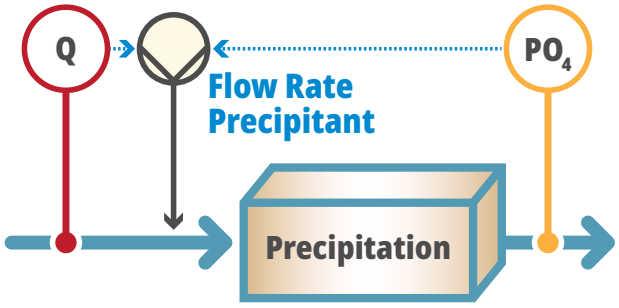
Improves compliance resilience with existing infrastructure. "Future proofs" plants against stricter regulations.

Avoids overdosing of precipitant resulting in:
- no over spending for precipitant
- no increased production of precipitation sludge which has to be treated and disposed
- reduced alkalinity demand, protecting nitrification

Versions

Closed loop control PO_4-P, Output: precipitant flowrate
LXZ515.53.A1010 (Single Channel), RTC-P_CL (1C)
LXZ515.53.A1011 (Double Channel), RTC-P_CL (2C)

In this version, the ortho phosphate concentration is measured after the precipitant is added. A specialized PID algorithm considering flow rates is applied to provide stable control even at ortho phosphorus set-points < 0.1mg/L. The closed loop control approach ensures that the ortho phosphate concentration of the effluent is constantly kept to the desired set point and provides a measurement value to prove effective control.



Precipitant has to be well mixed with the wastewater stream before the measurement sample is taken. The application of this technique is not specifically limited by hydraulic retention time. As the precipitation chemicals are highly acidic they "equalize" rapidly across a settlement or aeration phase (just as pH adjustment rapidly effects the whole tank volume).

Typical Configuration: Dosing effluent aeration / PO_4-P measurement distribution chamber to the final sediment

I/O and Parameter / Channel

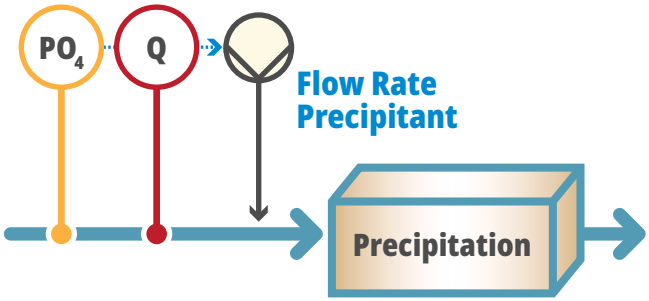
RTC-P Output
- Precipitant flow rate
- Controller status signal

RTC-P Input
- PO_4-P concentration
- Flow rate inflow wwtp
- Flow rate return activated sludge and internal recirculation (if available

RTC-P Control Parameter
- Set point for PO_4-P
- Min/max precipitant flow rate

Versions

Open loop control PO_4-P, Output: precipitant flowrate
LXZ515.53.A1110 (Single Channel), RTC-P_OL (1C)
LXZ515.53.A1111 (Double Channel), RTC-P_OL (2C)



In this version the ortho phosphate concentration is measured before the precipitant is added. Allowances are then made for chemical efficiency and bio-P uptake. Knowing the concentration of ortho phosphorus in the feed and relating that to the user defined set point ensures chemical efficiency is correctly accounted for. This understanding sets HACH feed forward control apart from simple static stoichiometric approaches common in the industry and is particularly important when low ortho phosphorus set points are required.

Typical Configuration
- Dosing point: Flow channel toward FST/ PO_4-P measurement: Effluent aeration

I/O and Parameter / Channel

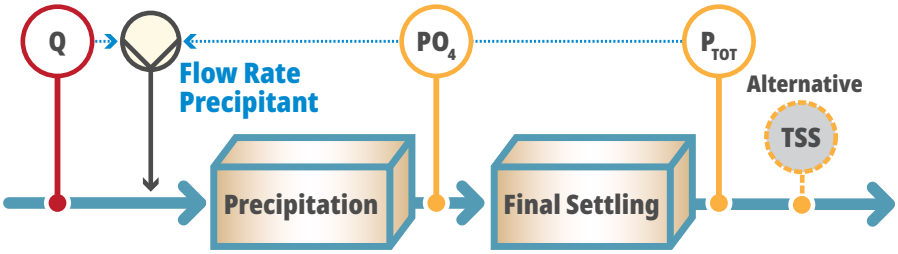
RTC-P Output
- Precipitant flow rate
- Controller status signal

RTC-P Input
- PO_4-P concentration
- Flow rate inflow wwtp
- Flow rate return activated sludge (if available)
- Flow rate internal recirculation (if available)

RTC-P Control Parameter
- Set point PO_4-P open loop control
- Min/max precipitant flow

Versions

Closed loop control PO_4-P considering P_tot / TSS in effluent, Output: precipitant flowrate
LXZ515.53.A1210 (Single Channel), RTC-P_CLCL



This RTC-P variant automatically reacts to elevated phosphorus associated with suspended solids in the final effluent. Using either a total phosphorus or suspended solids measurement in the final effluent, a user defined trigger level forces a lower ortho phosphorus set point in the primary control system to compensate for phosphorus unaffected by chemical dosing (particulate P). The combination of interlinking control loops is of particular importance when considering low phosphorus limits, short term events such as pin point floc or solids loss spikes due to flow conditions represent significant P compliance risk with lower phosphorus limits.

Typical Configuration
- Dosing point: Effluent aeration
- Measuring points: PO_4-P Distribution chamber to the final settling stage. P_Tot / TSS : Effluent wastewater treatment plant

I/O and Parameter / Channel

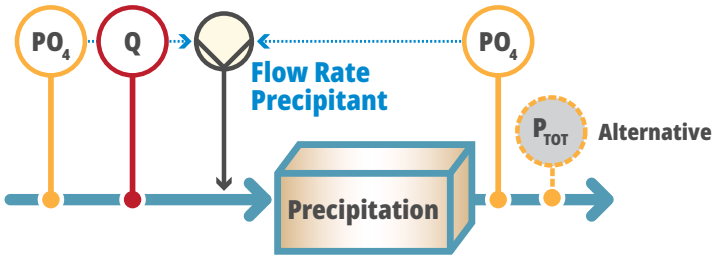
RTC-P Output
- Precipitant flow rate
- Controller status signal

RTC-P Input
- PO_4-P concentration after dosing point
- P_tot/TSS in plant effluent
- Flow rate inflow wwtp
- Flow rate return activated sludge (if available)
- Flow rate internal recirculation (if available)

RTC-P Control Parameter
- Set point PO_4-P closed loop control
- Set point P_TOT closed loop
- Min/max precipitant flow

Versions

Combination open / closed loop control PO_4-P, Output: precipitant flowrate
LXZ515.53.A1310 (Single Channel), RTC-P_OLCL (1C)
LXZ515.53.A1411 (Double Channel), RTC-P _OLCL (2C)



This RTC-P variant combines primary open loop control with closed loop "fine trim", informing the precipitant flow rate for one dosing point. This philosophy is particularly useful for sites with oversized assets where immediate reaction to load peaks is especially important.

As an option, the PO_4-P effluent aeration can be replaced by a measurement of P_Tot effluent wwtp.

I/O and Parameter / Channel

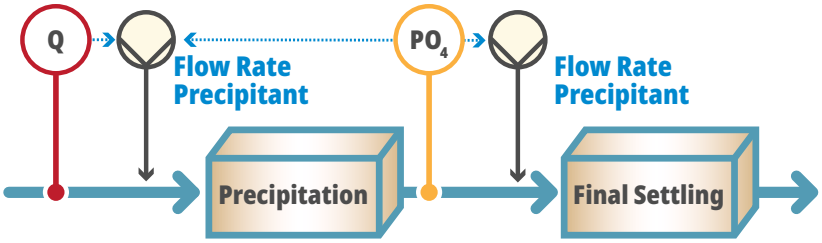
RTC-P Output
- Precipitant flow rate for one dosing point
- Controller status signal

RTC-P Input
- PO_4-P concentration before dosing
- PO_4-P in after dosing
- Flow rate inflow wwtp
- Flow rate return activated sludge (if available)
- Flow rate internal recirculation (if available)

RTC-P Control Parameter
- Set point PO_4-P closed loop
- Min/max precipitant flow

Versions

Combination open / closed loop control PO_4-P, Output: precipitant flowrate
LXZ515.53.A1311, RTC-P_CLOL



This RTC-P variant enables two dose points to be optimized from one ortho phosphate measurement Firstly, closed loop algorithms using a specialized PID control loop allow stable ortho phosphate levels to be passed forward to the secondary dose point. This allows residual phosphorus to be always made available to the biological stage. This residual can then be safely reduced to very low levels using an open loop philosophy on the secondary dose point. Alternatively, if the load conditions overwhelm the primary dosing point, the secondary open loop control can compensate to ensure breakthrough of orthophosphate does not occur. The ability to choose the balance of phosphorus removal across to dosing points opens up further chemical efficiency.

This approach is particularly suited to WwTW's with low total phosphorus consents, challenging chemistry or extreme ortho phosphate load conditions.

Typical Configuration
- Precipitant dosing 1: Aeration / PO_4-P measurement effluent aeration
- Precipitant dosing 2: Inflow final sedimentation (after PO_4-P measurement)

I/O and Parameter / Channel

RTC-P Output
- Precipitant flow rate for 2 dosing points
- Controller status signal

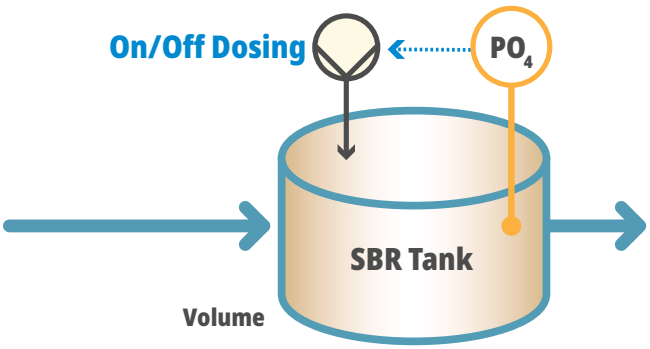
RTC-P Input
- PO_4-P concentration near/after dosing point
- Flow rate inflow wwtp
- Flow rate return activated sludge (if available)
- Flow rate internal recirculation (if available)

RTC-P Control Parameter
- Set point PO_4-P closed loop control
- Set point PO_4-P open loop control
- Min/max precipitant flow

Versions

PO_4-P precipitation (RTC-P, SBR version)
Closed loop control PO_4, Output: precipitant flowrate

1 reactor	RTC-P_SBR (1C)	LXZ515.53.B1010
2 reactor	RTC-P _SBR (2C)	LXZ515.53.B1011
3 reactor	RTC-P_SBR (1C)	LXZ515.53.B1012
4 reactor	RTC-P _SBR (2C)	LXZ515.53.B1013



The RTC-P SBR Version controls the PO_4-P concentration in an SBR reactor to a desired limit.

Based on the ortho phosphate concentration, the volume of the SBR tank and the applied dosing rate of precipitant the optimal point of time to start the precipitation dosing during the aeration process is calculated. It is ensured that (1) the dosing process starts as late as possible allowing all biological P uptake processes to be finished and (2) that there is sufficient time for mixing and reacting before the sedimentation process starts.

Typical Configuration
- Precipitant dosing and PO_4-P measurement in each SBR reactor

I/O and Parameter / Channel

RTC-P Output
- On/off signal for flow of precipitant
- Controller status signall

RTC-P Input
- PO_4-P concentration in each SBR Reactor
- SBR phase
- Reactor volume

RTC-P Control Parameter
- Set point PO_4-P for each reactor
- Precipitant flow rate applied

Intermittent Denitrification (RTC-N/DN)

RTC-N/DN Application Area
All plants using an aerated /non-aerated time (including SBR plants) to ensure ammonium and total nitrogen compliance.

RTC-N/DN Description
The N/DN RTC provides the ideal balance of aerated / non-aerated phases for intermittently operated plants or for SBR plants. The time interval for nitrification and denitrification phases is based on real time measurements of NH_4-N and NO_3-N in the aeration tank. Understanding both NH_4-N and NO_3-N levels in the treatment basin ensures the correct level of DO for the nitrification stage and prevents nitrate exhaustion causing orthophosphate release during the denitrification state or untreated nitrate harming total nitrogen compliance. Should the WwTW have a specific ammonium and total nitrogen limit, functionality is built in to allow priority to be given to a particular parameter, giving the plant maximum compliance protection and treatment flexibility. Additionally there is an option to include an ortho phosphate feedback control loop. In the event of any biological ortho P release, this step would automatically reinstate the aerated phase to protect total P compliance.

Optionally an additional DO controller compliments the RTC N/DN. This DO controller activates

- in the single DO version a single aeration device equipped with a VSD
- in the 6 stage VSD version up to six aeration devices, two of those optionally equipped with a variable frequency drive (VFD) providing smooth adjustment of aeration intensity, high blower efficiency and protection against excessive switching of duty.

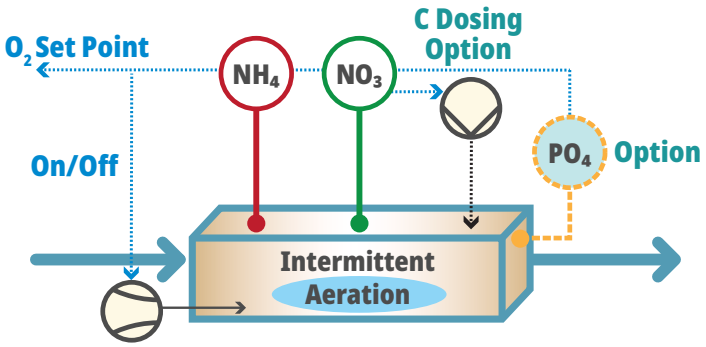
Optionally an adjustment of external carbon dosing during denitrification can be added to control the NO_3-N concentration to a desired level

Robust fall back strategies are an integral part of Hach RTC control. If input signals for ammonium and nitrate are not available, alternate (user selectable) fall back strategies are automatically activated to protect compliance.

RTC-N/DN Benefit
- Effectively increases treatment capacity compared to fixed timeframe control or methods based on measuring reductive conditions.
- Much lower total N consents can be met with existing assets.
- Sludge settlement characteristics improved as high aeration rates are not used in the absence of NH_4-N/COD load.
- Maximum performance on “nitrate harvesting” to drive low total nitrogen.
- Optimum energy usage (typical savings of circa 20%), providing air only when required and maximizing the available nitrate benefit
- Maximum alkalinity recovery to protect the nitrification rate and maximize available treatment without additional chemical treatment.
- Protects against off gassing of nitrogen in final tanks or SBR generating solids loss issues.
- Additional phosphorus compliance protection.

Versions

Intermittent aeration control, Output: Aeration on/off
LXZ520.53.C0101 (Single Channel), RTC-N/DN (1C)
LXZ520.53.C0111 (Double Channel), RTC-N/DN (2C)
LXZ520.53.D0101 (Single Channel SBR), RTC-N/DN SBR (1C)
LXZ520.53.D0111 (Double Channel SBR), RTC-N/DN SBR (2C)
LXZ520.53.C0201 (Single Channel) RTC-N/DN_C (1C)
LXZ520.53.C0211 (Double Channel RTC-N/DN_C (2C)



I/O and Parameter / Channel

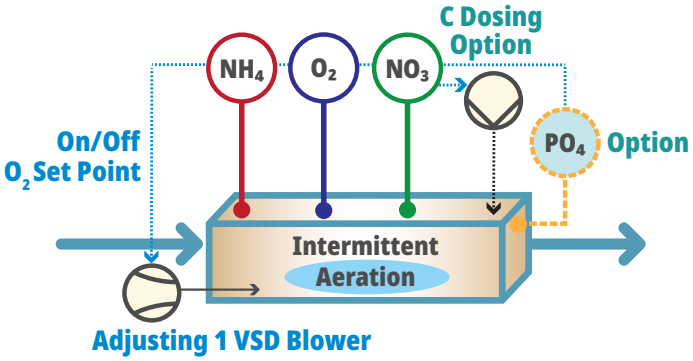
RTC-N/DN Output
- Activation signal for aeration
- DO set-point
- Controller status signal
- Option: External Carbon dosing rate

RTC-N/DN Input
- NH_4-N and NO_3-N
- SBR Version: Activation signal (filling)
- Option: Flow rate wwtp

RTC-N/DN Control Parameter
- Target value NH_4-N & NO_3-N-N
- Weighting NH_4-N & NO_3-N-N
- Maximum NH_4-N (stop deni)
- Min/max DO concentration

Versions

Intermittent aeration & O_2 control,
Output: Aeration on/off, 1 aeration stage, VSD
XZ520.53.C3101 (Single Channel), RTC-N/DN_DO (1C)
LXZ520.53.C3111 (Double Channel), RTC-N/DN_DO (2C)
LXZ520.53.D3101 (Single Channel SBR), RTC-N/DN SBR_DO (1C)
LXZ520.53.D3111 (Double Channel SBR), RTC-N/DN SBR_DO (2C)
LXZ520.53.C3201 (Single Channel) RTC-N/DN_DO_C (1C)
LXZ520.53.C3211 (Double Channel RTC-N/DN_DO_C (2C)



I/O and Parameter / Channel

RTC-N/DN Output
- Activation signal for aeration
- DO set-point
- Blower frequency [0 ...100%]
- Controller status signal

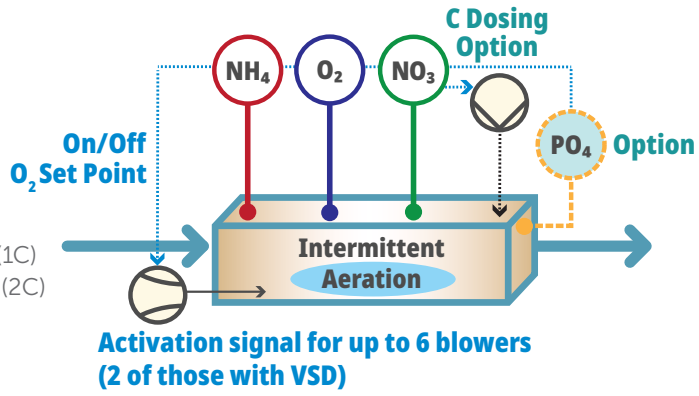
RTC-N/DN Input
- NH_4-N and NO_3-N
- SBR Version: Activation signal (filling)
- DO concentration
- Option: Flow rate wwtp, PO_4-P

RTC-N/DN Control Parameter
- Target value NH_4-N & NO_3-N-N
- Weighting NH_4-N & NO_3-N-N
- Maximum NH_4-N (stop deni)
- Min/max DO concentration
- Parameter for DO PID control (closed-loop)

Versions

Intermittent aeration & O_2 control,
Output: Aeration on/off, 6 aeration stages, 2 VSD
LXZ520.53.C2101 (Single Channel), RTC-N/DN_DO 2VFD (1C)
LXZ520.53.C2111 (Double Channel), RTC-N/DN_DO 2VFD (2C)
LXZ520.53.D2101 (Single Channel SBR), RTC-N/DN SBR_DO 2 VFD (1C)
LXZ520.53.D2111 (Double Channel SBR), RTC-N/DN SBR_DO 2VFD (2C)

Intermittent aeration control incl. external Carbon addition,
Output: Aeration on/off, 6 aeration stages,
2 VSD external Carbon dosing
LXZ520.53.C2201 (Single Channel) RTC-N/DN_DO VFD_C (1C)
LXZ520.53.C2211 (Double Channel RTC-N/DN_DO VFD_C (2C)



I/O and Parameter / Channel

RTC-N/DN Output
- Activation signal for aeration
- DO set-point per channel
- Blower stage [1...6]
- Blower frequency [0 ...100%]
- Controller status signal

RTC-N/DN Input
- NH_4-N and NO_3-N
- SBR Version: Activation signal (filling)
- DO concentration for each lane
- Option: Flow rate wwtp

Main Control Parameter
- Target value NH_4-N & NO_3-N-N
- Weighting NH_4-N & NO_3-N-N
- Maximum NH_4-N (stop deni)
- Min/max DO concentration
- Parameter for DO PID control (closed-loop)

Simultaneous Denitrification (RTC-SND)

RTC-SND Application Area
Typically, carousel mixed (not plug flow) Activated sludge systems with aerated and non-aerated zones within treatment basin. All plants with simultaneous nitrification/denitrification controlling aerated volume.

RTC-SND Description
Carousel flow ASP's often suffer from the problem of where to place the DO probe. The RTC-SND control system removes the problem entirely. Direct measurement for NH_4-N and NO_3-N in the treatment basin allows the control to safely step away from DO set points, instead relying on aeration intensity as a means of controlling aeration and anoxic volume within the tank. Measurement of NO_3-N allows safe minimum aeration to drive NO_3-N consumption as an oxygen source without the risk of re-solubilization of ortho phosphate. Measurement of ammonium allows a clear understanding of aeration intensity requirement and ensures the discharge levels meets the user defined set points. More than this the user can decide which parameter takes priority for treatment, so if the site has a particularly challenging ammonium permit limit for example, higher priority can be given to this.

Optionally 6 digital and 2 analog signals are provided to provide specific control to the aerators / aeration zones in the aeration tank, based on the calculated RTC-SND calculated output.

Additionally, this control can be linked with RTC-SRT. Sludge age can be particularly difficult to control well on these plants as it depends on aerated volume which can be highly variable (compared to plug flow ASP's). RTC-SRT for this type of plant automatically estimates aerated volume to provide a high-quality sludge wastage rate using measured DO within the tank.

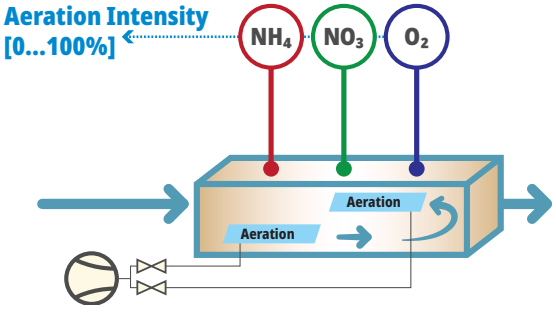
Further value can be obtained from this measurement to ensure a minimum DO threshold is maintained. If this falls below or exceeds adjustable limits, the aeration intensity signal is increased/decreased, and aerators are activated/deactivated ensuring the DO concentration is between the limits.

If input signals for NH_4-N, NO_3-Nor DO are not available the system automatically switches to fallback strategies.

RTC-SDN Benefit
- Improves settlement characteristics of MLSS due to reliable maintenance of anoxic zones providing unfavorable conditions for filamentous bacteria.
- Opens the opportunity to achieve much lower total nitrogen levels than conventional control can deliver.
- Significant savings on aeration energy due applying only the air that is required and unlocking the nitrate value present from effective denitrification (typical 15%-35% compared to fixed DO aeration methods)
- Improved acid capacity/alkalinity recovery due to enhanced denitrification
- Minimized denitrification/off gassing in final clarification tank
- Constant validated proof control maintaining user specified set points

Versions

NH_4-N & NO_3-N control, Output: Aerated volume (0...100%)
LXZ522.53.A0101 (Single Channel), RTC-SND (1C)
LXZ522.53.A0111 (Double Channel), RTC-SND (2C)



I/O and Parameter / Channel

RTC-SND Output
- Aeration intensity [0...100%]
- Controller status signal

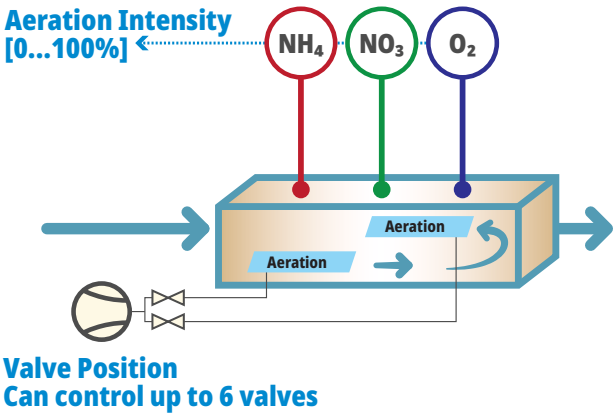
RTC-SND Input
- NH_4-N and NO_3-N
- DO concentration
- Option: Flow rate wwtp

RTC-SND Control Parameter
- Target value NH_4-N & NO_3-N-N
- Weighting factor NH_4-N & NO_3-N-N
- Min/max DO concentration

Versions

NH_4-N & NO_3-N control,
Output: Aerated volume (0...100%), Output: 6 stages, 2 VSD
LXZ522.53.B0101 (Single Channel), RTC-SND (1C6Z)
LXZ522.53.B0111 (Double Channel), RTC-SND (2C6Z)

In this variant of the RTC-SND, in addition to the aeration intensity, signals for controlling several aerator elements are also generated. The order in which these aerator elements are activated can be configured in the RTC-SND.



I/O and Parameter / Channel

RTC-SND Output
- Aeration intensity [0...100%]
- Blower / valve stage [1...6]
- Blower frequency [0 ...100%]
- Controller status signal

RTC-SND Input
- NH_4-N and NO_3-N concentration
- DO concentration
- Option: Flow rate wwtp

RTC-SND Control Parameter
- Target value NH_4-N & NO_3-N-N
- Weighting factor NH_4-N & NO_3-N-N
- Min/max DO concentration

Nitrification, Plug Flow (RTC-N)

RTC-N Application Area
- Plants with plug flow nitrification basins
- Step feed plants (cascade denitrification)

RTC-N Description
The RTC-N control software calculates the required DO concentration in the aeration basins to achieve a user defined NH_4-N set point concentration in the aeration effluent. To do this (amongst other factors), it accounts for the NH_4-N load, but also for temperature, hydraulic retention time, amount of nitrifying bacteria in the MLSS and actual discharged ammonium concentration in the aeration effluent. More than this it provides ideal dissolved oxygen levels for each of the ASP aerated zones as the ammonium load travels along the lanes. Concentrating the air to the zones of greatest need both saves energy and maximizes the value of the available process air. This has the potential to unlock performance not typically observed on ASP's and provide enhanced compliance security. By combining an accurate open loop dissolved oxygen set point with closed loop fine trim, a much more dynamic DO set point can safely be used to save energy and provide greater treatment capacity.

The RTC-N can be used in conjunction with internal recirculation, external carbon addition, swing zone, and/or sludge retention time (sludge age). The RTC-N can also be used w/o the NH_4-N inlet measurement. In this version the incominig NH_4-N load is predicted based on flow and historical data.

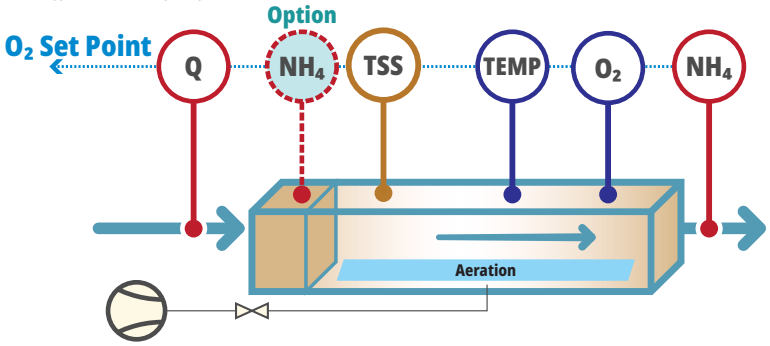
Optionally an additional DO controller compliments the RTC-N. This DO controller activates:
- in the single DO version, a single aeration device equipped with a VSD
- in the 6 stage VSD version up to six aeration devices, two of those optionally equipped with a variable frequency drive (VFD) providing smooth adjustment of aeration intensity, high blower efficiency and protection against excessive switching of duty.

If input signals for NH_4-N, NO_3-Nor TSS are not available the system automatically switches to fallback strategies.

RTC-N Benefits
- Ensure compliance on NH_4-N due to load based O_2 set point adjustment
- Improved denitrification and compliance on N_TOT due to load based aeration (less O_2 recirculated)
- Energy savings: 15%-30% due to lower DO concentration in aeration (compared to fixed O_2 control on 1,5 mg/L...2,5 mg/L)
- DO recovery due to improved denitrification.
- 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

Versions

Combination open / closed loop NH_4-N control, Output: O_2 setpoint
LXZ519.53.B0101 (Single Channel), RTC-N (1C)
LXZ519.53.B0111 (Double Channel), RTC-N (2C)



I/O and Parameter / Channel

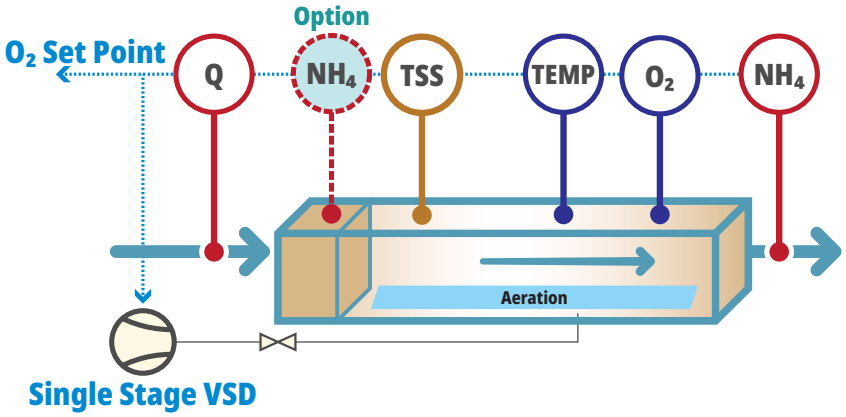
RTC-N Output
- DO set-point
- Controller status signal

RTC-N Input
- NH_4-N inlet and effluent
- TSS concentration aeration
- DO concentration
- Temperature (from DO probe)
- Flow rates: inflow, internal recirculation; surplus activated sludge

RTC-N Control Parameter
- Parameter for NH_4-N PID control
- Min/max DO, max. rate of change

Versions

Combination open / closed loop NH_4-N control, Output: Aeration on/off, 1 aeration stage, VSD
LXZ519.53.B3101 (Single Channel) , RTC-N_DO (1C)
LXZ519.53.B3111 (Double Channel), RTC-N_DO (2C)



I/O and Parameter / Channel

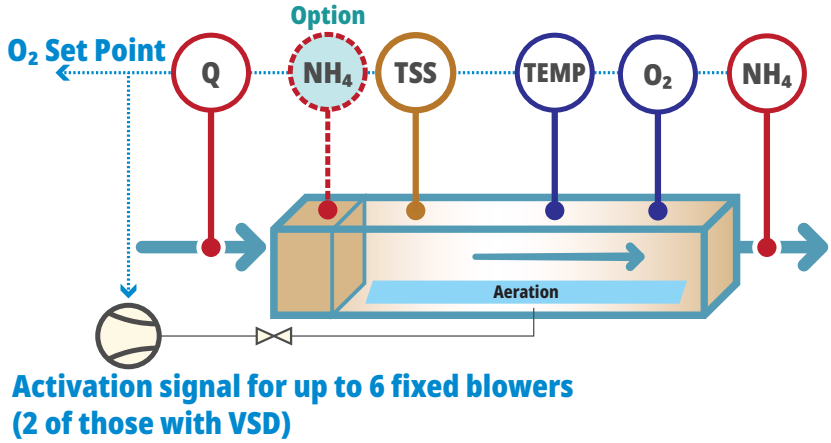
RTC-N Output
- DO set-point
- Blower frequency [0 ...100%]
- Controller status signal

RTC-N Input
- NH_4-N inlet and affluent
- TSS concentration aeration
- DO concentration
- Temperature (from DO probe)
- Flow rates: inflow, internal recirculation, surplus activated sludge

RTC-N Control Parameter
- NH_4-N set point effluent aeration
- Parameter for NH_4-NPID control
- Min/max DO, max. rate of change

Versions

Combination open / closed loop NH_4-N control, with O_2 control, Output: O_2 setpoint, 6 aeration stages, 2 VSD)
LXZ519.53.B2101 (Single Channel), RTC-N_DO 2VFD (1C)
LXZ519.53.B2111 (Double Channel), RTC-N_DO 2VFD (2C)



I/O and Parameter / Channel

RTC-N Output
- DO set-point
- Blower stage [1...6]
- Blower frequency [0 ...100%]
- Controller status signal

RTC-N Input
- NH_4-N inlet and effluent
- TSS concentration aeration
- DO concentration in each zone
- Temperature (from DO probe)
- Flow rates: inflow, internal recirculation; surplus activated sludge

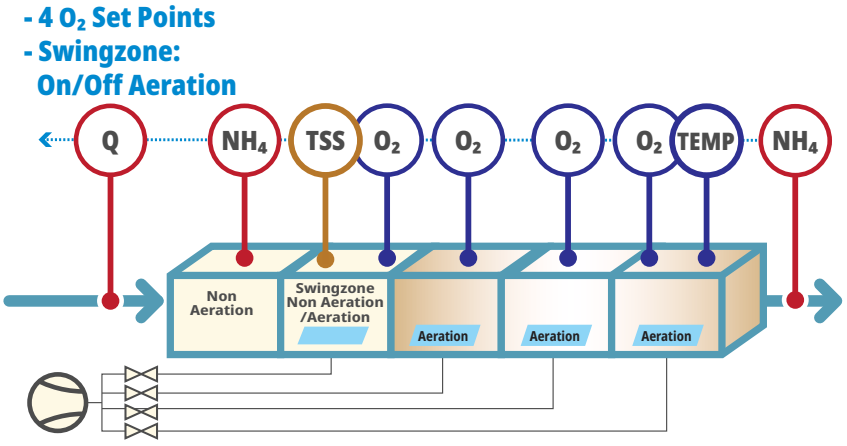
RTC-N Control Parameter
- NH_4-N set point effluent aeration
- Parameter for NH_4-NPID control
- Min/max DO, max. rate of change

Versions

Combination open / closed loop NH_4-N control, Output: O_2 setpoints for 4 zones, control of one swing zone
LXZ519.53.D0101 (Single Channel), RTC-N_4Z (1C)
LXZ519.53.D0111 (Double Channel), RTC-N_4Z (2C)

The RTC-N_4Z considers for up to 4 aerated zones the hydraulic retention time of the NH_4-N load in each aerated zone for set point calculation. This feature allows to provide the air exactly to the zones with the highest air demand.

Based on the inflow load and the current nitrification capacity the RTC-N_4Z calculates if a swing zone has to be aerated and used for nitrification to meet the NH_4-N effluent target or if it can be operated as an anoxic zone for enhanced denitrification in order to minimize the N_TOT effluent concentration and cost for aeration.



I/O and Parameter / Channel

RTC-N Output
- DO set-point for up to 4 zones (one zone facultative aeration)
- Controller status signal

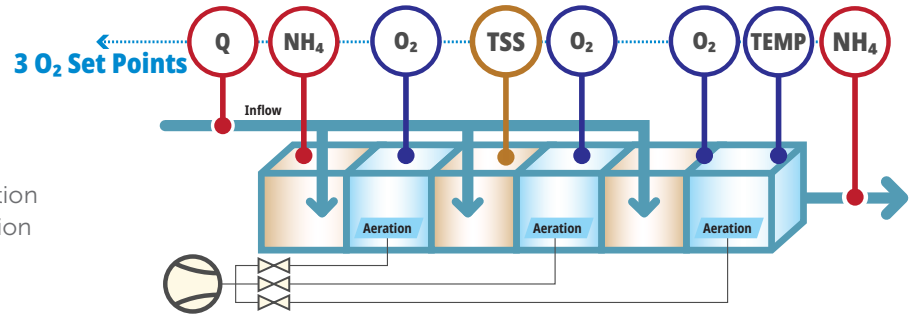
RTC-N Input
- NH_4-N inlet and affluent
- TSS concentration aeration
- DO concentration in each zone
- Flow rates: inflow, internal recirculation, surplus activated sludge

RTC-N Control Parameter
- NH_4-N set point effluent aeration
- Parameter for NH_4-NPID control
- Min/max DO, max. rate of change for each zone

Versions

Combining open / closed loop NH_4-N control on Step Feed reactors, Output: O_2 set points for 3 zones
LXZ519.53.D1101 (Single Channel), RTC-N_STEP (1C)
LXZ519.53.D1111 (Double Channel), RTC-N_STEP (2C)

The RTC-N_STEP is designed for step feed resp. cascade denitrification plants. Based on the influent NH_4-N concentration and the settled sewage inflow rate to each denitrification zone, for each nitrification zone the RTC-N_STEP calculates the DO concentration required to reach the NH_4-N target concentration is calculated.



I/O and Parameter / Channel

RTC-N Output
- DO set-point for up to 3 zones
- Controller status signal

RTC-N Input
- NH_4-N concentration inlet and effluent
- TSS concentration aeration
- DO concentration in each zone
- Flow rates: inflow, internal recirculation; surplus activated sludge

RTC-N Control Parameter
- NH_4-N set point effluent aeration
- Parameter for NH_4-N PID control
- Min/max DO, max rate of change for each zone

Dissolved Oxygen Control (RTC-DO)

RTC-DO Application Area
Biological Wastewater treatment plants. Independent DO control in multiple zones of an aeration tank. Each aerated zone is equipped with an actuator (e.g. surface aerator or dedicated blower, air control valve with fixed pressure in manifold) and a dedicated DO sensor to control the DO concentration to a desired DO set point.

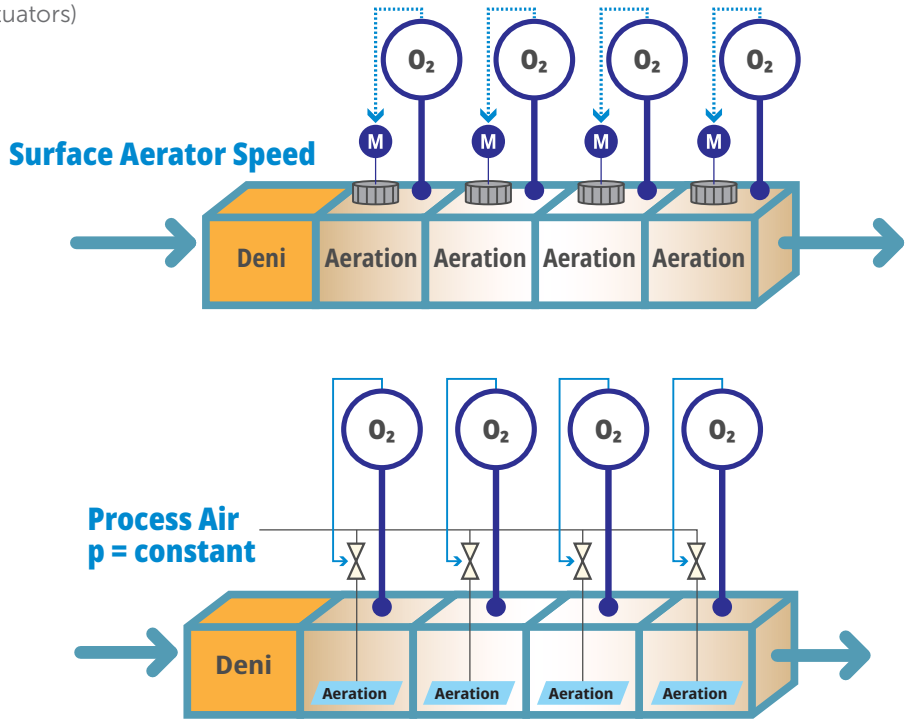
The RTC-DO can be combined with an RTC-N_4Z zone controller which provides up to 4 DO setpoints based on the current NH_4-N loading of a lane.

RTC-DO Description
The RTC-DO independently controls up to 16 zones to a desired DO set point. 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.

RTC-DO Benefits
- Minimizes aeration energy / drives cost savings
- Increase process treatment capacity in an ASP

Versions

O_2 control in zones. Output: Surface aerator speed / valve positions LXZ530.53.C0101 (4 Actuators)
LXZ530.53.C0101 (4 Actuators)
LXZ530.53.D0101 (8 Actuators)
LXZ530.53.C0111 (12 Actuators)
LXZ530.53.D0111 (16 Actuators)



I/O and Parameter / Channel

RTC-DO Output
- Up to 16 valve setpoints for zone valve opening degrees
- Controller status signal

RTC-DO Input
- Up to 16 zone DO conc.
- Optionally: DO setpoints from RTC-N

RTC-DO Control Parameter
- PID-Control Parameter

Most Open Valve DO Control (RTC-MOV)

RTC-MOV Application Area
All wastewater treatment plants with multiple aeration zones. Process air is provided from a manifold. Each aerated zone is equipped with an automatic air valve and a DO sensor to control the DO concentration to a desired DO set point.

The MOV controller can be combined with a RTC-N 4 zone controller which provides up to 4 DO setpoints based on the current NH_4-N loading of a lane.

RTC-MOV Description
The RTC-MOV (Most open valve) independently controls in up to 16 zones the DO concentration to a desired DO set point. Adjusted variable is the opening degree of the air valve assigned to the corresponding zone. If the air is provided through a common manifold, the RTC-MOV can provide a set point for the manifold air pressure ensuring that the valve assigned to the volume with highest air demand has got the highest opening degree (Most open valve control). Optionally a set point for the overall air flow can be provided. The pressure on the manifold has to be controlled by the PLC.

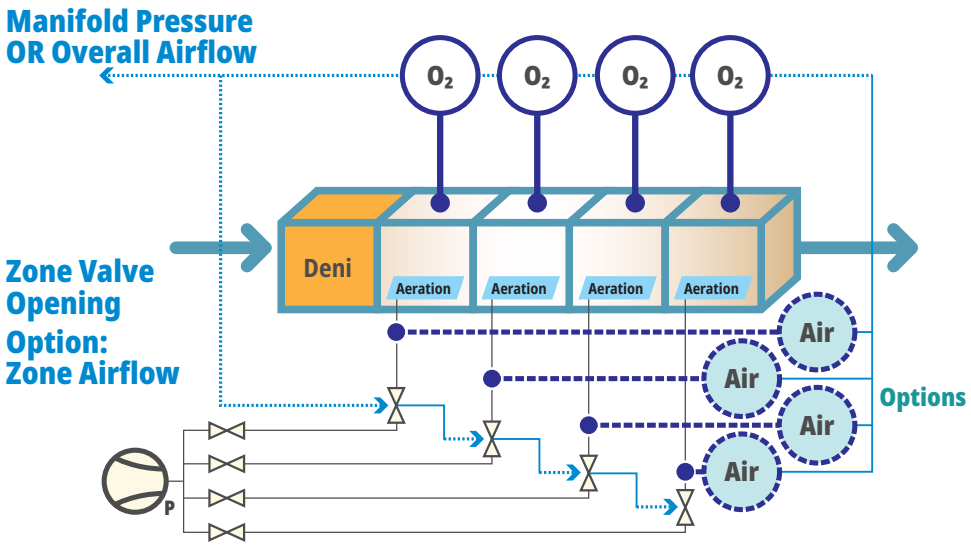
In order to react fast to changes in the manifold pressure (caused by load changes or changes in the opening degree of the other air valves) the RTC-MOV can be designed as a cascade controller, considering air flow measurements in each individual zone.

RTC-MOV Benefits
- Efficiently drives process air to zones of greatest need, maximizing treatment potential of ASP
- Minimize aeration energy / drive cost savings
- Increase process treatment capacity in an ASP-duplication. Extend blower system working lifetime

Versions

O_2 control in zones. Output: Air valve positions, pressure on manifold or overalloverall air flow
LXZ530.53.A0101 (4 Zones) LXZ530.53.B0101 (8 Zones) LXZ530.53.A0111 (12 Zones) LXZ530.53.B0111 (16 Zones)

If more than four zones will be controlled with the RTC-MOV, a signal exchange between RTC and the PLC via an OPC server is recommended.



I/O and Parameter / Channel

RTC-MOV Output
- Up to 16 valve setpoints for zone valve opening degrees
- Option: Up to 16 set points for zone air flow
- Setpoint for manifold pressure
- Option: Overall airflow set point
- Controller status signal

RTC-MOV Input
- Up to 16 zone DO concentration
- Up to 16 zone air flow signals
- Optionally: DO setpoints from RTC-N

RTC-MOV Control Parameter
- PID-Control Parameter

Denitrification (RTC-DN)

RTC-DN Application Area

- Pre-denitrification plants with internal recirculation
- Plants dosing external carbon to ensure compliance on N_TOT

RTC-DN Description

The controller optimizes both internal recirculation and/or carbon dose flow rates to maximize the available NO_3-N removal of an ASP. Both approaches are based on measured NO_3-N concentration typically at the discharge of the denitrification stage. Further treatment enhancements are provided by protection against oxygen carryover from the internal recirculation.

For plug flow ASP's a particularly helpful addition is the swing zone controller (in conjunction with RTC-N). This safely allows the ASP to extend the anoxic zone by "sacrificing" aeration volume (zone 1 of a lane) when ammonium load conditions allow. Especially useful in low flow / load conditions (every night) where minimum air flow requirements often cause oxygen carry over to inhibit denitrification.

If input signals for NO_3-N-N, DO or flow rate are not available, the system automatically switches to considered fallback strategies.

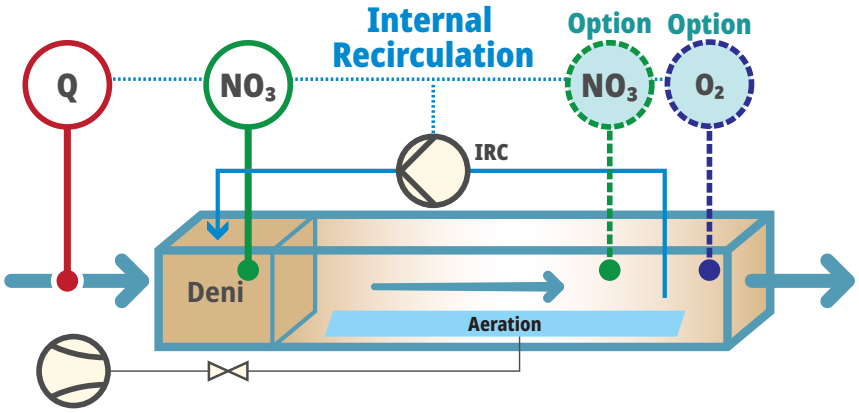
RTC-DN Benefits

- Maximized leverage of denitrification capacity and improved compliance on N_TOT due to minimized O_2 transfer from nitrification to denitrification
- Reduced O_2 demand (less aeration energy) due to O_2 recovery from denitrification
- Reduced risk breaching COD effluent limit due to overdosing of external carbon
- Minimized cost for product and aeration (if overdosed)
- Improved acid capacity (alkalinity) recovery

Versions

Closed loop control NO_3-N effluent anoxic or aeration. Output: Internal recirculation

LXZ521.53.A0101 (Single Channel), RTC-DN_IRC (1C
LXZ521.53.A0111 (Double Channel), RTC-DN_IRC(2C)



I/O and Parameter / Channel

RTC-DN_IRC Output

- Set point internal recirculation flow rate [L/s or minutes/hour]
- Controller status signal

RTC-DN_IRC Input

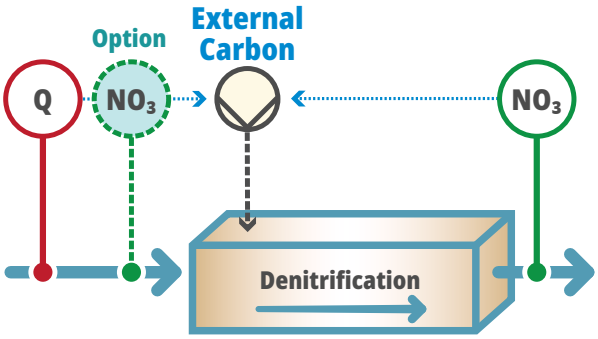
- NO_3-N concentration effluent denitrification or effluent aeration
- Option: DO concentration effluent aeration / IRC draw off point
- Flow rate

RTC-DN_IRC Control Parameter

- Target value for NO_3-N effluent denitrification zone
- Option: Target value for NO_3-N effluent nitrification zone
- Min/max IRC flow rate
- IRC run time for fixed speed pumps or systems with low dynamic range

Versions

Combination open / closed loop NO_3-N control. Output: External carbon flow
LXZ521.53.D0101 (Single Channel), RTC-DN_C (1C)
LXZ521.53.D0111 (Double Channel), RTC-DN_C (2C)



I/O and Parameter / Channel

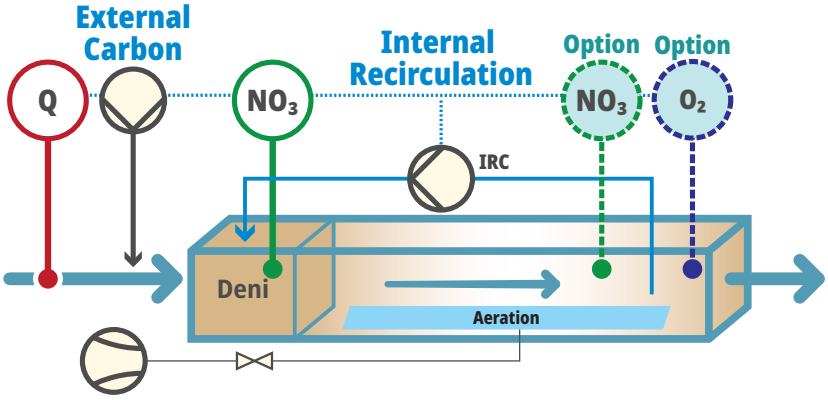
RTC-DN-C Output
- Set point ext. C dosing rate [L/h]
- Controller status signal

RTC-DN-C Input
- NO_3-N concentration effluent denitrification
- Option: NO_3-Ninflow denitrification
- Flow rate (pot. incl. IRC)

RTC-DN-C Control Parameter
- Set point NO_3-N effluent denitrification
- PID control parameter
- Min/max external Carbon flow rate

Versions

Closed loop control NO_3-N effluent denitrification or effluent aeration.
Output: Internal recirculation and /or external carbon addition
LXZ521.53.B0101 (Single Channel), RTC-DN_IRC_C (1C)
LXZ521.53.B0111 (Double Channel), RTC-DN_IRC_C (2C)



I/O and Parameter / Channel

RTC-DN_IRC Output
- Set point internal recirculation flow rate [L/s or minutes/hour]
- Set point external C dosing rate [L/h]
- Controller status signal

RTC-DN_IRC Input
- NO_3-N concentration effluent denitrification
- NO_3-N concentration effluent aeration
- Option: DO concentration NO_3-N concentration effluent aeration

RTC-DN_IRC Control Parameter
- Target value NO_3-N effluent denitrification
- Min/max IRC flow rate
- Min/max external C flow rate
- PID control parameter

Alkalinity (RTC-ALK)

RTC-ALK Application Area
- Plants dosing lime or chalk to ensure sufficient Alkalinity (carbonate balance) for biological wastewater treatment

RTC-ALK Description

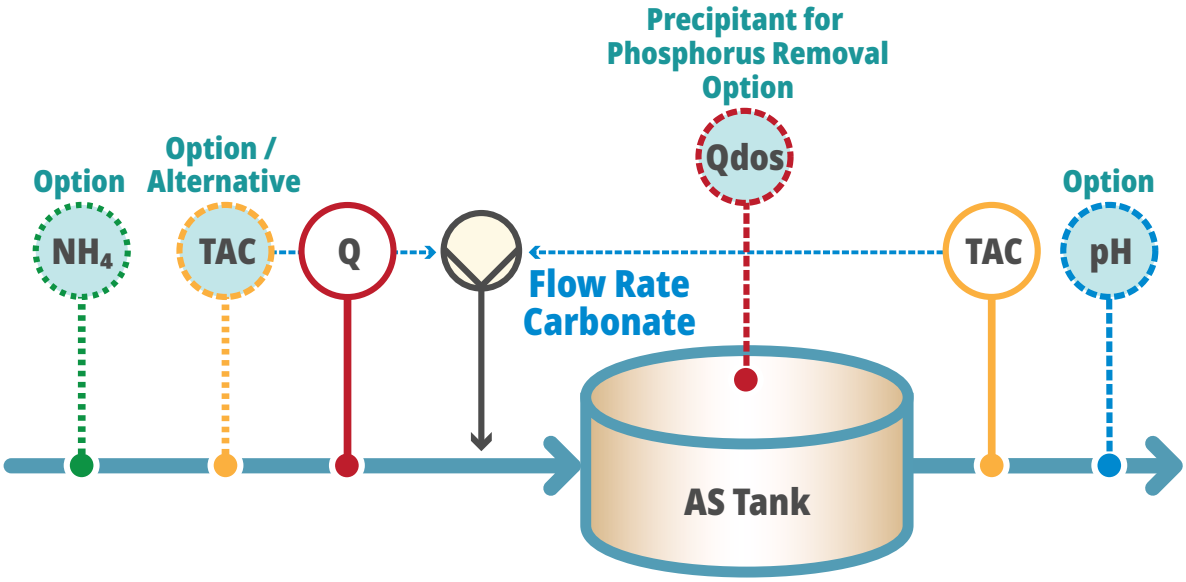
The controller adjusts the Alkalinity in an activated sludge plant to a desired level by adding lime or chalk to the treatment process.

The controller can act as a feedback (preferred) of feed forward controller based on an alkalinity measurement effluent / influent aeration. As an alternative or in combination with open/closed loop control the RTC-ALK can be combined with an RTC-N and/or RTC-P to calculate the amount of lime or chalk to be added in order to compensate the loss of alkalinity caused by addition of precipitant (2,5 mg HCO_3^- per mg Fe added) and by nitrification/denitrification (nitrification consumes 8,7 mg HCO_3^- per mg N nitrified, denitrification provides back 4,34 mg HCO_3^- per mg N denitrified). In order to consider varying Inflow conditions measurements including flow, optional pH, conductivity and/or temperature can be considered to immediately react on changing inflow conditions.

RTC-ALK Benefits
- Avoid acidity in biological treatment increasing the risk of inhibiting nitrification due of the high sensitivity of autotrophic organisms to low pH values and harming coagulation and flocculating processes in sludge sedimentation

Versions

Open closed loop control of Alkalinity,
Output: Caustic dosing rate
LXZ514.53.A0101 (One Channel), RTC-ALK RTC-AL (1C)
LXZ514.53.A0111 (Double Channel), RTC-ALK RTC-ALK (2)



I/O and Parameter / Channel

RTC-ALK Output
- Lime/chalk dosing rate
- Controller status signal

RTC-ALK Input
- Flow rate
- pH, Conductivity, Temp
- Alkalinity (option)
- NH_4-N, NO_3-N (from RTC-N and RTC-DN, precipitant flow

RTC-ALK Control Parameter
- PID settings
- Min/Max dosing rate of Lime/chalk
- Specific dosing rate (kg/m³, mg/L)

Nutrient Dosing (RTC-C/N/P)

RTC-C/N/P Application Area

- All biological treated waste with an imbalance of Nitrogen and/or Phosphorus with respect to COD/BOD.
- The RTC-C/N/P can be combined with the RTC-SRT to avoid the growth of nitrifiers further enhancing COD removal

RTC-C/N/P Description

The RTC C/N/P maintains ideal nutrient levels within wastewater to ensure COD/BOD treatment is not biologically limited. This is achieved using feed forward control with online TOC measurement allied to feedback control using ammonium and ortho phosphate measurement. Further flexibility allows user defined nutrient ratios to be input for specific process waste streams. Additionally, there is an option to supplement the feed forward algorithm with N and /or P measurements to automatically account for variations in background nutrient levels and TOC values.

In order to avoid unwanted nitrification, nitrate concentration in the effluent can be measured to inform aeration conditions.

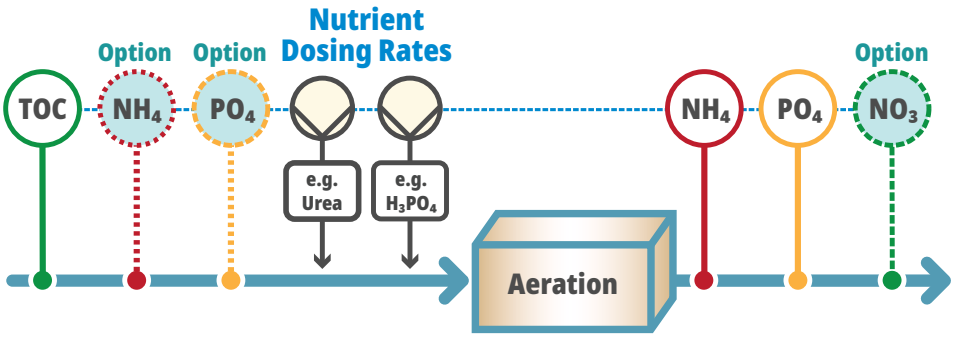
If input signals for TOC, NH_4-N, PO_4-P -P, NO_3-N or flow rate are not available, the system automatically switches to considered fallback strategies.

RTC-C/N/P Benefits

- Ensure compliance on COD/BOD, NH_4-N / total N and PO_4-P
- Reduced effluent discharge costs
- Improved sludge settlement characteristics
- Avoid nitrification (in conjunction with RTC-SRT)
- Minimized cost on nutrients added.
- Wasteful aeration avoided

Versions

Organic load based nutrient dosing combined with effluent nutrient control.
Output: External Nitrogen and Phosphorous dosing rate
LXZ514.53.B0101 (Single Channel), RTC-C/N/P (1C)
LXZ514.53.B0111 Double Channel), RTC-C/N/P (2C)



I/O and Parameter / Channel

RTC-C/N/P Output
- Set point dosing rate urea [L/h]
- Set point dosing rate phosphoric acid [L/h]
- Specific nutrient dosing rates (N/TOC and P/TOC)
- Controller status signal

RTC-C/N/P Input
- TOC concentration
- Option: Inflow: NH_4-N and PO_4-P
- Effluent: NH_4-N, NO_3-N, PO_4-P
- Inflow
- Flow rate Urea
- Flow rate Phosphoric acid

RTC-C/N/P Control Parameter
- Specific urea dosing rates N/TOC
- Specific phosphoric acid dosing rates P/TOC
- Set point PO_4-P, NH_4-N and NO_3-N effluent aeration
- Min / Max dosing rate
- Min / Max specific dosing rate
- PID Control parameter

Sludge Retention Time (RTC-SRT)

RTC-SRT Application Area

- All biological stages requiring wastage of biology (Activated sludge systems)

RTC-SRT Description

The SRT controller automatically maintains the correct amount and type of biology in the treatment basin. Biological growth and decay rates are determined using measured sewage temperature (typically from DO probe). The aerated treatment volume is taken into account (particularly important with intermittent or carousel ASP's), then the mass of biology to be wasted can accurately be determined. Measurement of solids within the waste-activated sludge (typically RAS solids as surrogate) allows conversion to a waste volume that can then be acted on. An additional solids measurement in the final effluent can be incorporated into the control to account for additional solids lost from the treatment system.

This control can be used to provide ideal conditions for ammonium removal (avoiding high MLSS in summer placing unnecessary pressure on aeration systems, and too low MLSS in winter risking ammonium compliance). Alternatively, a sludge age can be manually entered (e.g. 3.5 days) to inhibit nitrification and direct process air more specifically for COD/BOD treatment—especially useful for sites without ammonium limits.

Additionally, to this the user can specify minimum and maximum MLSS levels in the aeration basin. So, if a plant temporarily suffers poor settlement problems, the mass flux of the final tanks can be calculated and the controller will not allow the MLSS to raise above that point, protecting against sludge blanket loss.

Additional safety factors are built in to protect the sludge volume wasted does not exceed the sludge processing capacity of a facility.

If input signals for TSS or DO are not available, the system automatically switches to considered fallback strategies.

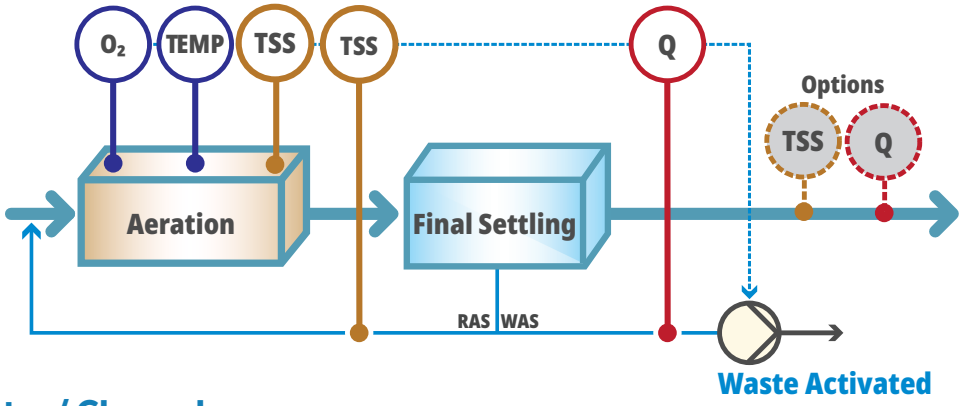
RTC-SRT Benefits

- Ensures compliance on ammonium or COD/BOD
- Provides process stability
- Prevents excessive air demand on blower system in warmer weather
- Saves on aeration energy (circa 5-10%)
- Improves sludge age calculation accuracy by considering large data sets (reduces human error in this area)

Versions

Adjustment of sludge retention time according to temperature. Output: Surplus activated sludge flow rate

LXZ518.53.A0101 (Single Channel), RTC-SRT (1C)
LXZ518.53.A0111 (Double Channel), RTC-SRT (2C)



I/O and Parameter / Channel

RTC-SRT Output

- Flow rate excess sludge [L/s]
- Controller status signal

RTC-SRT Input

- TSS concentration activated sludge [g/L]
- TSS concentration surplus activated sludge [g/L]
- DO concentration in up to 4 zones [mg/L]
- Temperature [°C]
- Excess sludge flow rate [L/s]

RTC-SRT Control Parameter

- Table for SRT target value
- Safety factor for SRT calculation
- Min/Max flow rate for SAS
- Min/max TSS concentration in activated sludge tank

Chlorination-Dechlorination (RTC-C/DC)

RTC-C/DC Application Area
- Treatment plants with Disinfection processes based on Chlorine

RTC-C/DC Description
The Hach Claros Process Management (CPM) system for Chlorination/Dechlorination (RTC-C/DC) measures chlorine demand in real time and adjusts chemical dosing to achieve the required disinfection to meet effluent chlorine limits.

The RTC-C/DC system calculates the minimum amount of chemical disinfectant required in the contact tank to maintain a user-defined CT (concentration x contact time) value within Total Residual Chlorine (TRC) limits. The RTC-C/DC system also calculates the required amount of dechlorination chemical to achieve effluent compliance. Fallback strategies, safety limits, and condition-based monitoring are preprogrammed in the system and configured for the specific facility during commissioning.

The system uses both feed forward and feedback loops to manage chlorination and dechlorination. The feed forward chlorination calculation is based on continually maintaining an influent concentration of chlorine that correlates to the chosen CT by adjusting the dosage based on wastewater flow. The feedback calculation modifies the influent chlorine dosage based on the measurement of TRC at the end of the chlorine contact tank which will detect when the chlorine demand has changed.

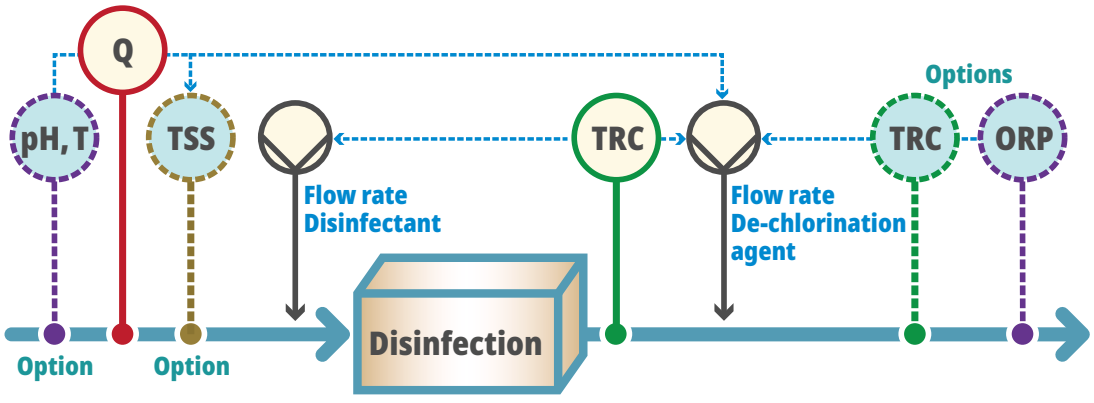
The feed forward dechlorination calculation is based on flow and the measurement of TRC at the end of the chlorine contact tank. The optional feedback calculation modifies the dechlorination chemical set point based on the measurement of TRC at the end of the dechlorination tank.

Additional Claros Process Management calculations provided within the controller:
- Total Chlorine Demand
- Instantaneous Chlorine Demand
- Chlorine Decay Demand
- By-Product Formation (TTHM & HAA) Estimation
- Estimate of Log Inactivation

RTC-C/DC benefits
- Ensures compliance on TRC limits
- Optimized chemical usage
- Visibility into disinfection process
- Consistent effluent quality

Versions

LXZ531.53.A1010 (Single Channel), RTC-C/DC (1C)
LXZ531.53.A1011 (Double Channel), RTC-C/DC (2C)



I/O and Parameter / Channel

RTC-C/DC Output
- Flow rate Chlorine dosing
- Flow rate de-chlorination agent
- Controller status signal

RTC-C/DC Input
- pH, T influent contact chamber
- Total Residual Chlorine (TRC), alternative Total Free Chlorine (TFC)
- Option: ORP

RTC-C/DC Control Parameter
- Specific dosing rate (mg CL_2/L)
- PID Parameter
- Min/Max Chlorine dosing rate

Return Activated Sludge (RTC-RAS)

RTC-RAS Application Area
- All biological stages that require the return of activated sludge from the final settlement tank (activated sludge process)

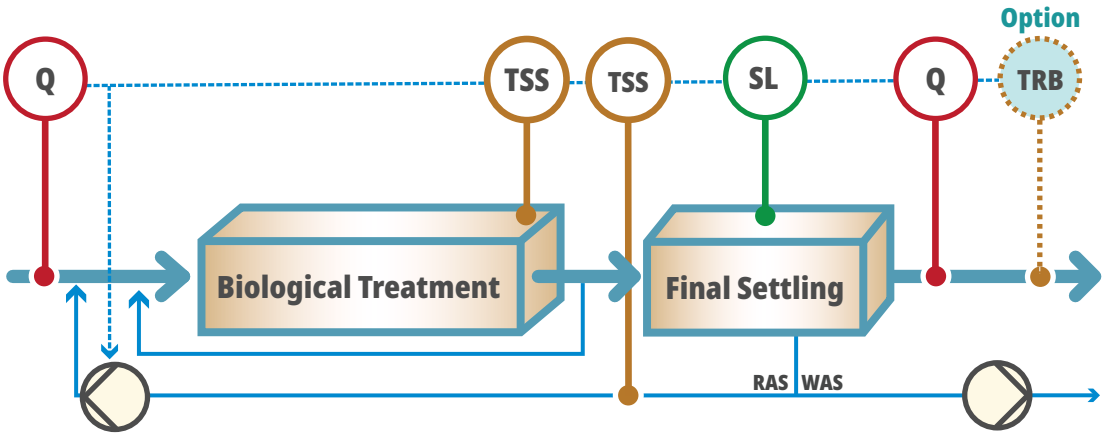
RTC-RAS Description
The RTC-RAS optimizes the return activated sludge effluent. The aim of the optimization is to ensure that the conditions in the final settling stage meet the prerequisites for sedimentation and thus result in low TSS concentrations in the effluent. To achieve this, the optimum return sludge rate is calculated by comparing the TSS concentration in the aeration tank and in the return activated sludge. Sludge levels and turbidity in the effluent (optional) are taken into account to ensure good effluent quality.

If turbidity values are not available for the effluent, the system can be adjusted to operate without these signals. If no input signals are available for important measurements (TSS in the return, treatment tank), the system automatically switches to selectable fallback strategies.

RTC-RAS Benefits
- Improved final settlement tank performance
- Improved compliance security for solids, COD/BOD & phosphorus
- Reduced energy cost associated with RAS pumping

Versions

Control of the Return Activated Sludge Rate
LXZ518.53.C0101 (Single Channel), RTC-RAS (1C)
LXZ518.53.C0111 (Double Channel), RTC-RAS (2C)



Input and Output Signals/Channel

RTC-RAS Output
- Flow rate of the return activated sludge [L/s]
- Status

RTC-RAS Input
- TSS concentration in the aeration tank [g/L]
- TSS concentration in the return activated sludge [g/L]
- Sludge level in the final settlement tank [m]
- Effluent rate [L/s] or
- Feed flow rate [L/s] optionall
- Optional: TSS or turbidity in the effluent

RTC-RAS Control Parameters
- Target value for TSS in the aeration tank/TSS in the return activated sludge
- Target value for sludge level
- Optional: Target value for TRB effluent
- Limit values for sludge level, TSS effluent
- Min./max. effluent rate
- Optional: Freely selectable target value

Sludge Thickening (RTC-ST)

RTC-ST Application Area

- Plants with mechanical sludge thickening devices (belt / drum thickeners etc.)
- Plant with varying TSS concentration in thickener feed flow
- Plants applying fixed polymer dosing rate / periodical adjustment based on visual judgement or lab results / flow proportional dosing
- Plants with low solids capture rate, unstable TSS concentration in filtrate and thickened sludge

RTC-ST Description

The RTC-ST (sludge thickening) controller improves and stabilizes thickened sludge concentration or filtrate quality in mechanical sludge thickening. Based on the solids load in the feed flow, either the polymer dosing rate or the feed flow rate is adjusted to a specific polymer dosing rate [g/kg]. This feed forward control can be combined with a feedback control of the TSS in the thickened sludge or in the filtrate to either increase or decrease the specific polymer dosing rate (within a user defined window).

Fixed polymer dosing rate and variable feed sludge flow rate is particularly helpful strategy if an asset experiences solids feed overload.

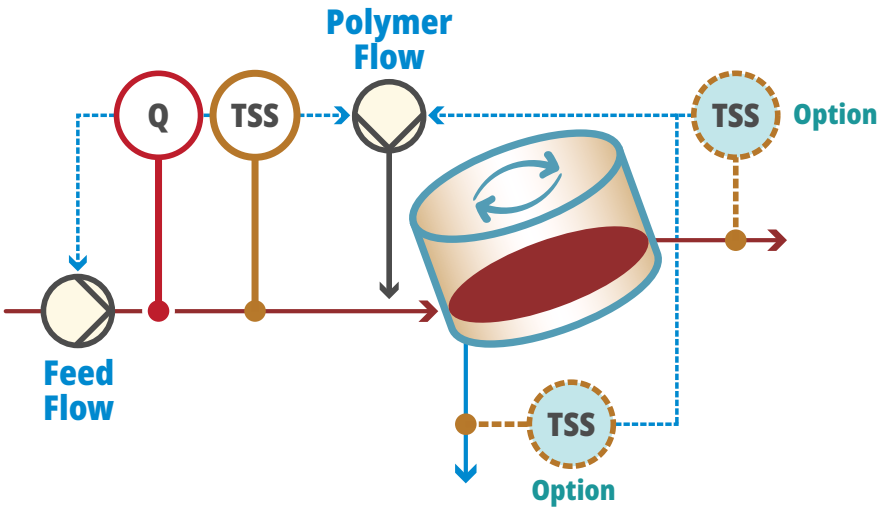
RTC-ST Benefits

- Increased gas yield from anaerobic digestion due to consistently higher TSS in thickened sludge
- Polymer overdosing avoided. Reduced maintenance work on sludge thickening machines (no belt blending).
- Reduced amount of polymer dosed
- Improved solids capture preventing recycling of solids to head works, impacting aeration efficiency and reducing compliance risk

Versions

Open and closed loop contr. of TSS in thickened sludge and/or filtrate. Output: Polymer flow and/or feed flow

LXZ517.53.A0101 (Single Channel), RTC-ST (1C)
LXZ517.53.A0111 (Double Channel), RTC-ST (2C)



I/O and Parameter / Channel

RTC-ST Output

- Polymer dosing flow rate or feed flow rate
- Controller status signal

RTC-ST Input

- TSS concentration in feed flow
- TSS concentration in thickened sludge / filtrate
- Feed flow dewatering device
- Flow rate polymer dosing

RTC-ST Control Parameter

- Specific dosing rate (kg polymer / t TSS)
- PID Parameter for thickened sludge or filtrate TSS control

Sludge Dewatering (RTC-SD)

RTC-SD Application Area
- Plants with sludge dewatering devices (centrifuges)
- Plants with changing TSS concentration in feed flow to the centrifuges
- Plants applying fixed polymer dosing rates based on visual judgement / lab results / flow paced

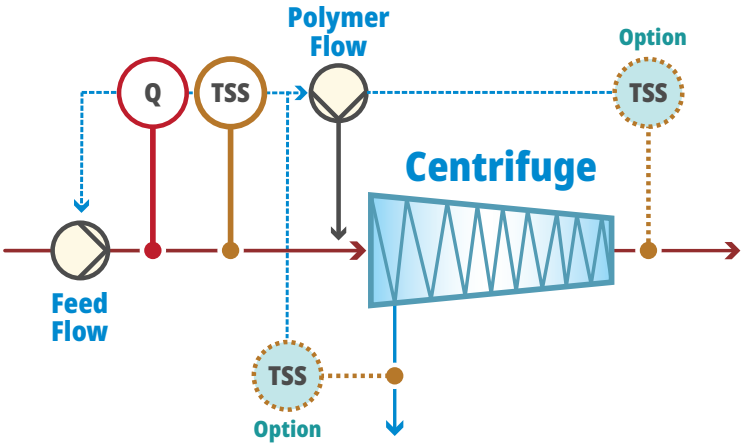
RTC-SD Description
The RTC-SD (sludge dewatering) controller adjusts polymer dosing rate or feed flow rate in mechanical sludge dewatering. Based on the current solids feed load (TSS concentration and flow rate), either the polymer dosing rate or the sludge feed flow rate is controlled ensuring an adjustable specific polymer dosing rate [g Poly/kg Dry Solids]. This feed forward control can be combined with a feedback control of the TSS in the centrate or dewatered sludge.

If input signals inflow or TSS concentration are not available the system automatically switches to fallback strategies.

RTC-SD Benefits
- Savings on polymer (typical 10-15% compared to fixed dosing rate)
- More consistent dewatered product
- Increased TSS concentration in dewatered sludge and subsequently decreased cost for sludge disposal
- Decreased TSS concentration in centrate and reduce issues on process water returns
- Reduce issues of foaming due to polymer overdose. Avoids need for expensive anti-foam chemicals.
- Improved solids capture preventing recycling of solids to head works, impacting aeration efficiency and reducing compliance risk

Versions

Control of TSS in dewatered sludge or centrate: Output: Polymer flow or feed flow
LXZ517.53.B0101 (Single Channel), RTC-SD (1C)
LXZ517.53.B0111 (Double Channel), RTC-SD (1C)



I/O and Parameter / Channel

RTC-SD Output
- Polymer dosing flow rate or feed flow rate
- Controller status signal

RTC-SD Input
- TSS concentration in feed flow
- TSS concentration in dewatered sludge / centrate
- Feed flow dewatering device
- Flow rate polymer dosing

RTC-SD Control Parameter
- Specific dosing rate (kg polymer / t TSS)
- PID Parameter for dewatered sludge or centrate TSS control

Dissolved Air Flotation (RTC-DAF)

RTC-DAF Application Area

- Dissolved Air Flotation processes (DAF) in water treatment
- Plants with changing TSS (TOC) concentration in DAF feed
- Processes with unusable TSS in floated sludge
- Processes with poor solids capture (high solids in clear water)

RTC-DAF Description

This controller maximizes the solids capture and clear water quality through balancing chemical addition with plant load conditions. The RTC-DAF provides a specific feed-forward dose rate for coagulant and flocculant and uses feedback trim to automatically account for chemical effectiveness (based on TSS or TOC). The feedback trim alters the specific dosing rates for coagulant and flocculant to ensure user defined quality set points for the discharged liquid & sludge are met.

To support coagulation, the pH in the inflow can be automatically adjusted to a user-defined point. If after buffering, the pH-value remains outside a user defined window, dosing of coagulant and flocculant are stopped.

If input signals inflow or TSS (TOC) concentration are not available, the system automatically switches to fall back strategies.

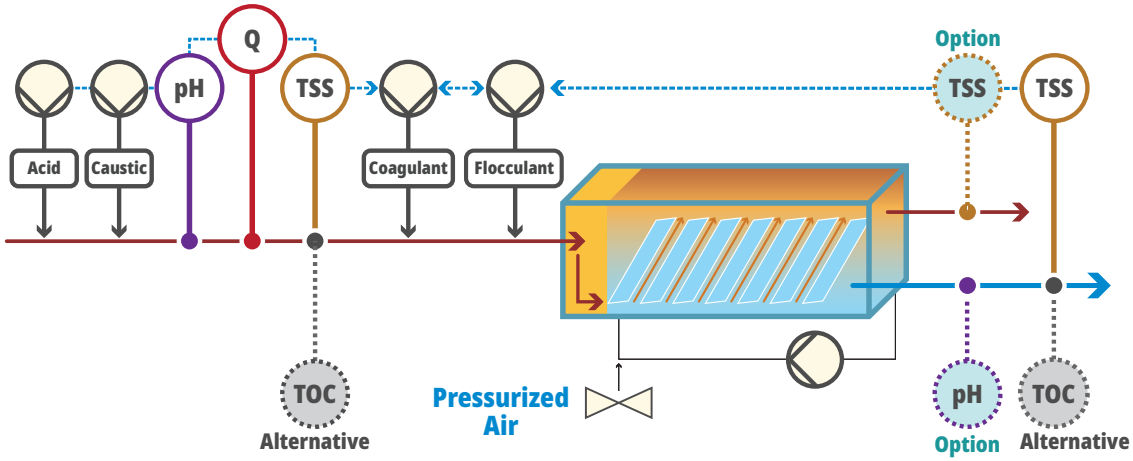
RTC-DAF Benefits

- Ensure Permit compliance, stabilize downstream processes, and reduce effluent costs
- Increase TSS concentration in floated sludge and reduces cost for further sludge treatment
- Improve solids capture respectively decrease TSS concentration in clear water effluent

Versions

Control of TSS in floated sludge and TSS in clear water.
Output: Dosing of Coagulant and polymer, dosing of acid and or caustic
LXZ517.53.B0101 (Single Channel), RTC-DAF (1C)
LXZ517.53.B0111 (Double Channel), RTC-DAF (2C)

Control of TSS in flotated sludge and TSS in clear water.
Output: Dosing of Coagulant and polymer (2 dosing points), 2 point dosing of acid and or caustic for pH control
LXZ517.53.B0201 (Single Channel) RTC-DAF+ (1C)



I/O and Parameter / Channel

RTC-DAF Output
- Coag. / floccul. dosing rate
- Caustic / acid flow rate
- Feed flow rate
- Controller status signal

RTC-DAF Input
- TSS concentration in
  - Feed flow
  - Floated sludge
  - Clear water effluent
- Feed flow rate
- Flow rate polymer / coagulant

RTC-DAF Control Parameter
- Specific dosing rates kg polymer / t TSS)
- PID Parameter for floated sludge resp. clear water TSS (TOC) control
- PID parameter for pH control

Source Water Coagulation (RTC-COAG)

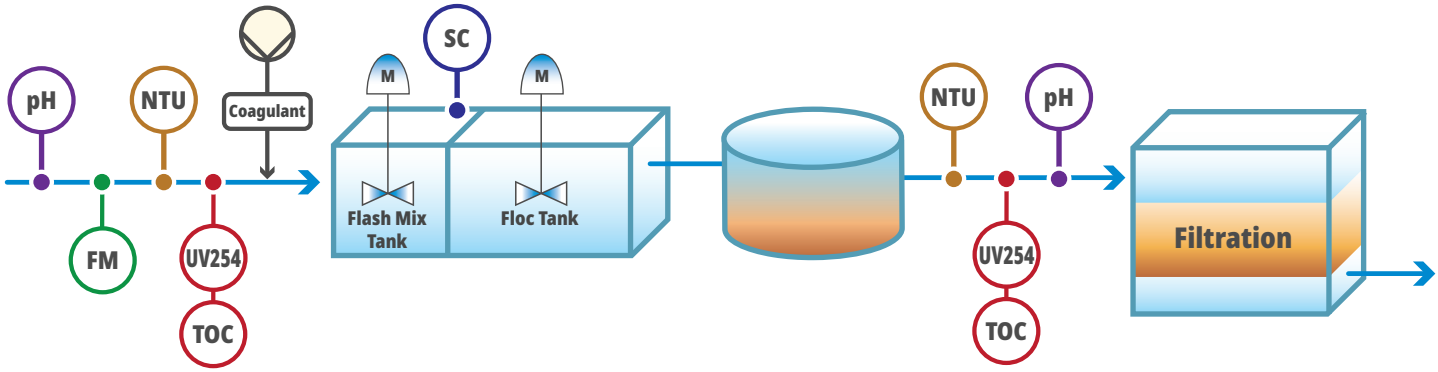
RTC-COAG Application Area
Utilizes machine learning and a variety of parameter inputs to adjust coagulant dosing in real time, optimizing chemical costs and ensuring compliant finished water.

RTC-COAG Description
Calculates coagulant dosing rates in the coagulation/flocculation/sedimentation process using feed forward and feedback control loops. To build the feedforward model, Hach will collect available historical raw and finished water analytical data to develop a machine learning model that can predict the coagulation dosage based on raw water analytical data. Coagulation is a complex process which is influenced by several raw water parameters, therefore using a machine learning model that takes account of several raw water parameters will provide a more robust and optimal dosage calculation. The software will continually retrain the model as the system receives new data to ensure the model is accurate as possible. The feedback trim modifies the specific dosing ratio for coagulant are based on available instrumentation and data available such as streaming current and or prefilter turbidity and organics.

RTC-DAF Benefits
- Optimization of coagulation/ flocculation water treatment process; achieve savings on coagulant usage; and improve solids and natural organic matter removal.

Versions

LXZ532.53.A1010 (Small)
LXZ532.53.A1011 (Medium)
LXV532.53.A1012 (Large)



I/O and Parameter / Channel

RTC-COAG Output
- Coagulant concentration
- Coagulant flow rate
- Controller status signal

RTC-COAG Input
- Raw parameters (sensor)
- Raw lab parameters
- Settled turbidity and organics

RTC-COAG Control Parameter
- Settled turbidity setpoint
- PID settings
- Min/Max flow rate of coagulant

Source Water Pre-Oxidation (RTC-PREOX)

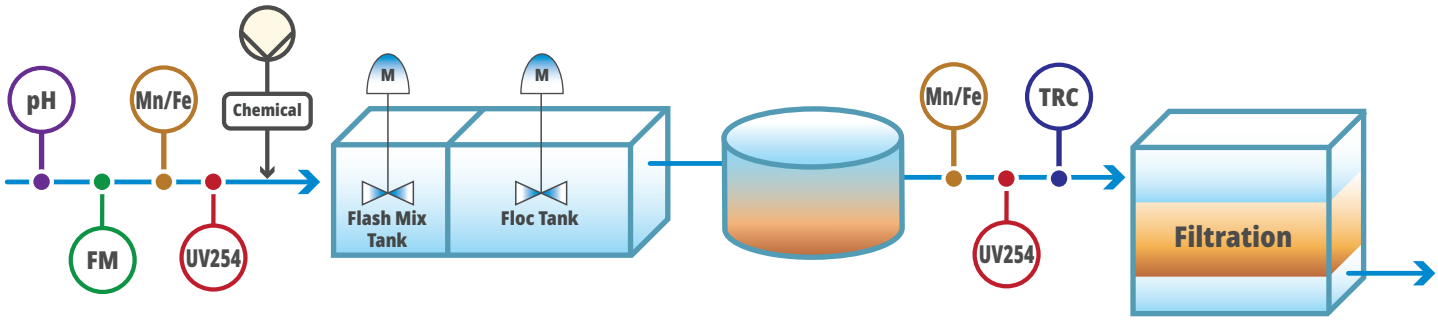
RTC-PREOX Application Area
Source water treatment plants that dose oxidants (MnO_4) to oxidize raw Mn, Fe and organics.

RTC-PREOX Description
Utilizes a ratio feed forward model and a variety of parameter inputs to adjust oxidant dosing in real time, optimizing chemical costs and ensuring compliant finished water. This system improves the Oxidant usage to remove Mn, Fe, and organics from the raw water supply. The RTC-PREOXD calculates Oxidant dosing rates in the pretreatment process using feed forward and feedback control loops. The feed forward loop calculation is based on continuously maintaining a constant ratio of Mn/Fe to Oxidant concentration as well a constant ratio of Organics to Oxidant concentration. The feedback trim then modifies the dosing rates for Oxidant based on the concentration of Oxidant prior to sedimentation and or Mn/Fe measured in the finished water.

RTC-PREOX Benefits
- Optimization of water treatment process achieve savings on Oxidant; reduce the risk of overdosing Oxidant; and Mn/Fe/Organic removal optimization.

Versions

LXZ532.53.B1010 (Small)
LXZ532.53.B1011 (Medium)
LXV532.53.B1012 (Large)



I/O and Parameter / Channel

RTC-PREOX Output
- Oxidant concentration
- Oxidant flow rate
- Controller status signal

RTC-PREOX Input
- Raw Mn, Fe, Organics
- Settled Mn, Fe, Organics
- Oxidant residual

RTC-PREOX Control Parameter
- Mn, Fe, oxidant setpoints
- Oxidant to parameter ratios
- PID settings
- Min/Max flow rate of oxidant

Hardware

Hardware Touch Panel

Touch panel industrial PC for installation in a control cabinet. Aluminium housing with glass front and one slot for CFast cards, accessible from the outside. Communication to Hach SC4500 controller via Hach Claros network bus. Communication to SC1000 controller via RTC communication card. Direct communication to PLC via Modbus TCP/IP or any other protocol Kepware (3rd party SW).

LXV515.53.0003C 15" touch wide screen (SIEMENS IPC477E)
LXV515.53.0004C 19" touch wide screen (SIEMENS IPC477E)
LXV515.53.0003B 15,6" touch wide screen (CP2716, Beckhoff)
LXV515.53.0004B 18,5" touch wide screen (CP2718, Beckhoff)

Hardware for DIN Rail Mounting

IPC for DIN rail mounting, one slot for CFast cards, accessible from the outside. Communication to Hach SC4500 controller via Hach Claros network bus. Communication to SC1000 controller via RTC communication card. Direct communication to PLC via Modbus TCP/IP or any other protocol Kepware (3rd party SW) . Operation of the RTC e.g. via TeamViewer, VNC Viewer.

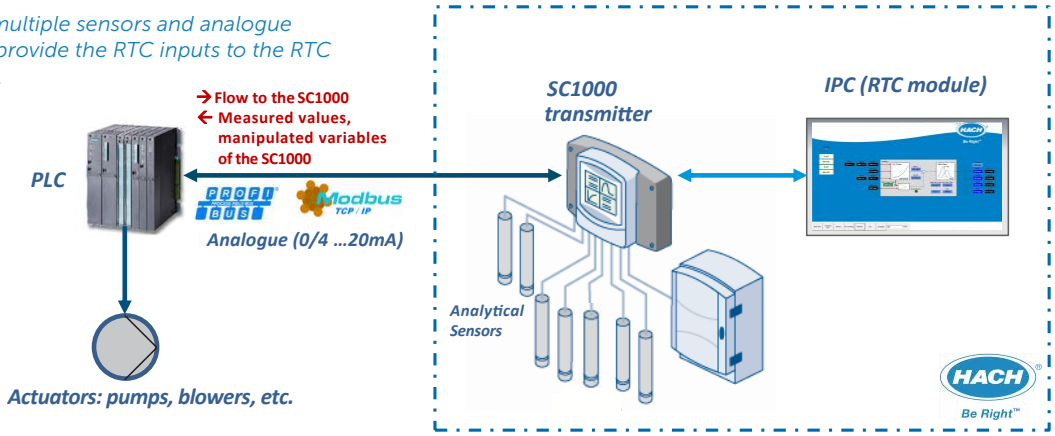
LXV515.53.0005C DIN Rail IPC with UI and Basic SW (SIEMENS IPC427E Microbox)
LXV515.53.0005B DIN Rail IPC with UI and Basic SW (CX5130 Beckhoff)

RTC /PLC Integration

Integration via SC1000

The RTC modules are installed on an industrial PC. The site PLC communicates with the SC1000 via PROFIBUS, MODBUS TCP/IP or analogue (0/4...20 mA). The data exchange between the IPC (on which the RTC modules are installed) and the SC1000 takes place via an internal RTC communication card.

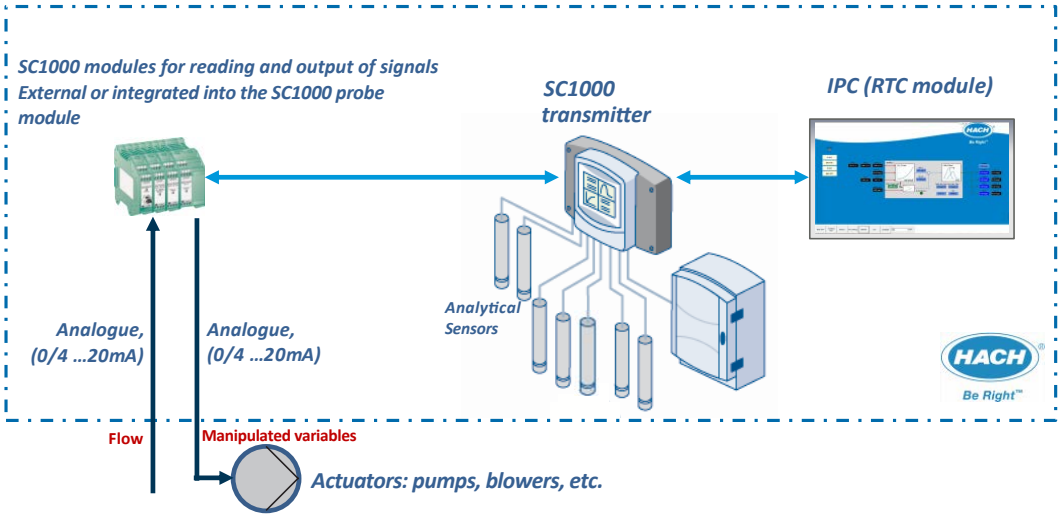
This configuration is recommended if multiple sensors and analogue mA inputs and outputs are required to provide the RTC inputs to the RTC and deliver the RTC outputs to the PLC.



Integration via SC1000. Direct Control of Actuators.

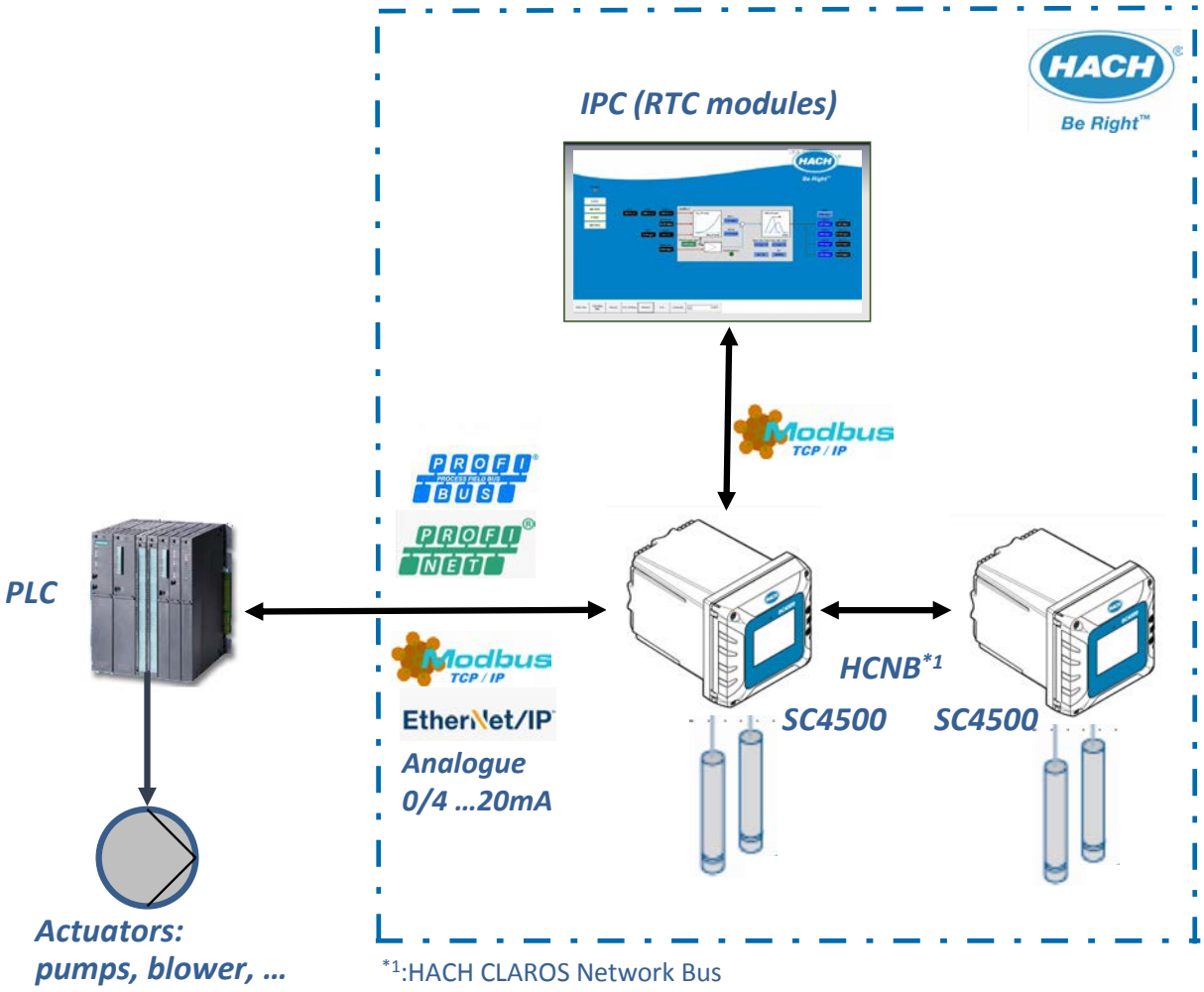
The RTC modules are installed on an industrial PC. Communication with the sensors for flow and with the actuators takes place via the input and output modules that are integrated in the SC1000 probe module or external (figure).

This configuration is recommended if multiple HACH analytical sensors and analogue mA inputs and outputs are required. It allows direct communication between the RTC and site sensors (e.g. flow meters) and site actuators (e.g. dosing pumps).



HACH®

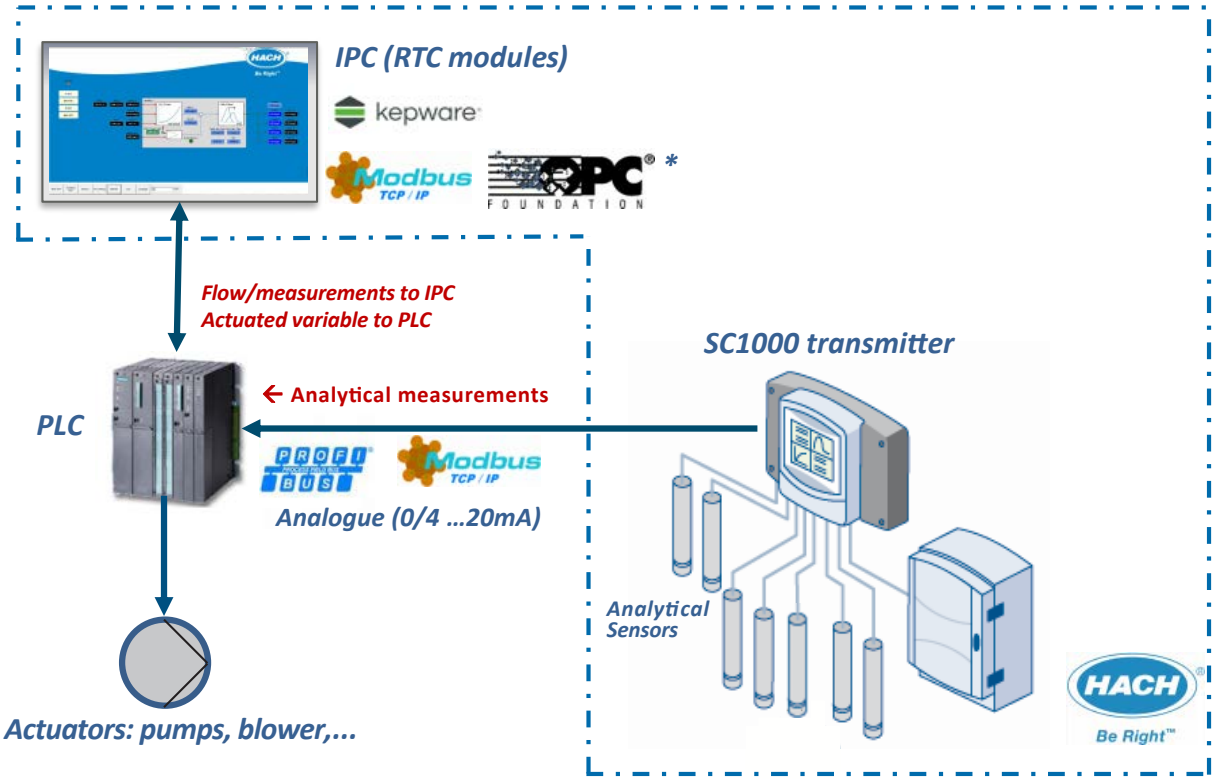
RTC modules are installed on an industrial PC. The site PLC receives analytical data from SC4500 Modbus, Ethernet IP, Profibus, Profinet or analogue (0/4...20mA). The IPC hosting the RTC modules communicates to SC4500 via Modbus TCP/IP (LXZ515.53.B0002)

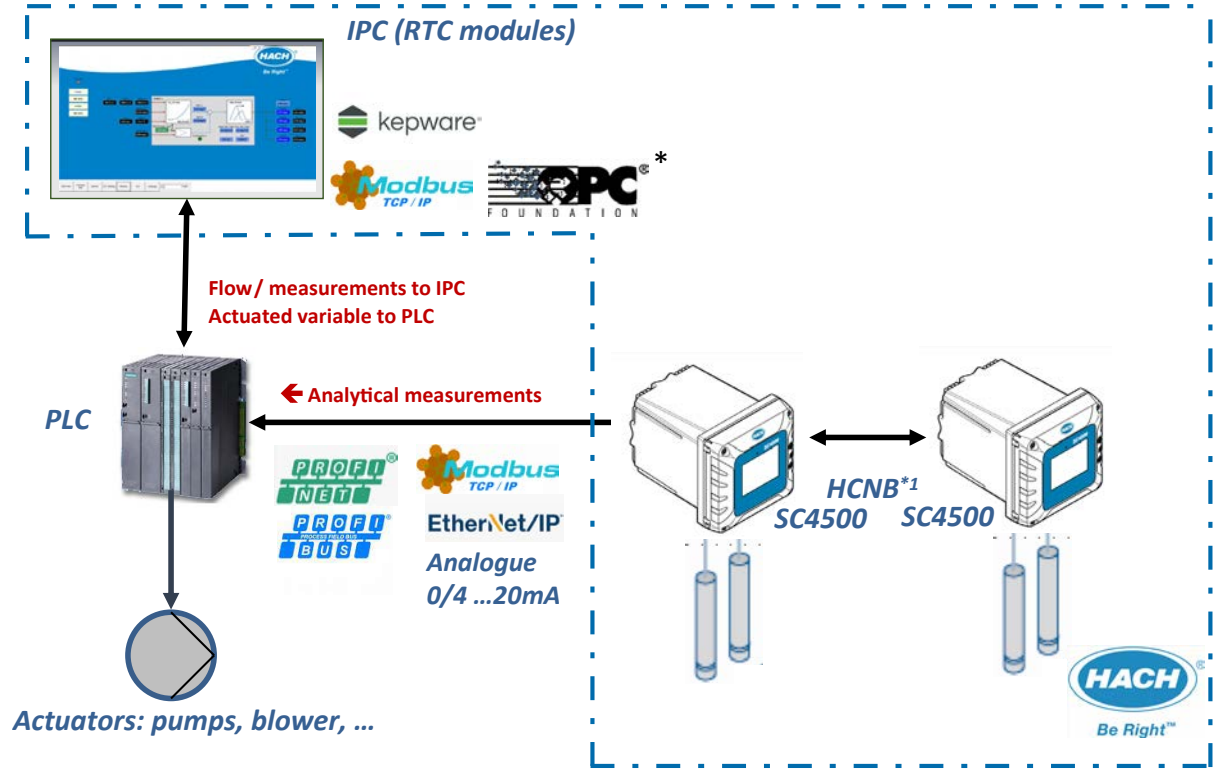


*1:HACH CLAROS Network Bus

Direct Communication Between RTC and PLC

RTC modules are installed on an industrial PC. The site PLC receives analytical data from SC1000 via Profibus, Modbus TCP/IP or analogue (0/4...20mA) or from SC4500 (lower picture) via Modbus, Ethernet IP, Profibus, Profinet or analogue (0/4...20mA). The IPC hosting the RTC modules communicates to the site PLC, via ModBus TCP (Server) or any other specific PLC communication protocol (via 3rd party SW from Kepware).





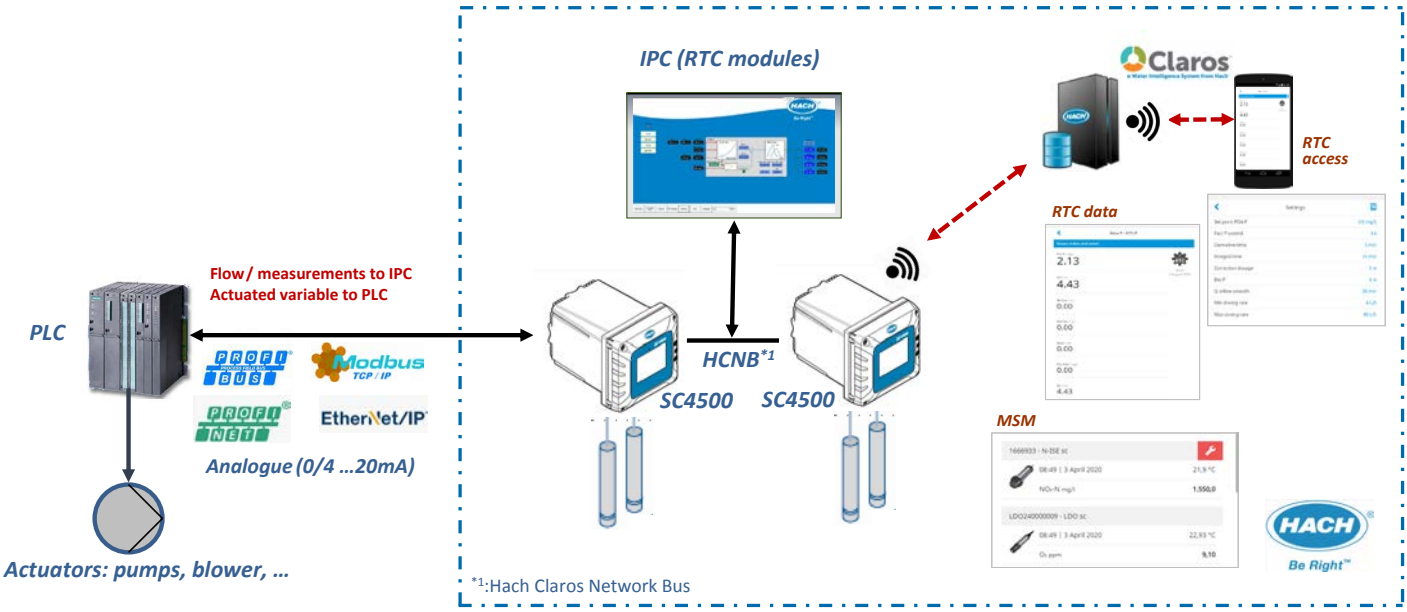
*1:Hach Claros Network Bus

*OPC UA via KepWare

Claros Integration

RTC modules are installed on an industrial PC. The site PLC receives analytical data from SC4500 via Profibus, Profinet, Ethernet IP, Modbus TCP/IP or analogue (0/4...20mA). RTC is connected to the SC4500 and to Claros Cloud through HCNB (Hach Claros Nerwork Bus).

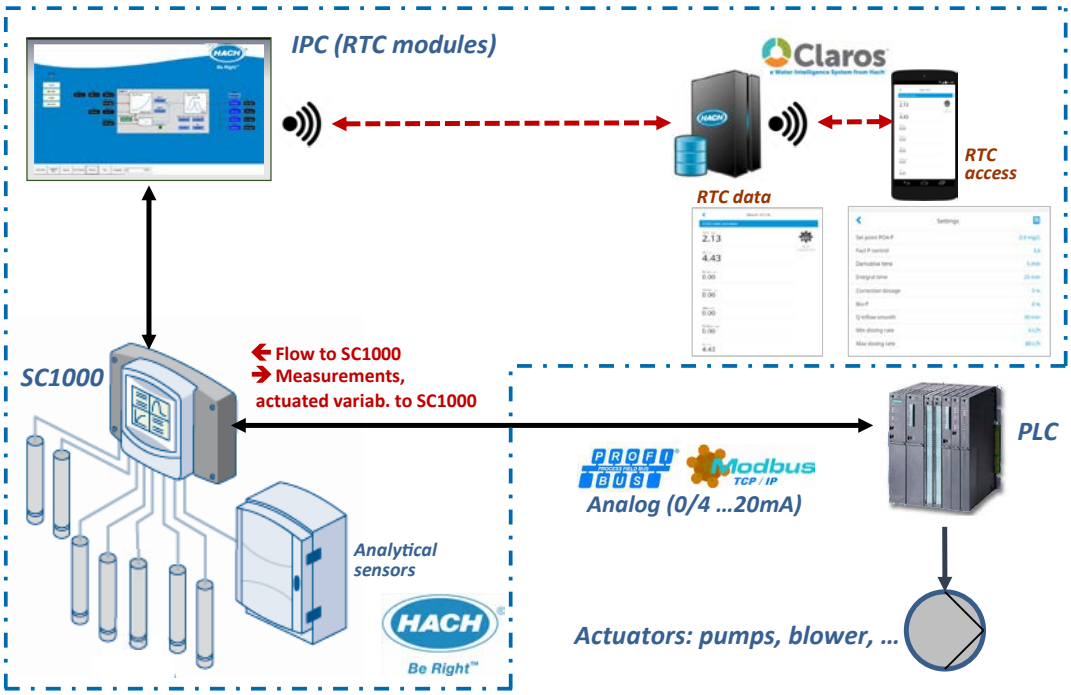
Currently limited to the following Modules: RTC-P; -N/DN; -N; -SRT; -SD; - ST, -SND, -CNP, -MOV, -DN

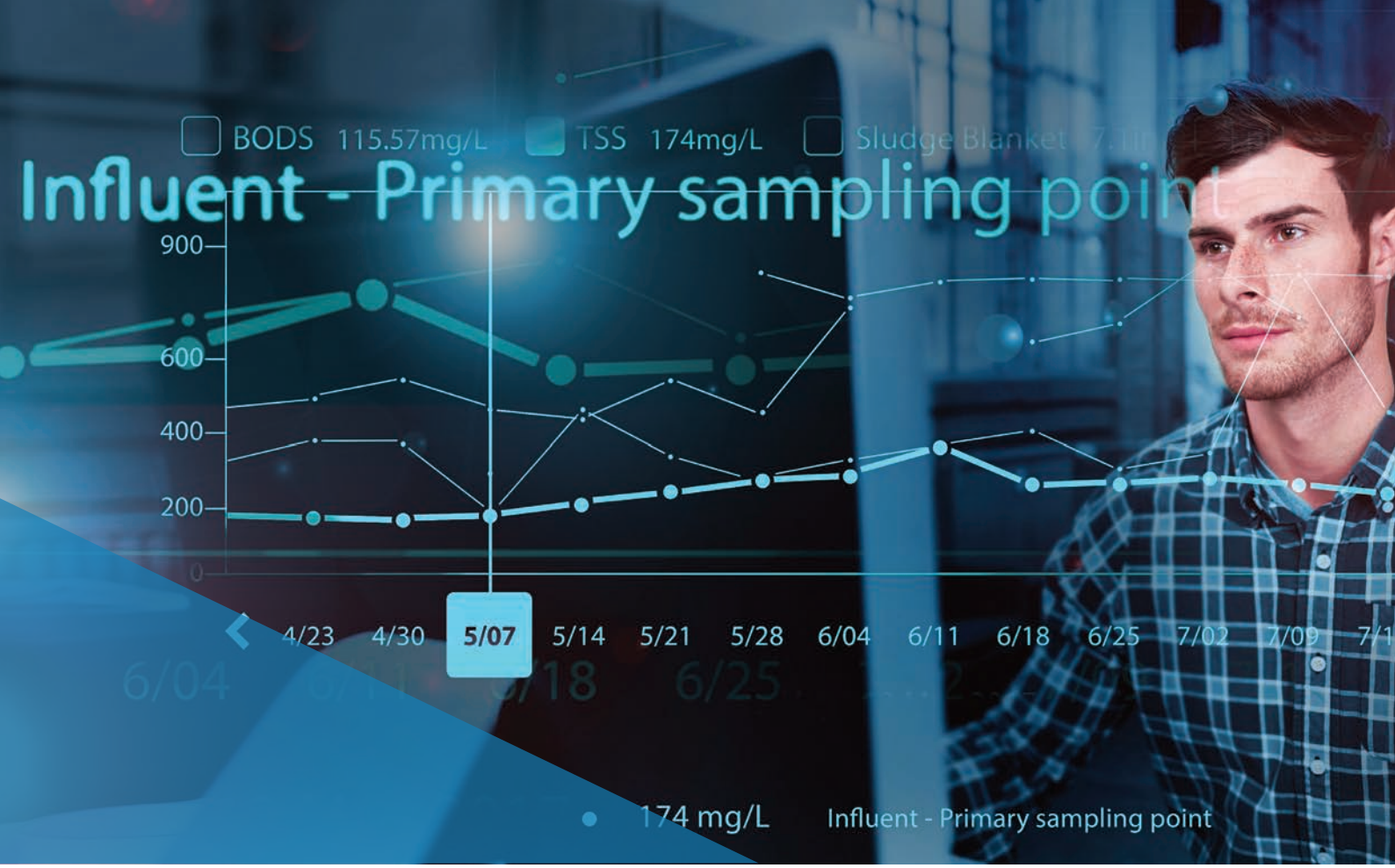


RTC modules are installed on an industrial PC. The site PLC communicates with the SC1000 via PROFIBUS, MODBUS TCP/IP or analogue (0/4...20 mA). The data exchange between the IPC (on which the RTC modules are installed) and the SC1000 takes place via an internal RTC communication card.

RTC is connected to Claros for remote operation.

Currently limited to the following Modules: RTC-P; -N/DN; -N; -SRT; -SD; - ST, -SND, -CNP, -MOV, -DN





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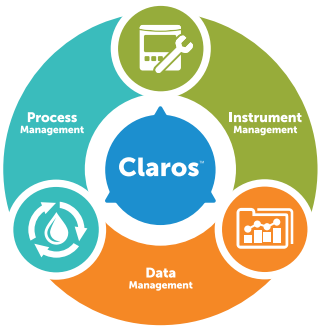

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