Ditch Upgrade Results in Energy Savings at North Cary WRF

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AGENDA

- Intro to Veolia's Ditch Technologies
- Key Benefits for WWTPs
- Upgrade Reference
- Advanced Online Control
- Questions??

VEOLIA WATER TECHNOLOGIES
INSTALLATIONS

Approximately 100 Veolia Ditch Installations in the United States

- ~ 20% < 1 MGD
- ~ 60% 1 - 5 MGD
- ~ 20% > 5 MGD

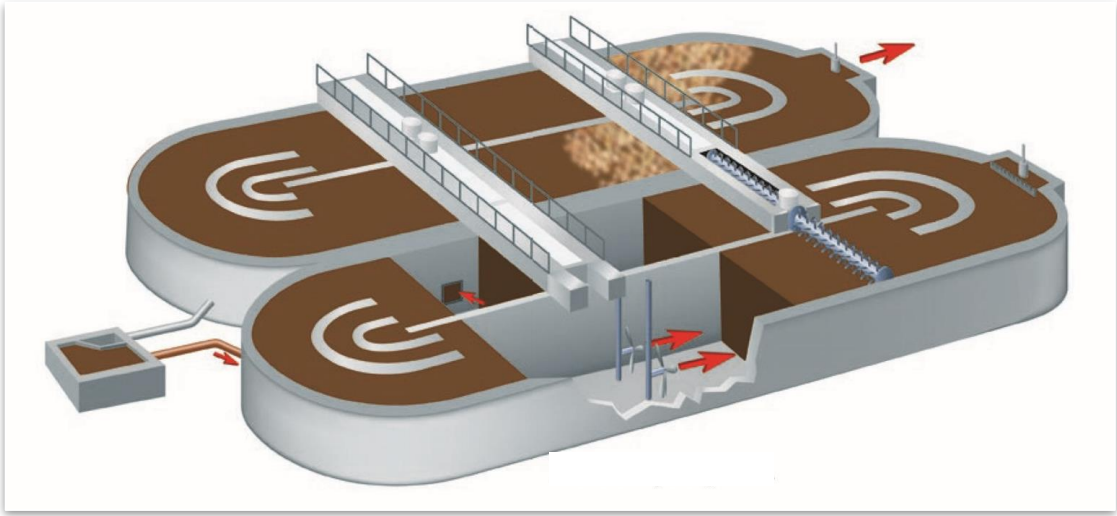
Over 50% of these are BIO-DENITRO™ systems

30+ years applying this technology

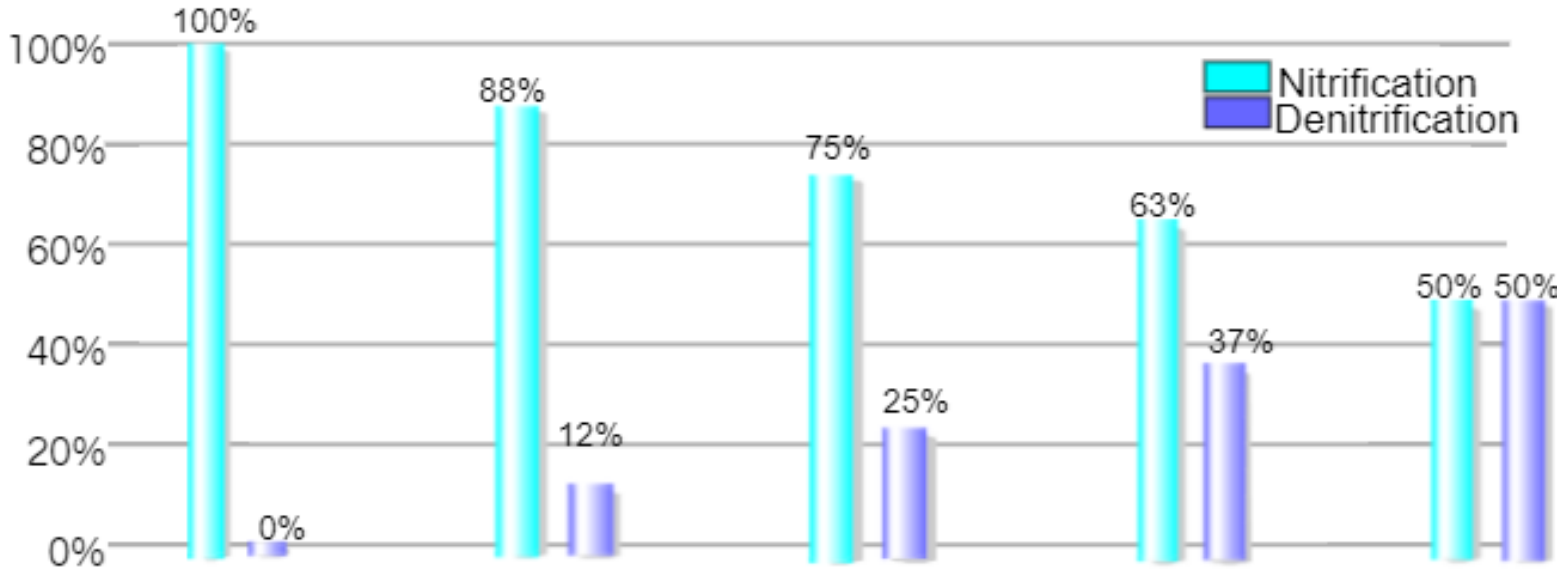
Phased control for superior effluent quality

BIO-DENITRO™
BENEFITS

- Highly controlled N and P removal
- No internal mixed liquor recycle pumping
- Separation of mixing and aeration
  - * Unlimited aeration turndown
- Operational flexibility
- TN < 4-5 without secondary anoxic zones



PHASING WITH
TIME BASED CONTROL



Resulting Volume Allocation (%)

CASE STUDY
NORTH CARY, NC BIO-DENIPHO™

References

CASE STUDY GOALS
NORTH CARY, NC BIO-DENIPHO™

Primary Goal of Project:

Upgrading the Plant's aeration capacity from 12 MGD to 15 MGD without adding additional process volume meeting the existing effluent limits of the Plant

- TN < 3 mg/L
- TP< 1.0 mg/L
- NH4-N< 0.5 mg/L

Secondary Goal of Project:

Operate the Plant without addition of external carbon nor chemical precipitation of phosphorus

CASE STUDY PROJECT
NORTH CARY, NC BIO-DENIPHO™

- Replace existing rotors with diffused air for increase aeration capacity
- Installation of new blower station (centrifugal blowers)
- Existing Wilo mixers remain in place for mixing during anoxic phase
- Installation of online ammonium and nitrate analyzers
- Upgrading the control of the Plant from time-based control to real-time PLC online control

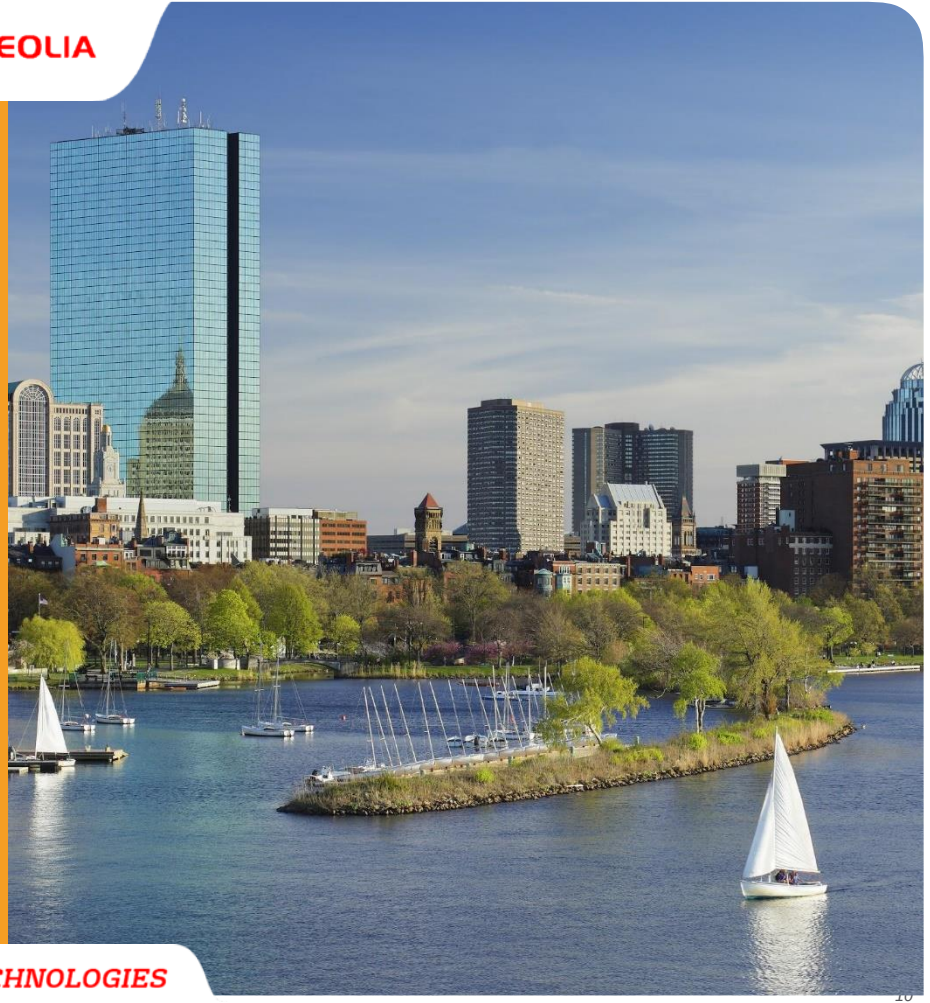
CASE STUDY RESULTS
NORTH CARY, NC BIO-DENIPHO™

- Operating two out of three trains. Current hydraulic load 7.0 MGD
- Reduction of about 6% of energy overall at the Plant
  - Centrifugal blowers with blow-off valves utilized
- Average effluent values before and after the upgrade of the Plant
- Deeper understanding of the biological process through online measurements of nutrients

Effluent Values	Before (Jan - Dec 2022)	After (Oct-2022- Sep 2023)
TN (mg/L)	1.95	1.79
TP (mg/L)	0.34	0.27

HUBGRADE PERFORMANCE

History, Overview and Main Usage



HUBGRADE PERFORMANCE DIGITAL TWIN TO OPTIMIZE MUNICIPAL & INDUSTRIAL PLANTS WORLDWIDE

15 Patents

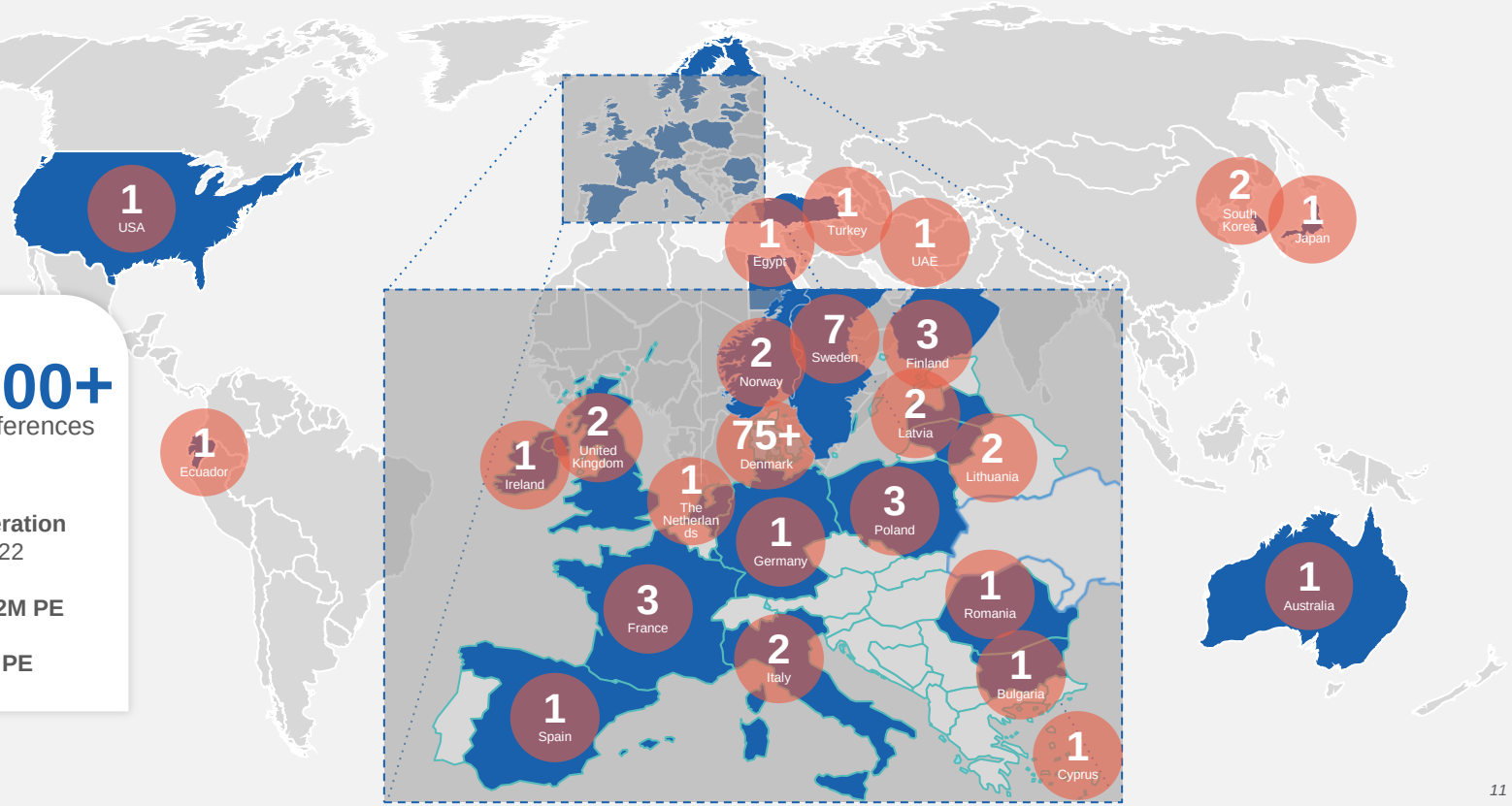
30+ years of experience

100+ references

1000+ years of operation
from 1992 to 2022

WWTP from 2k to 2M PE

More than 20 M PE



ADVANCED OPTIMIZATION
WHY ?

Reduced operating costs

- Reduced energy consumption
- Increased energy production
- Reduced chemical consumption

Increased hydraulic capacity

- Reduced overflow / bypass
- Increased flow through existing plant
- Less / avoided CAPEX

Increased biological capacity

- Increased biological load
- Improved effluent quality
- Less / avoided CAPEX

Increased capacity of sewer

- Reduced combined sewer overflow (CSO)
- Save extension of retention basin volume
- Less / avoided CAPEX

Compliance and stable operation

- Stability results in savings
- Meet your targets
- Easy for operator to perform
- Continuously acting to the actual situation in load and flow

HUBGRADE PERFORMANCE PLANT
TYPICAL OPEX SAVINGS RANGES

Less energy consumption
- Aeration | 10 – 30 %
- Mixing | 25 – 75 %
- Internal pumping | 25 – 75 %

Less chemical dosage
- P-precipitation 20 – 100 %
- Dosage of COD, N & P 25 – 100 %

Less chemical sludge production
- Equivalent to less P-precipitation dosage

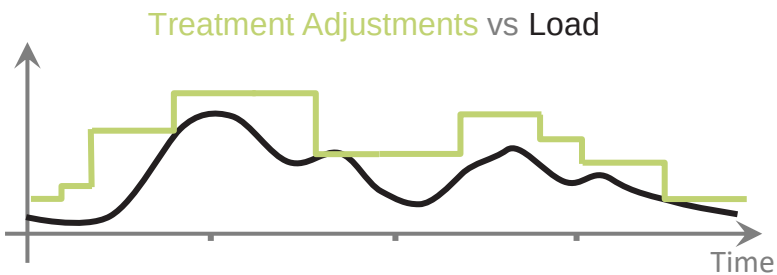
Higher Hydraulic / Biological capacity
- 20 – 100 % higher flow
- 10 – 40 % more load

Better effluent quality
- Total-N | 20 – 50 %
- Total-P, BOD, COD, SS… | 0 – 50 %

Better footprint – more valorised products
- $CO_{2\text{-eq}}$ reduction 10 – 30%
- Gaz production up to +5%
- P harvesting increased up to total P removal
- N2O reduction 50 - 90%

REAL TIME OPTIMIZATION
FASTER, BROADER AND CHEAPER

Traditional Operation



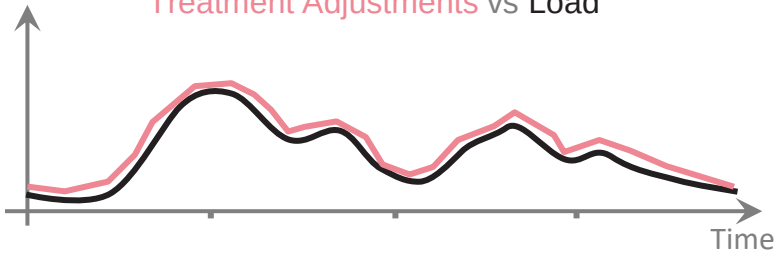
Optimization
+


WWTP Experts


PLC / SCADA


Smart Sensors / Equipments

With Digital Twin



Optimization
+++


WWTP & Twin Experts


RT Multiple optimisation loops


RT Comparisons with similar optimized plants


Predictive Model with weather & Grid Forecast

DO & N REMOVAL
COMPLIANT COD REMOVAL WITH LESS ENERGY

OPEX Energy Compliance Capacity Footprint

PATENTED

DO & Nitrogen Removal

AI

WHY ?

- Ensure compliance
- Reduce OPEX
- Reduce energy use
- Reduce CO_2 emissions

HOW ?

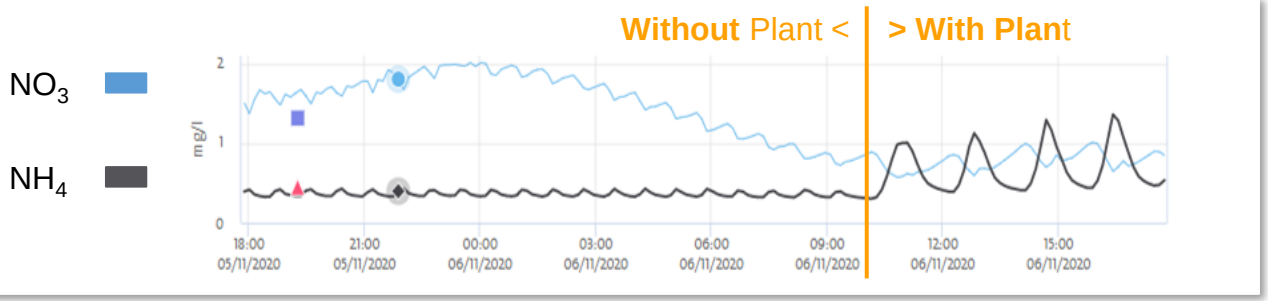
- Avoid over-aeration & enhance the usage of COD for NO3 removal.
- Enhance balancing of N/DN processes according to load variations.

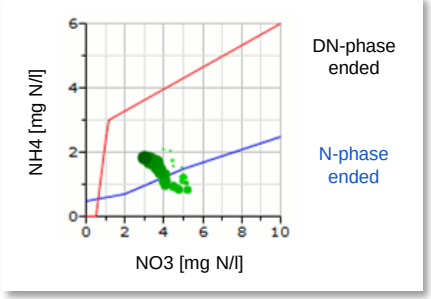
WHAT ?

Two patented optimized controls:

- regulating the DO set point
- regulating N/DN switching phases.

Providing set points for intermittent aeration and oxygen based on real-time measurements of NO3 and NH4 in the aeration tanks.



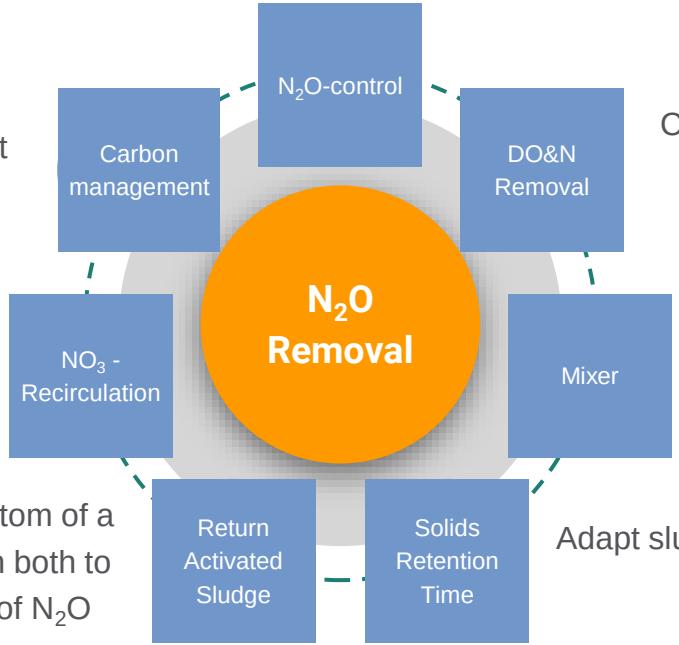


N_2O REMOVAL
ADVANCED OPTIMISATION IN ACTION

OPEX | Energy | Chemicals | Compliance | Footprint

PATENTED

Abort aeration and enforce denitrification sink of N_2O according to N_2O threshold measurements online



Add additional carbon to boost denitrification sink of N_2O

Control of N/DN phases and DO setpoint to minimize N2O emission

Balance NO_x concentrations and facilitate denitrification N_2O sink

Minimize DO gradients and reduce N_2O production and facilitate denitrification N_2O sink

Increase hydrolysis at the bottom of a settler. Minimize nitrate return both to facilitate denitrification sink of N_2O

Adapt sludge age to load and minimize N_2O production

SMART BIO-P® IN DETAILS
GROW BACTERIA DURING LOW LOAD

OPEX Chemicals Compliance Capacity

PATENTED

Smart Bio-P

WHY ?

- Enhance biological P-removal
- Reduction of chemicals OPEX

HOW ?

- Real time control of aeration phases to create temporary anaerobic phases during low load (NH4+NO3) & low flow

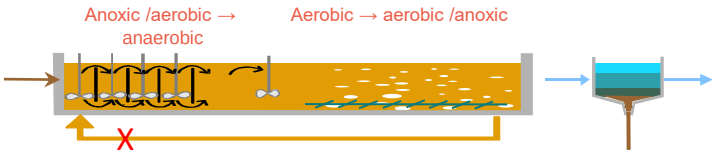
WHAT ?

- Find a time slot for growth of Bio-P bacteria somewhere in existing volume.

Adaptable to all activated sludge plant designs

Pre DN - Plugflow - MLE

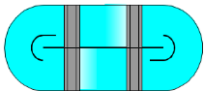
Change of process in the upstream anoxic/aerobic sections to temporary anaerobic



One tank/single ditch - Azenit™

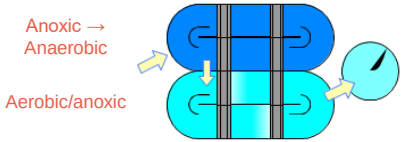
Change of process to temporary anaerobic

Aerobic/Anoxic → Aerobic/Anoxic/Anaerobic

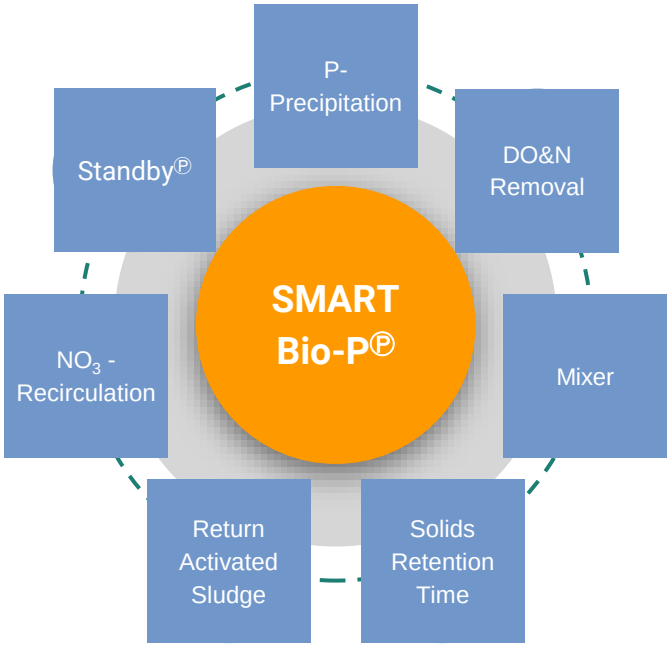


BioDenitro™/BioDenipho™

Change of process in inlet section to temporary anaerobic



SMART BIO-P®
P-REMOVAL DOSAGE & BIOLOGICAL P-PRECIPITATION



Why use SMART Bio-P?

Aim: Do it better and cheaper

Key idea:
Find a time slot for growth of Bio-P bacteria somewhere in existing volume

Save CAPEX
For construction/reconstruction of anaerobic volume

Save OPEX
Dosage for co-P-precipitation and/or
Dosage for post P-precipitation
Handling of chemical sludge

REFERENCES - *Reduction in chemical for precipitation*

- **Helsingør WWTP**, DK (75.000PE)
  → 80% Reduction
- **Nosedo WWTP**, IT (1.250.000PE)
  → 70% Reduction
- **EDE**, NL (300.000PE)
  → 20% Reduction
- **Riga**, LV (750.000 → 1.050.000 PE)
  → Extension without Bio-P Tank

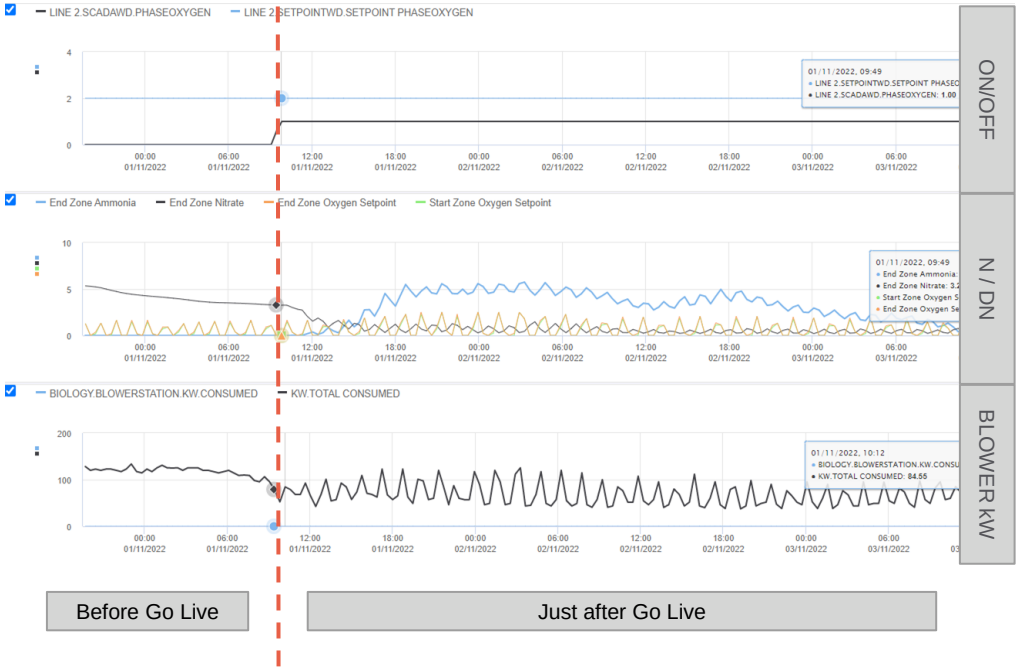
+

wetsus

47000 PE - OMAGH WWTP, NORTHERN IRELAND

SMOOTH, FAST AND PROVEN PROCESS - 5 MONTHS

CONFIDENTIAL



ENERGY COSTS

35K€ saved

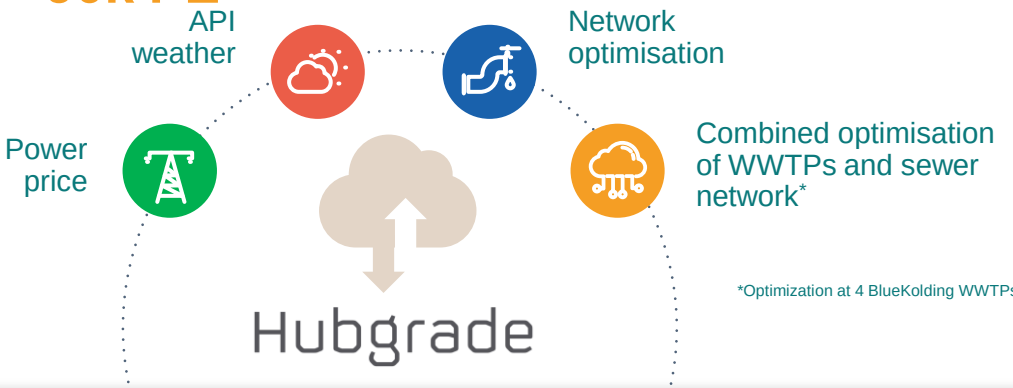
SPECIFIC ENERGY CONSUMPTION

Reduced by 45%

KWH DAILY AVERAGE CONSUMPTION

Reduced by 32%

CASE STUDY - HPP
BLUEKOLDING - 90k PE



*Optimization at 4 BlueKolding WWTPs, in connection with Sewer

Drivers

- Reduces **operating costs**
+ Increased **hydraulic & biological capacity**

Benefits

- Increased **capacity of sewer**
- **Compliance** and stable operation
- **Improved operation**, staff advantages, data handling and reporting

Reduced:

Nitrogen	- 27%
Chemical	- 46%
Energy consumption	- 23%
Overflow	- 83%

Increase:

Hydraulic capacity	+ 80%

Thank You!

Questions?

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