

FOSFORREDUKTIONER FRA SPILDEVAND

Optimeret fosforjernelse fra renselanlæg

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Our office
in Aarhus

**Present in Denmark
since 1980's**

**Part of SUEZ group with
40,000+ employees globally**

**Core business is to design
and build water and
wastewater treatment
plants for municipal and
industrial clients**

Phosphorus removal from wastewater

⇒ **BIOLOGICAL REMOVAL**

- Requires biological process design targeting biological phosphorus removal
- Due to variability in inlet flow and load there it is difficult to maintain high P-removal at all times only with biological P-removal

⇒ **CHEMICAL REMOVAL BY PRECIPITATION**

- Simultaneous precipitation in biological process and/or dedicated precipitation after biological process
- To achieve high P-removal rates requires large reactor volume and high dosage of chemicals

⇒ **MOST WWTPS IN DENMARK WORK WITH A COMBINATION**

⇒ **IN BOTH CASES, PHOSPHORUS ENDS UP IN THE SLUDGE WITH DIFFERENT AVAILABILITY**

Case:

Upgrade of P-removal at Skanderborg Central WWTP, Denmark

FACTS ON THE EXISTING WWTP

- Plant design capacity: 42.000 PE
- Treated volume 2019: 1.900.000 m³
- Max. capacity: 24.000 m³/d
- Phosphorus limit: 504 kg/year





Kanderborg
forsyning a/s



The challenges in Skanderborg



⇒ CENTRALIZATION OF WASTEWATER TREATMENT AND URBANIZATION

- plans to close small, old plants and expand central WWTP
- Skanderborg is growing → more wastewater
- Existing sand filters were a hydraulic bottleneck
- Limited footprint available for expansion

⇒ SENSITIVE RECIPIENT: FRESHWATER LAKES SURROUNDING SKANDERBORG

- Fixed limit for Phosphorus discharge (**max. 1,38 kg/d**) will remain unchanged despite increased load of the plant

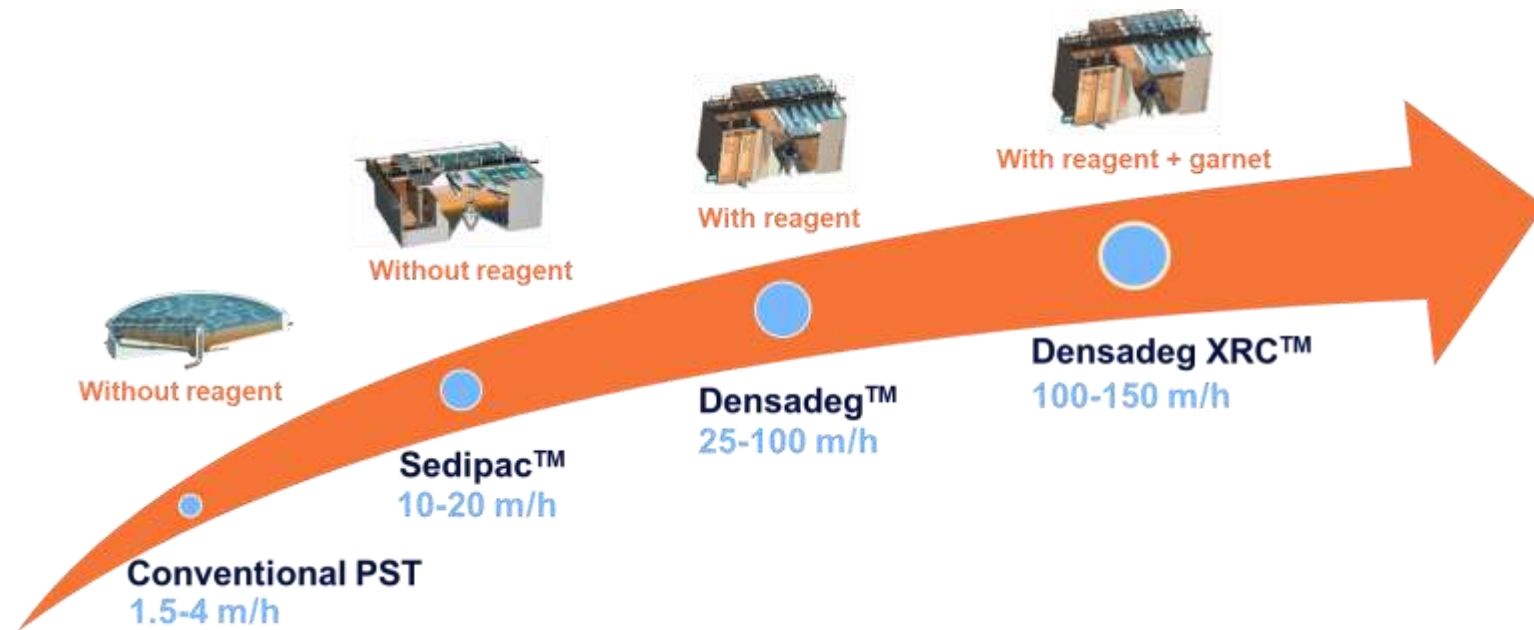
⇒ OVERFLOWS DURING HEAVY RAIN EVENTS

- Climate changes had led to an increased number of events with heavy rain resulting in overflows of untreated wastewater

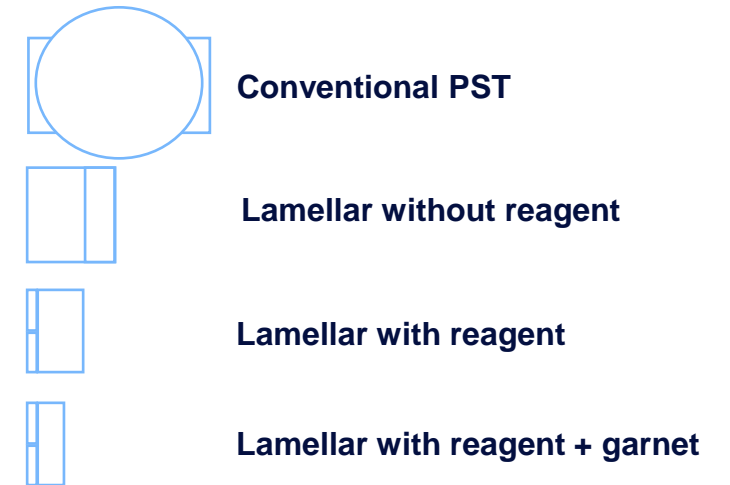
Why lamellar clarifiers for tertiary and CSO treatment?

⇒ DRIVERS:

- Footprint
- TOPEX
- Ability to handle large flow variations



Footprint:

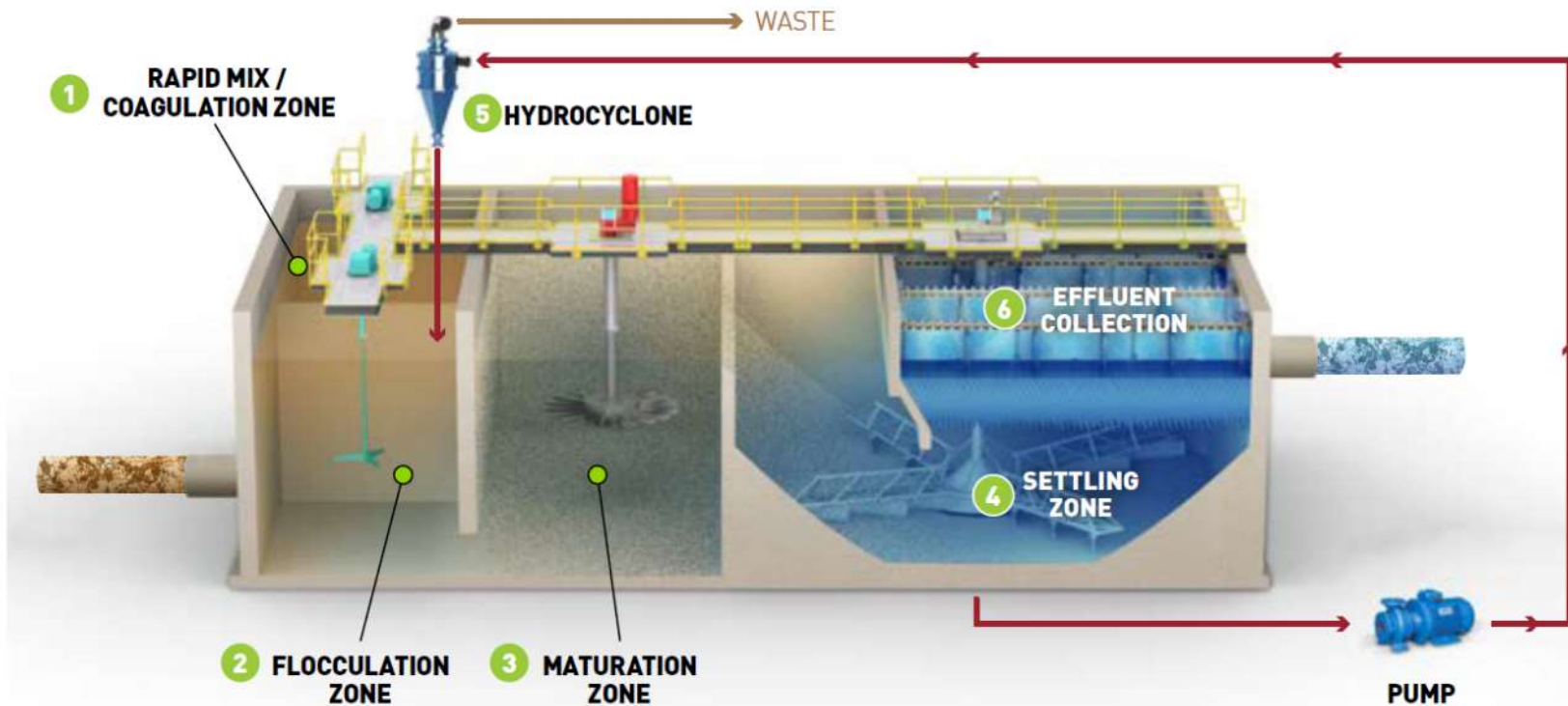


Densadeg XRC™ is 30 times more compact than conventional PST

Densadeg XRC™ – Extreme Rate Clarifier

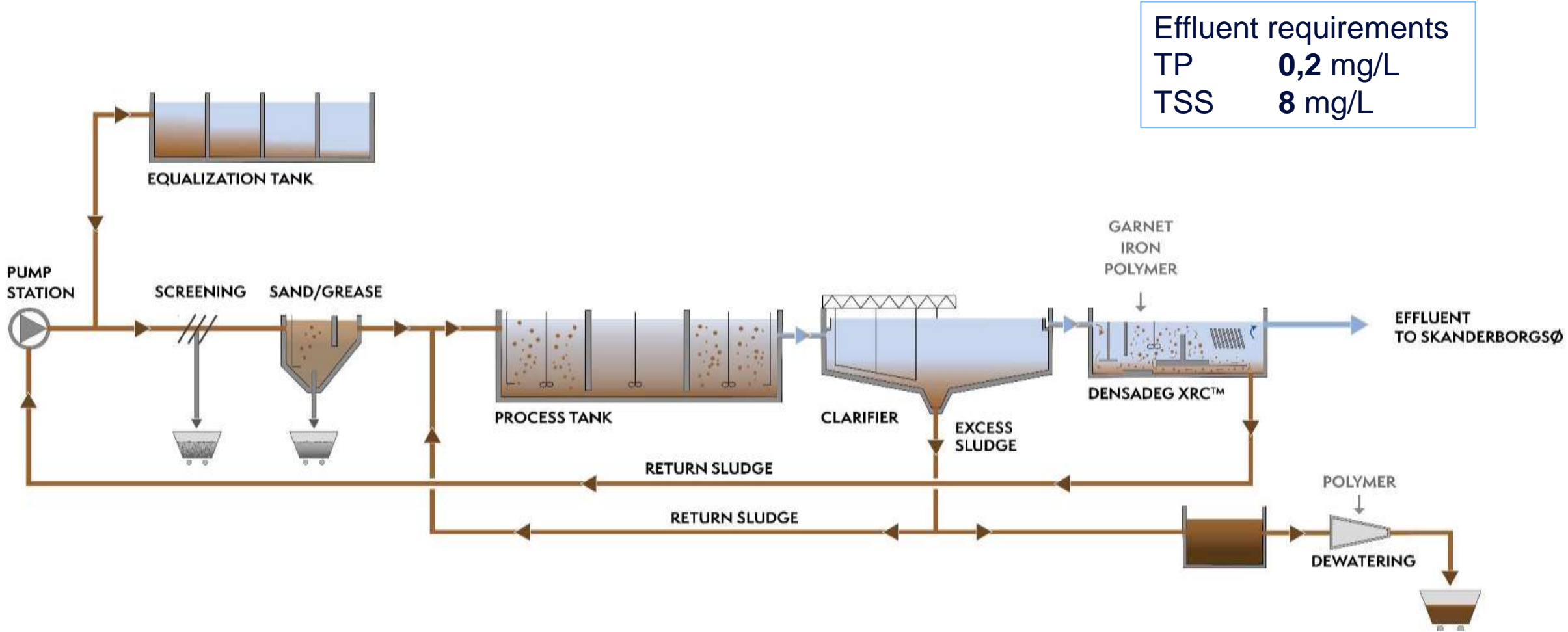
⇒ LATEST DEVELOPMENT OF BALLASTED LAMELLAR CLARIFIER USING HIGH DENSITY BALLAST

⇒ EXTREME LOADING RATES (100-150 M/H) ENSURE VERY COMPACT DESIGN



[YOUTUBE ANIMATION VIDEO: CLICK HERE](#)

The treatment line



Effluent requirements	
TP	0,2 mg/L
TSS	8 mg/L

Densadeg XRC™ at Skanderborg Central WWTP

- **First Densadeg XRC reference for SUEZ in Europe**
- Commissioning done ultimo March 2020



Designed with two lines in parallel to cope with hydraulic peak loads



- DURING DRY WEATHER ONLY ONE LINE IS IN OPERATION
- BOTH LINES IS IN OPERATION DURING RAIN
- THE SECOND LINE CAN BE **STARTED UP IN 15 MINUTES** – MORE THAN ENOUGH TIME TO ANTICIPATE INCREASED HYDRAULIC LOAD

Coagulant dosing algorithm based on online P-analyzer

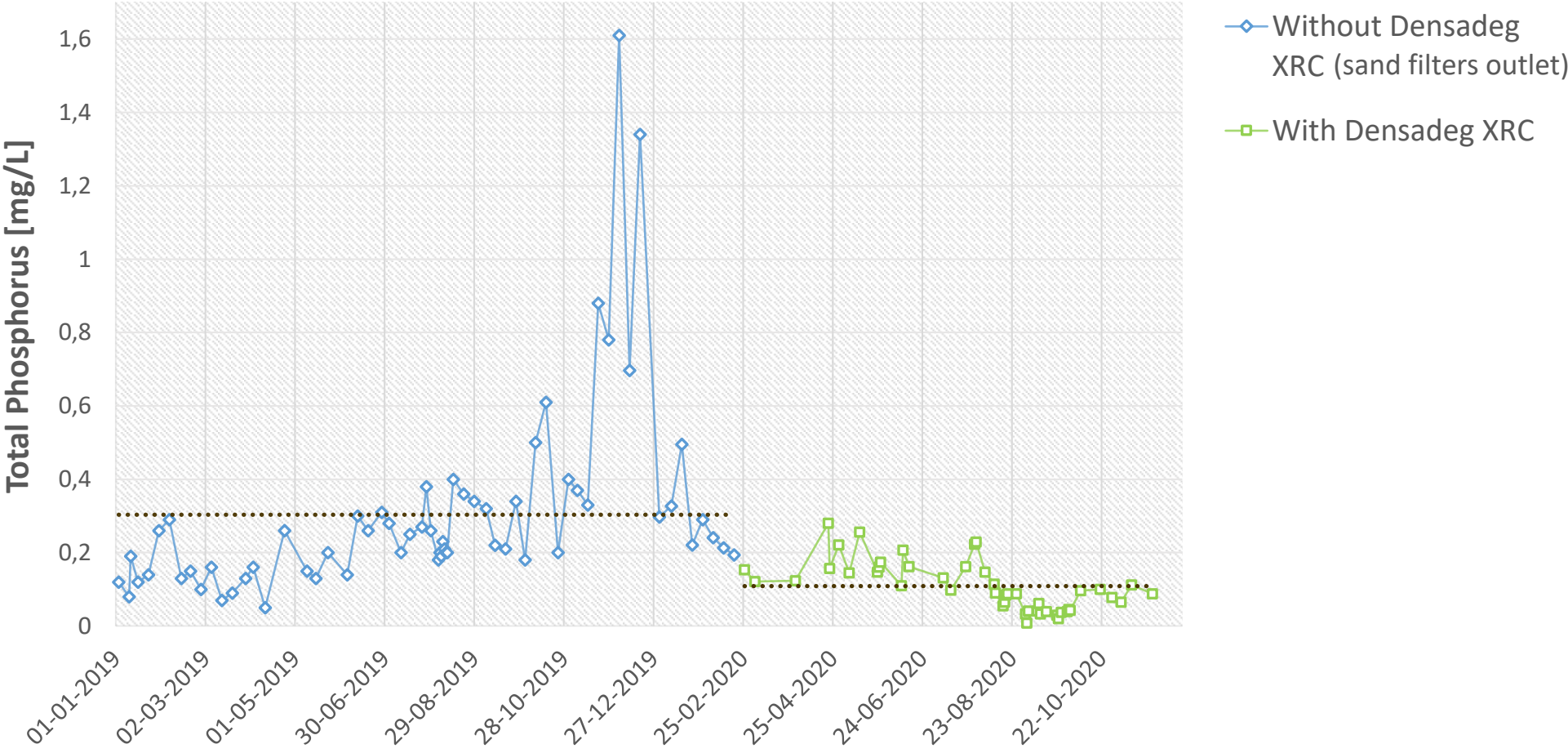
⇒ OBJECTIVES

- Optimize coagulant dosing based on online P-levels in inlet to maximize P-removal
- Reduce the consumption of coagulant (chemicals)



Tertiary treatment: Phosphorus removal

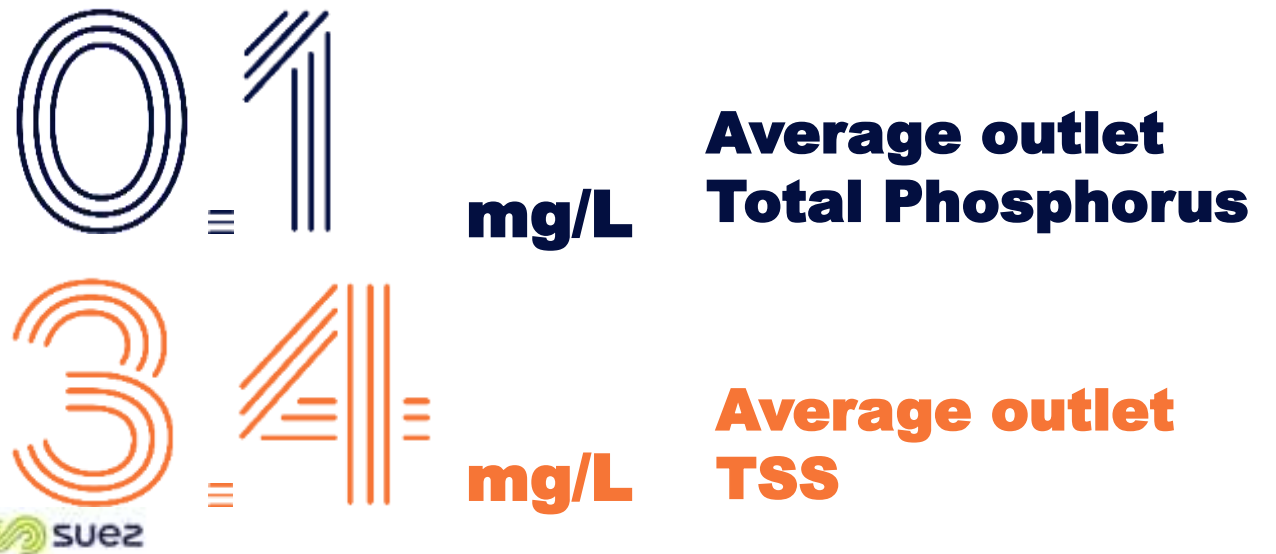
⇒ **AVERAGE OUTLET REDUCED FROM 0,30 MG/L TO 0,11 MG/L (24hr flow proportional samples)**





Summary

- ⇒ **ADDITIONAL 200 KG PHOSPHORUS REMOVED PER YEAR**
- ⇒ **LESS OVERFLOWS FROM THE WWTP DUE TO IMPROVED HYDRAULIC CAPACITY**
- ⇒ **ONLINE PHOSPHORUS SENSOR ENSURES BALANCED CHEMICALS CONSUMPTION**
- ⇒ **OPTIMIZATION HAS LED TO IMPROVED TOPEX: 1258 KR PER KG PHOSPHORUS REMOVED BY DENSADEG XRC**



Case: Phosphogreen™ for P-recovery at Marselisborg WWTP



Recovery of Phosphorus from wastewater

Commissioned in 2018

Producing a high-class fertilizer approved by EPA

Struvite production up to 800 kg/day

200,000 P.E.

Phosphogreen™ Struvite production

Struvite is normally a problem in WWTPs as it crystallizes e.g. in pipes and tanks

By controlled struvite precipitation it is possible to produce a high-class fertilizer essential for agriculture

20% of current world demand of phosphorus could be covered by recovery from wastewater



Pipe with struvite crystallization

3 Phosphogreen™ reactors



Recycled phosphorus in form of struvite

SPØRGSMÅL?

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