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Uppstart av DeAmmon® i Norrköping samt andra uppstarter

Linda Kanders

2018-12-04

Slottshagens rejektvattenrening

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Agenda

1. Allmänt om projektet och tidplan
2. Från SBR till DeAmmon
3. Resultat
4. Summering uppstart Norrköping
5. Uppstart utan ymp
6. Anammox i reningsverket

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Allmänt om projektet

- **NoVA har haft separat rejektvattenrening på Slotthagens reningsverk sedan 1995**
- **Fokus på att minska lustgasproduktion**
- **Purac levererar DeAmmon**
- **Möjlighet att använda befintlig utrustning**

Tidplan

2017 v22	Startmöte
2017 v24-26	Förprojektering
2017 v31	Detaljprojektering
2017 v45	Leverans luftarsystem och omrörare
2017 v47	Leverans av nytt elskåp
2017 v49	Utcheckning
2017 v51	Slutbesiktning
2018 v8	Bärare från Himmerfjärden
2018 mars-apr	Uppstart och intrimning
2018 v20	Klar provdrift

Från SBR till DeAmmon

Befintlig SBR utrustning

- Betongtankar
- Nästan ny blåsmaskin, Sulzer
- Ett antal instrument (nivå, nivåvakt, O2, pH)
- Elmatningsskåp
- Styrfunktioner i centrala styrsystemet

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Transport av bärarmaterial

Himmerfjärdsverket,
SYVAB

Slottshagen,
NoVA

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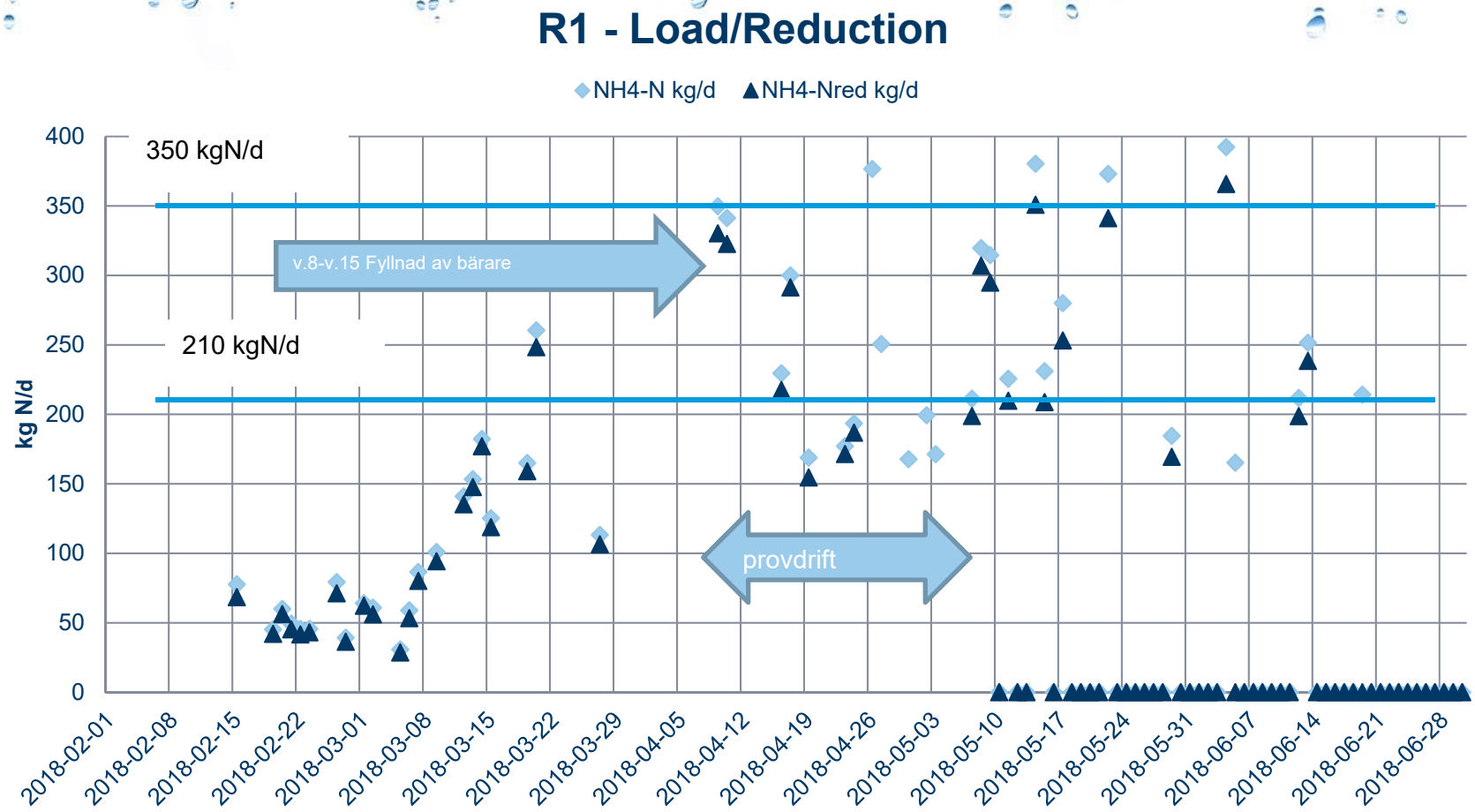
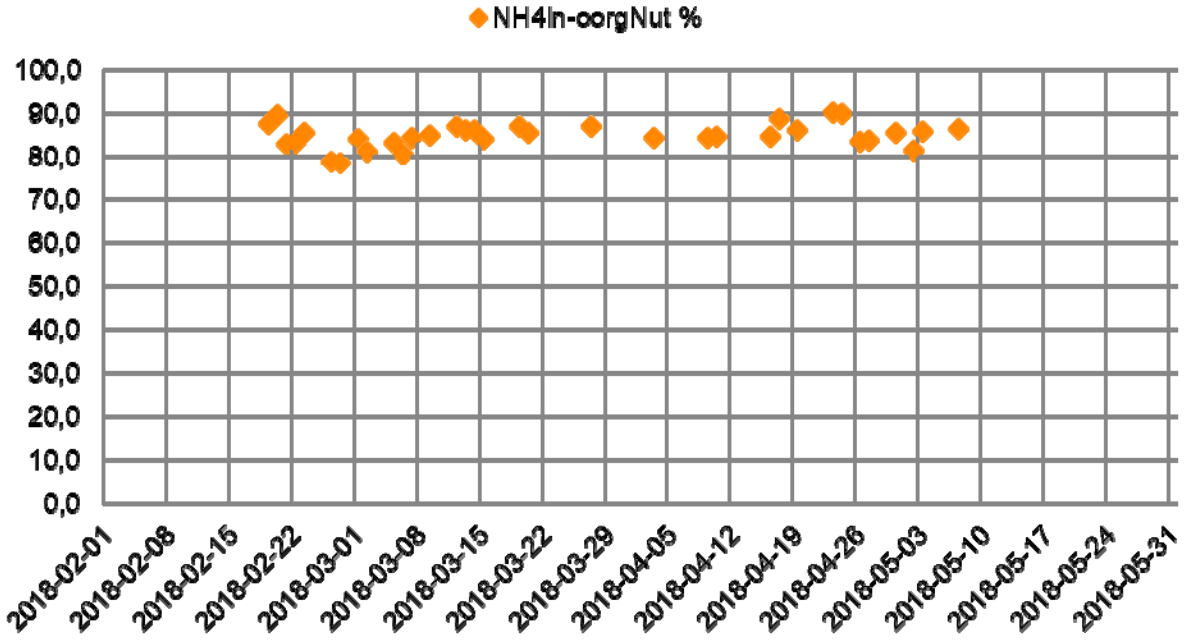
Resultat


R1 - Load/Reduction
NH4-N kg/d
NH4-Nred kg/d
kg N/d
400
350
300
250
200
150
100
50
0
350 kgN/d
210 kgN/d
v.8-v.15 Fyllnad av bärare
provdrift
2018-02-01
2018-02-08
2018-02-15
2018-02-22
2018-03-01
2018-03-08
2018-03-15
2018-03-22
2018-03-29
2018-04-05
2018-04-12
2018-04-19
2018-04-26
2018-05-03
2018-05-10
2018-05-17
2018-05-24
2018-05-31
2018-06-07
2018-06-14
2018-06-21
2018-06-28

R1 - Reduction



Summering av uppstart

- Uppstarten tog 3 månader
- Transporten av bärare tog 7 veckor
- Behov av renat avloppsvatten, aktivt slam, värmekälla
- Fortsatt god reduktion av oorg.N under 2018, 80-90%

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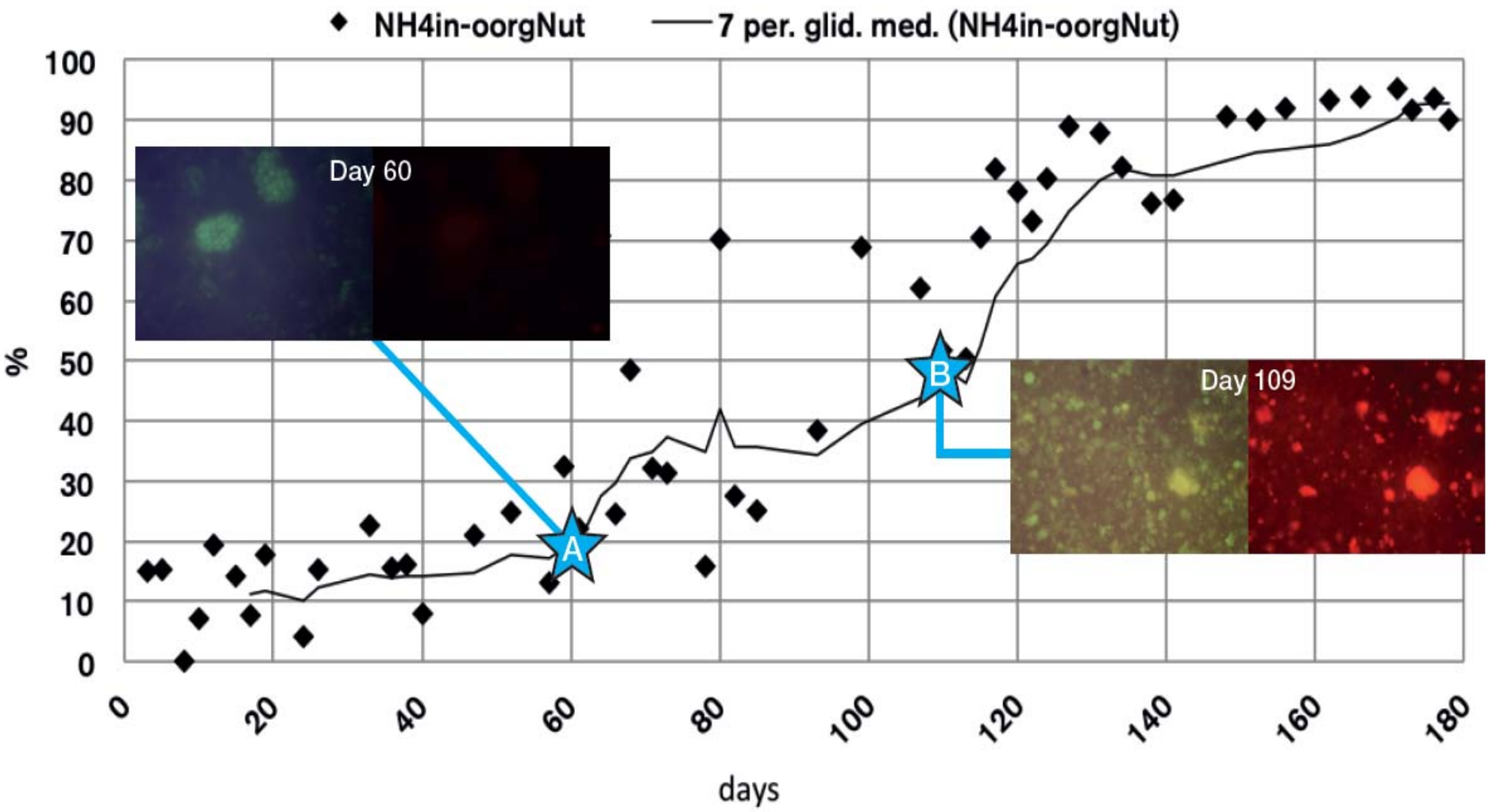
Uppstart Bekkelaget, Oslo



Uppstart utan ymp

RESULTS AND DISCUSSION

THREE MAIN ARGUMENTS WHY NEW ANAMMOX PLANTS DO NOT NEED TO BE SEEDED:

1. Several full-scale examples from the authors [1,4,8] and colleagues [7,13] provide proof of concept for non-seeded start-ups for reject water in MBBRs

2. Journal papers evaluating anammox doubling time [6,10,12,14] and advances in optimizing start-up conditions [2,11] for anammox bacteria

3. Our recent study [5] has found viable anammox bacteria in both activated sludge and reject water streams, independent of digestion mode or substrate pre-treatment

1996

Rosenwinkel & Cornelius 2005: "Deammonification in the moving bed process...." [9]

Beier & Focken 2006: " Evaluation of Carriers and Start-Up-Strategies in Pilot Scale..." [1]

Van den Graaf et al. 1996: "t_{AMX}=30d" [12]

Strous et al. 1998: "t_{AMX}=11d" [10]

2005

Hattingen Germany (6-9 months)

Park et al. 2010: "Impact of inocula..." [7]

Zekker et al. 2012: "Anammox enrichment on blank biofilm ..." [13]

Jaroszynski et al. 2012: "Impact of free ammonia..." [2]

2011

Himmerfjärden Sweden (7 months)

Plaza et al. 2011: " Swedish experience of the Deam. Process in a Biofilm System" [8]

2015

Bekkelaget Norway (4 months)

Kanders et al. 2016: " Rapid start-up ... without addition of external inoculum" [4]

Lotti et al. 2015: "Faster through training" "t_{AMX}=3d" [6]

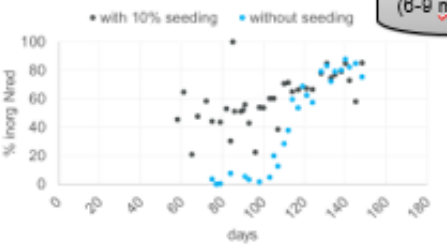
Zhang et al. 2017: "μ(AMX) revisited" "t_{AMX}=2-4d" [14]

Tomaszewski et al. 2017: "Influence of temperature and pH..." [11]

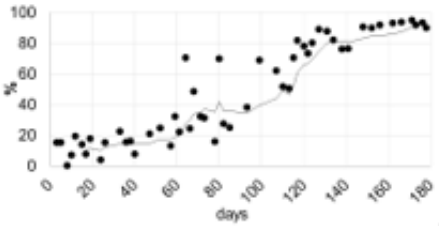
2018

Wang et al. 2015: "Anammox widespread but overlooked" [15]

Kanders et al. 2018: "Sinks and sources of AMX" [5]



Nitrogen reduction over time in two parallel operated laboratory reactors evaluating the necessity of seeding [3].



Nitrogen reduction over time at Bekkelaget reject water treatment during start-up.

Examples of carrier material suitable for biofilm growth

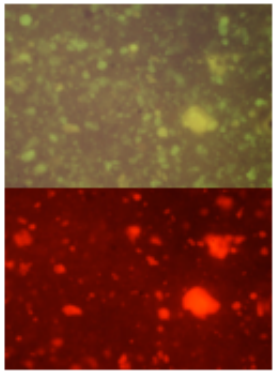
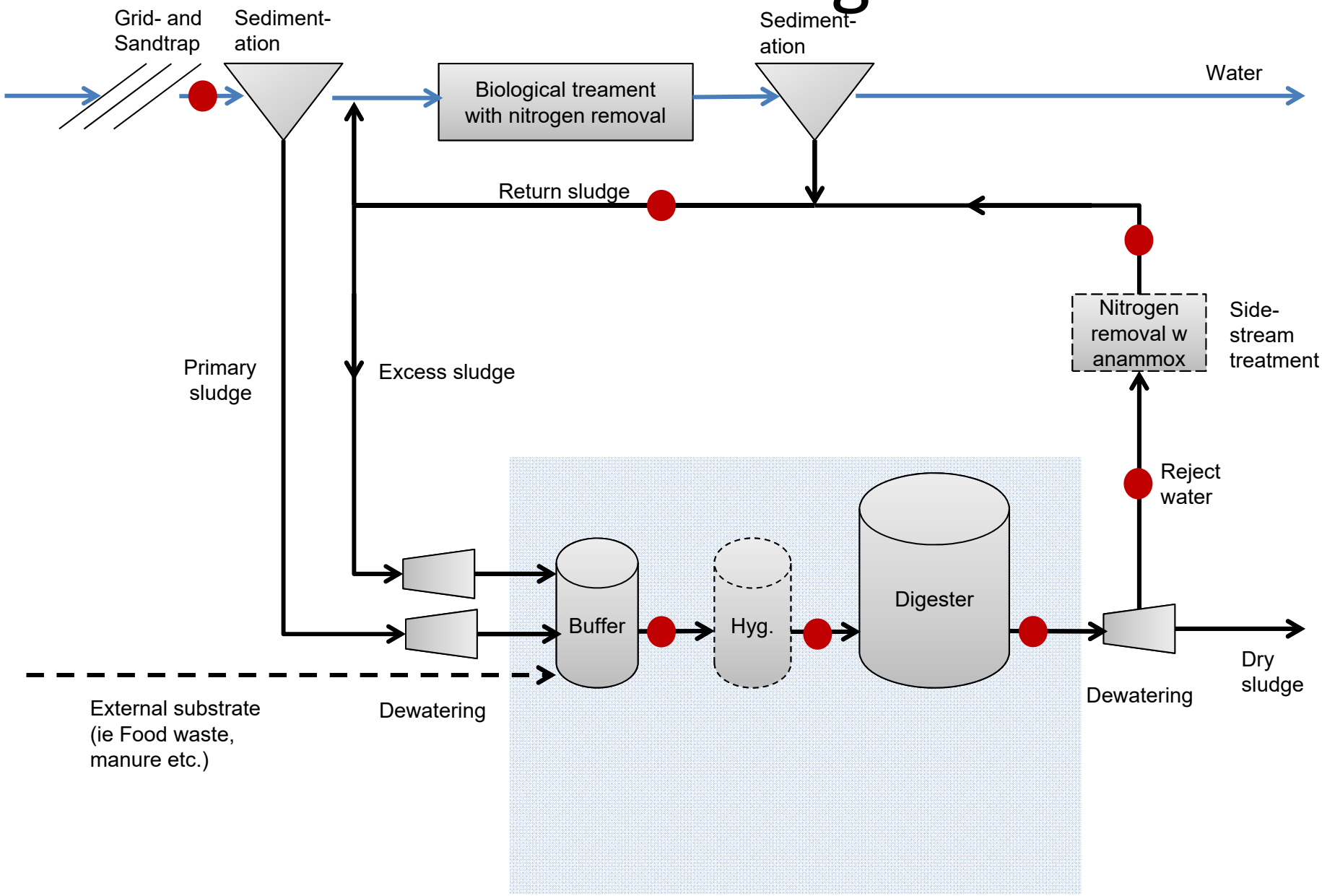


Image of FISH analyses, a useful tool during start-up
a) viable bacteria shine in green
b) anammox bacteria shine in red

Anammox i reningsverket




62
63
65
66
71
72
73

Anammox i reningsverket

- Sammanfattning

- Mesofila rötkammare med slam från biologisk kväverening *(BNR)* kan ses som en säker **källa** *(source)* till anammox
- Avvattning och hygienisering med termisk hydrolys kan ses en **sänka** *(sink)* för anammox

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Sinks and sources of anammox bacteria in a wastewater treatment plant – screening with qPCR

Linda Kanders, Maike Beier, Regina Nogueira and Emma Nehrenheim

ABSTRACT

The deammonification process, which includes nitritation and anammox bacteria, is an energy-efficient nitrogen removal process. Starting up an anammox process in a wastewater treatment plant (WWTP) is still widely believed to require external seeding of anammox bacteria. To demonstrate the principle of a non-seeded anammox start-up, anammox bacteria in potential sources must be quantified. In this study, seven digesters, their substrates and reject water were sampled and *quantitative* polymerase chain reaction (qPCR) was used to quantify both total and viable anammox bacteria. The results show that mesophilic digesters fed with nitrifying sludge (with high sludge ages) can be classified as a reliable source of anammox bacteria. Sludge hygienization and dewatering of digestate reduce the amount of anammox bacteria by one to two orders of magnitude and can be considered as a sink. The sampled reject waters contained on average $>4.0 \times 10^4$ copies mL^{-1} and

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Tack!