



Sludge liquor treatment at Rya WWTP

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Why should sludge liquor be treated separately at Gryaab?

- Increased nitrogen load due to increasing number of p.e.
- To meet today's discharge limits with a good margin.
- To cope with new, probably, more stringent discharge limits (new permit).
- Less need of aeration and lower methanol consumption.

Start now to learn how to run the process when there still is a big margin to the discharge limits.





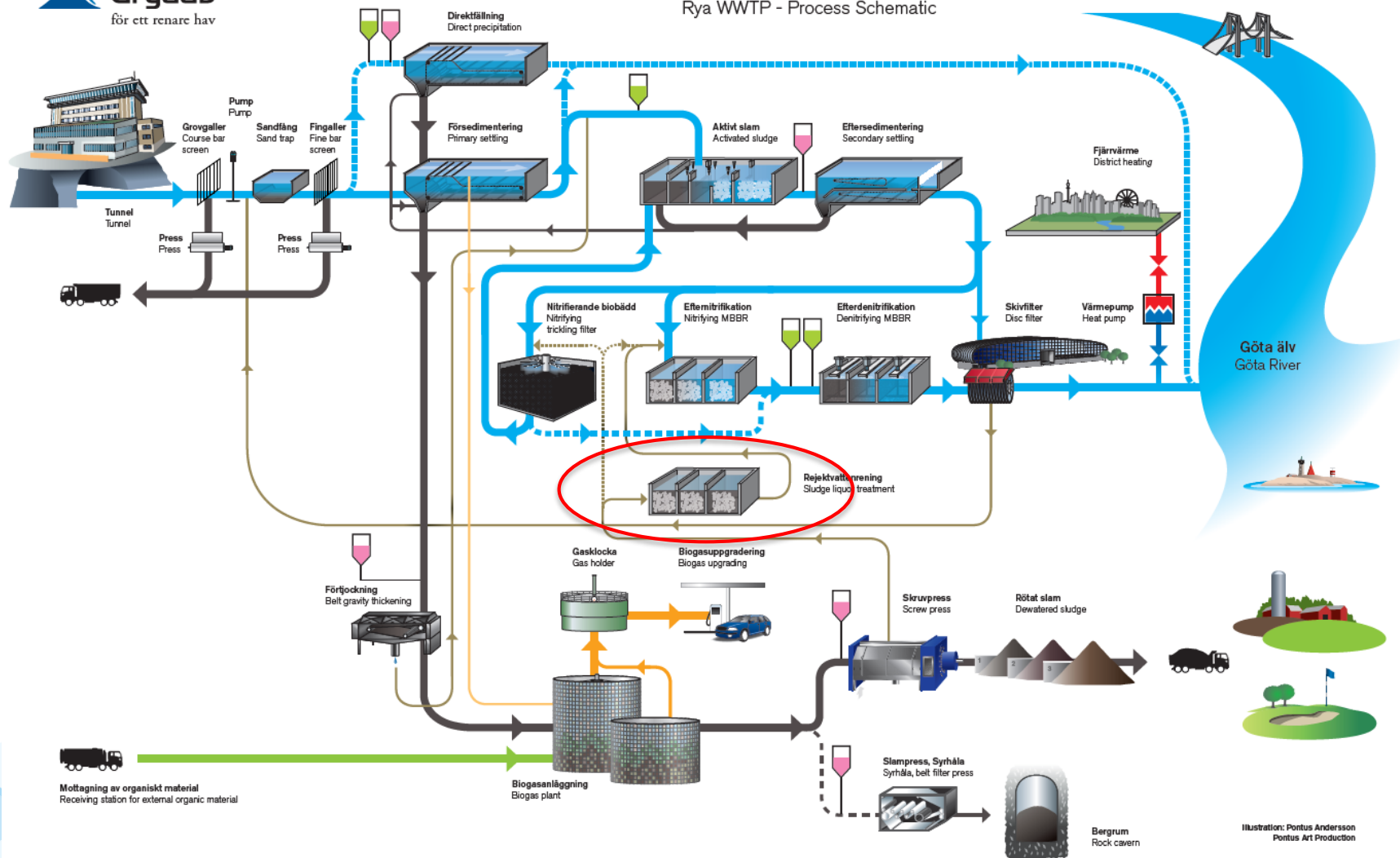
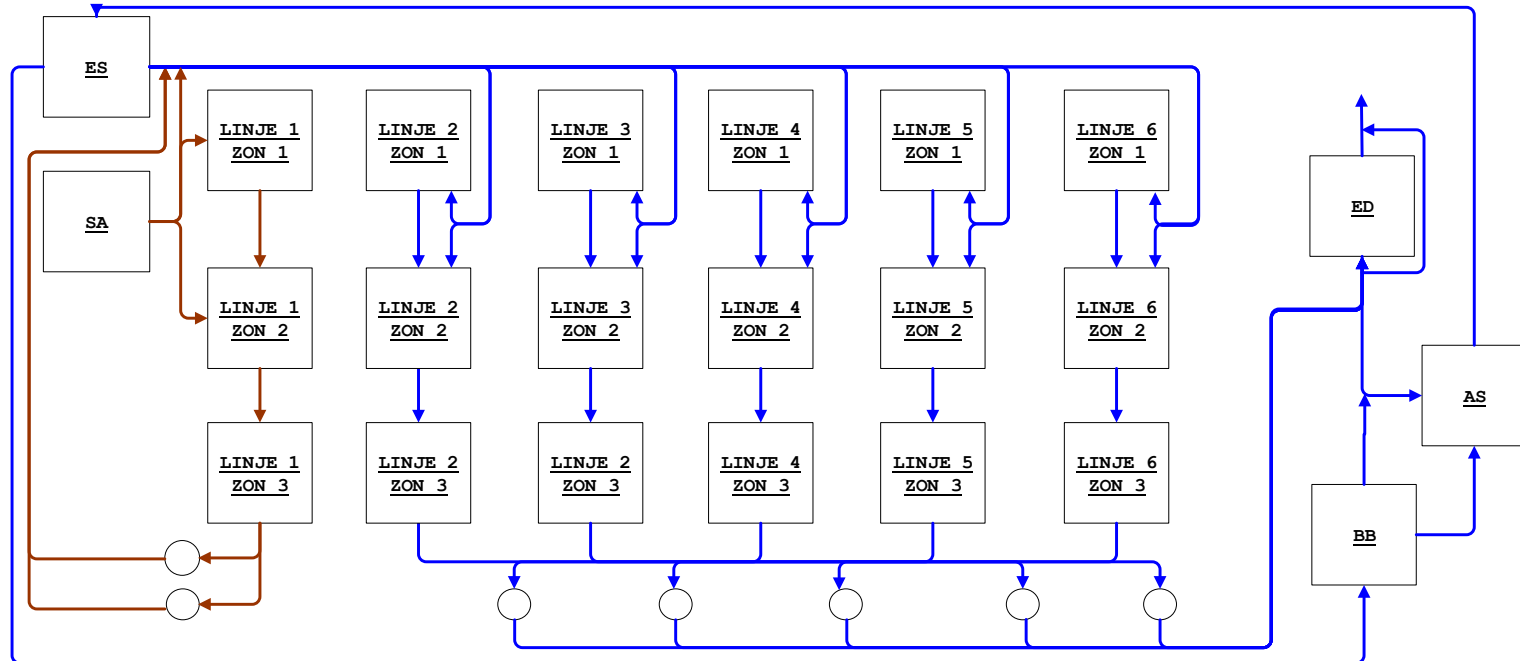


Illustration: Pontus Anderson
Pontus Art Production

Sludge liquor treatment and post nitrification



Reaktors:

Tank volume: 650 zone 1 + 650 zone 2 + 500 zone 3 = 1800 m³

Tank depth: 9,2 m

Air flow: Max 2500 zone 1 + 2500 zone 2 + 1800 zone 3
= 6800 Nm³/h

Medium bubble aeration (2-3 mm holes)

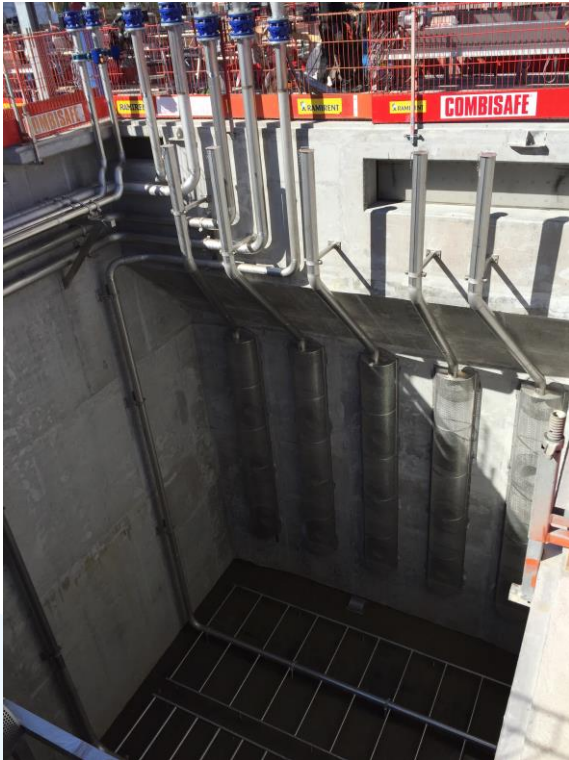
Air flow is controlled separately in each zone

Carriers : K5, 40% filling degree (surface 576 000 m²)



Aeration, inlet, outlet and mixers

Mixers in every zone. Sieves after each zone



Sludge liquor flow:
Max ca. 70-80 m³/h
(pump capacity
2*80 m₃/h)

Ammonia content:

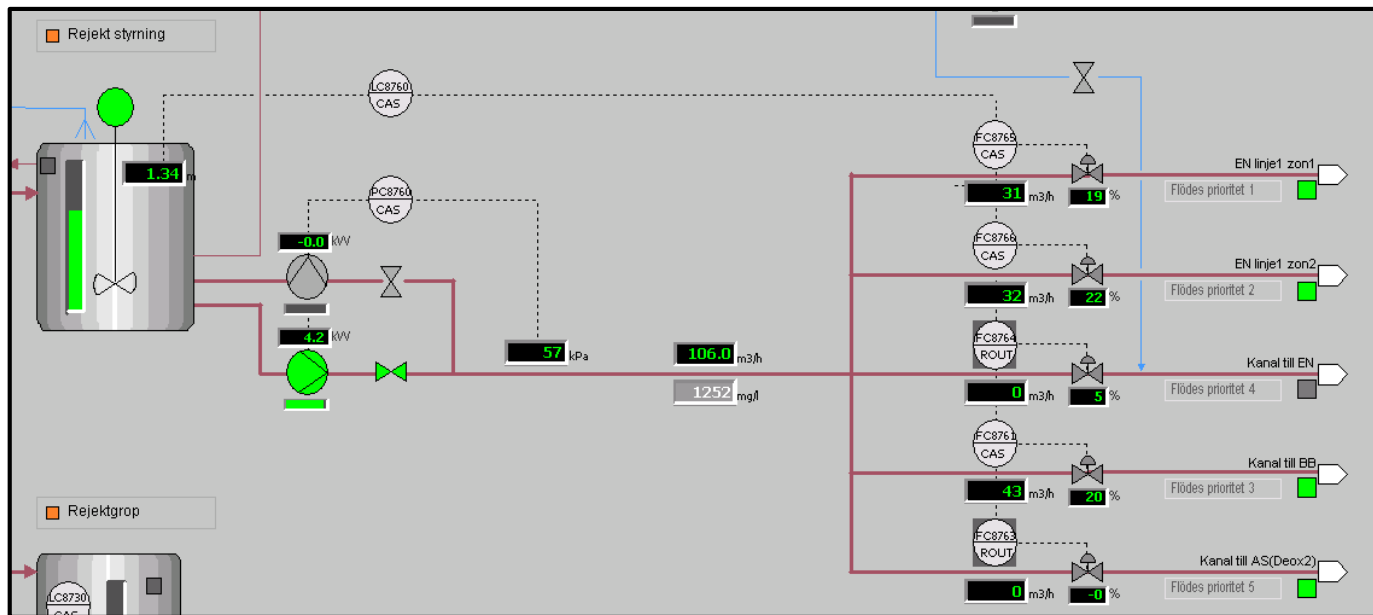
ca. 800-1400 mgNH₄-N/l

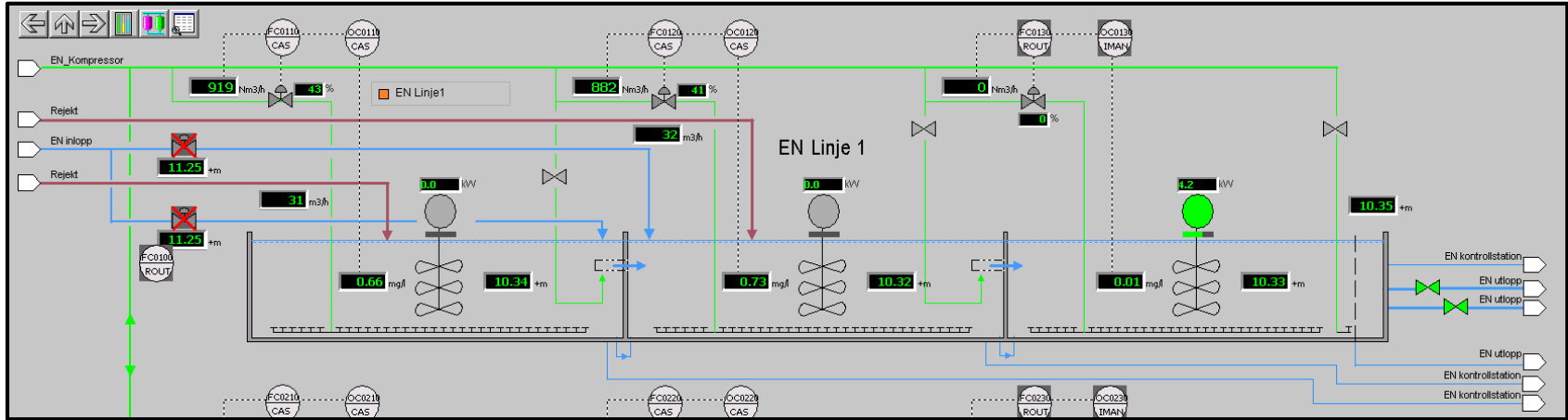
**Dimensioned
load:**

1800 kgNH₄-N/d,
1,0 kgNH₄-N/m³*d
2,5 gNH₄-N/ /m²*d

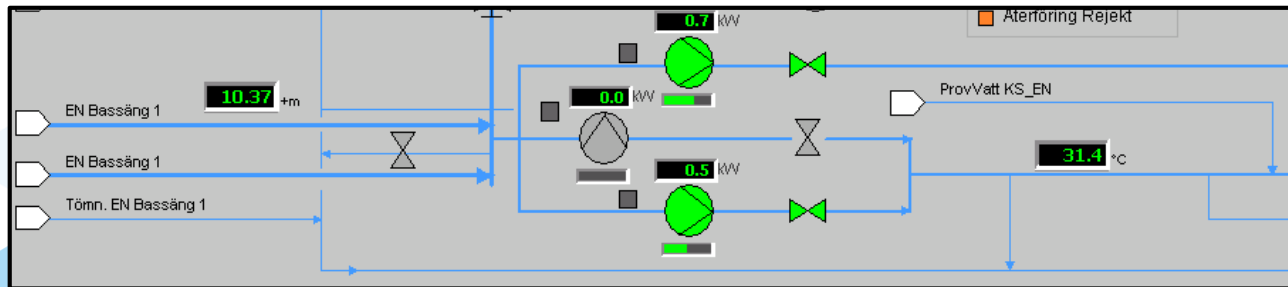
**Ammonium
reduction:
Over 85 %**

Control system





- Two outlet pumps dose treated sludge liquor to the inlet of the post nitrification tanks.
- Antifoaming pump recycle outgoing sludge liquor.



Control parameters

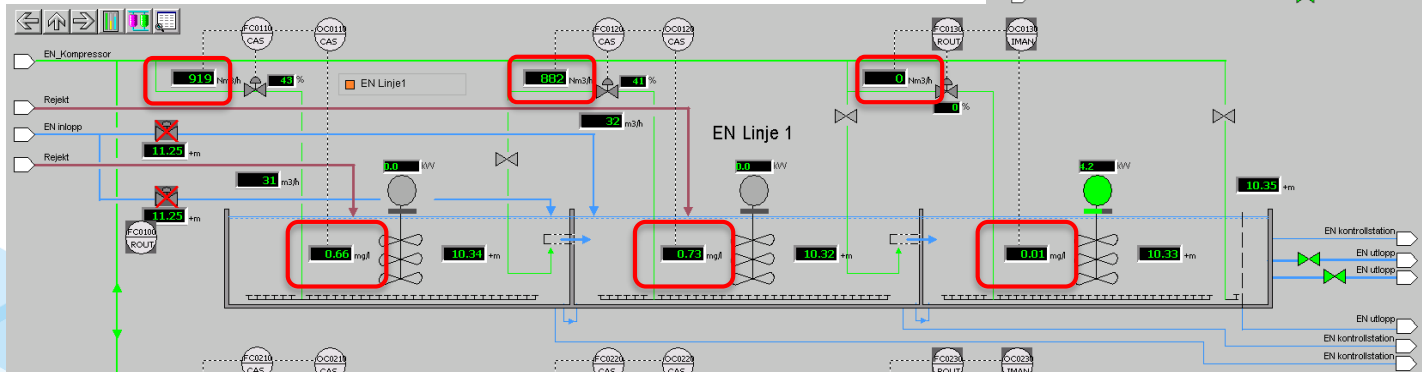
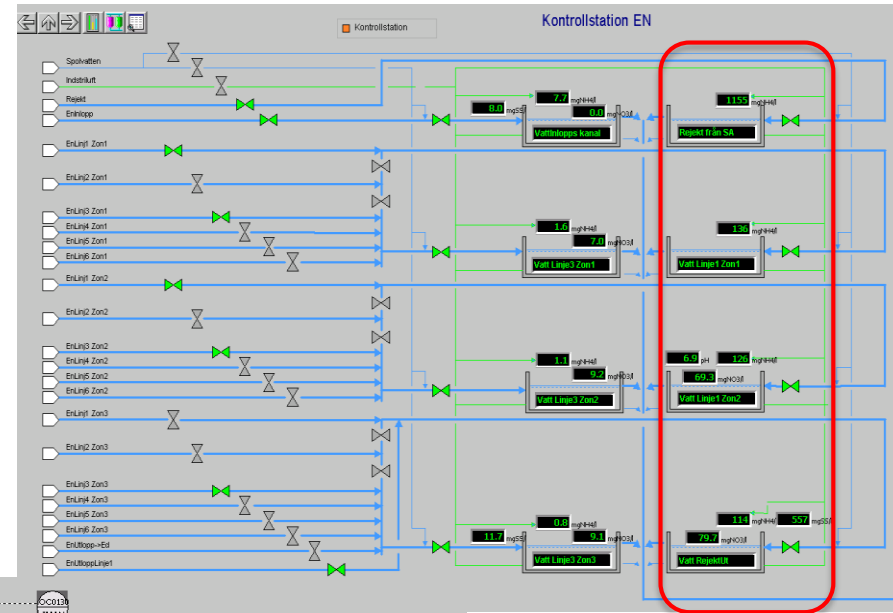
EN DRIFT		REJEKT DRIFT	
REJEKTVATTENRENING			
Önskat rejektflöde	Dosertid Minuter	Paustid Minuter	Önskat ammoniumhalt
Zon1 34 m ³ /h	60	0	Startgräns 125 mgNH ₄ /l
Zon2 27 m ³ /h	60	0	Stoppräns 175 mgNH ₄ /l
Zon1, 2		Zon3	
Syrehalt	Reglerval 0.50 mg/l	Syrehalt	Reglerval 0.00 mg/l
Kväveknot	<input checked="" type="checkbox"/> 9.00	Ammonium	<input type="checkbox"/> 0.00 mg/l
Syrehalt (mg/l)	Luftflöde zon1/2 (m ³ /h)	Syrehalt (mg/l)	Luftflöde (m ³ /h)
Max 0.80	Max 900 900	Max 0.70	Max 400
Min 0.00	Min 0 0	Min 0.00	Min 0

Controlled by the nitrogen quotient

Formed nitrate = max 11 %
Reduced ammonia

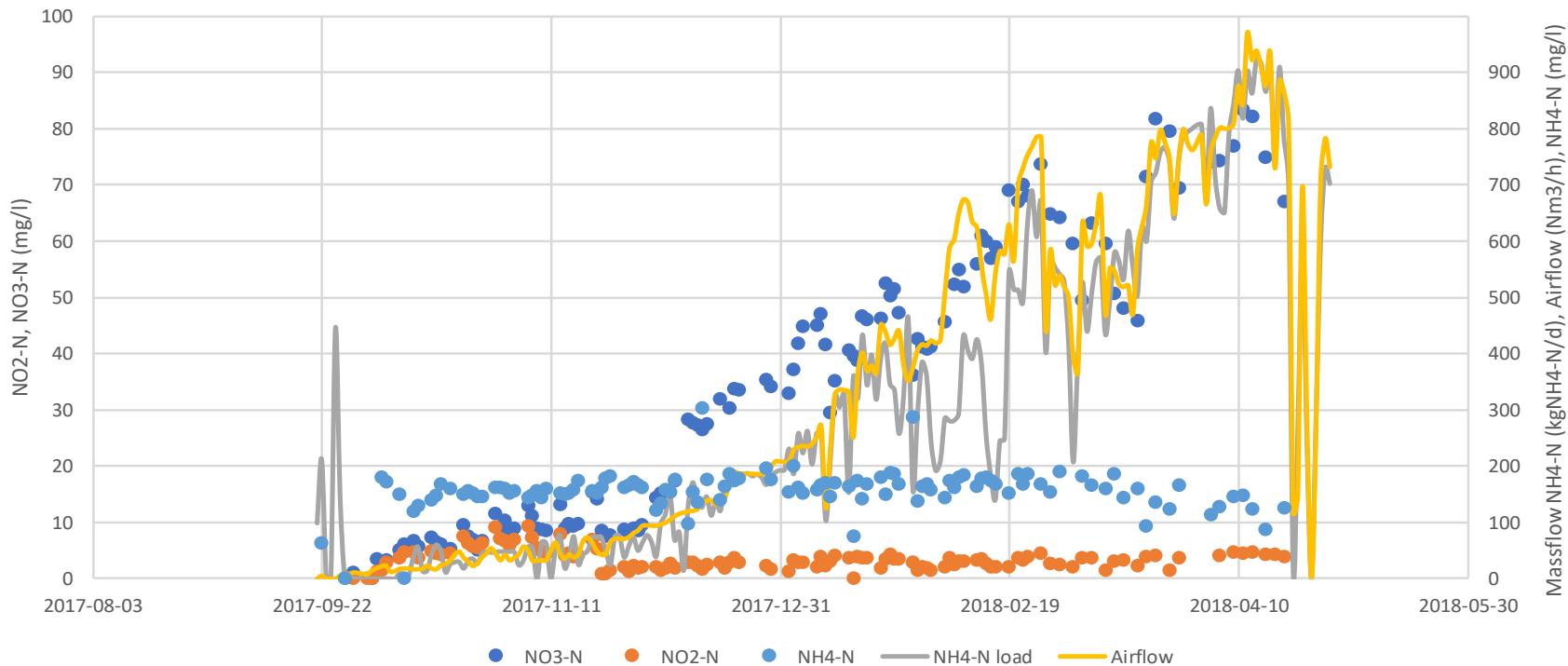
Online measurements:

- pH in zone 2 (1 pcs)
- DO in zone 1, 2 & 3 (3 pcs)
- Airflow zone 1, 2 & 3 (3 pcs)
- NH4 in influent, zone 1, 2 & 3 (4 pcs)
- NO3 in zone 2 & 3 (2 pcs)
- SS in zone 3 (1 pcs)
- Temp. in zone 3 (1 pcs)



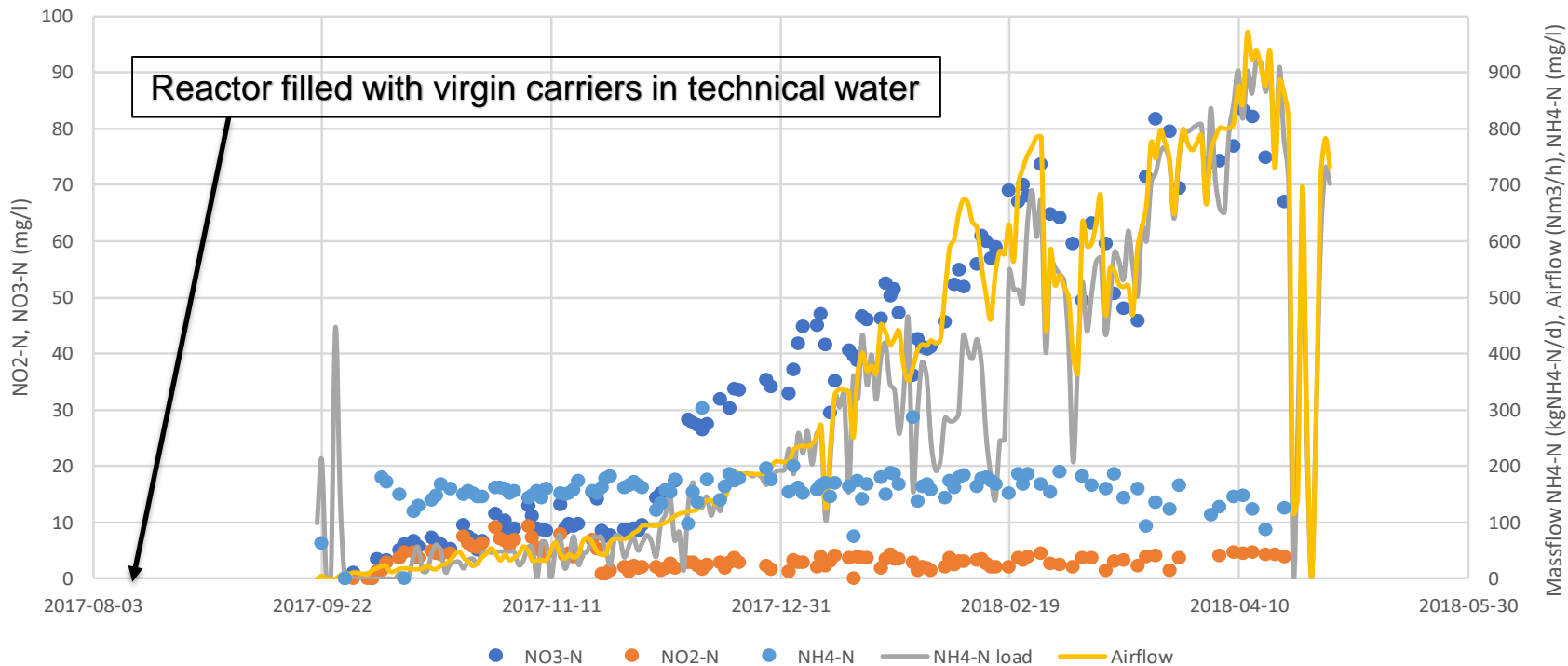
2017-08-08	The reactors are filled with virgin carriers in water and mixing with aeration for about 5 days.
2017-09-21	Start pumping sludge liquor to the reactor to about 500 mgNH ₄ -N/l.
2017-09-30	Heat the reactors with hot water to about 28 °C. This also dilutes the ammonia level to about 160 mgNH ₄ -N/l.
2017-09-30	Starts careful intermittent aeration.
2017-10-03	Addition of seeded carriers.
2017-10-04	Increases the intermittent aeration carefully with operation support of Veolia/AnoxKaldnes.
2017-12-07	Enough biofilm to be able to start the mixers in zone 1 and zone 2
2018-02-12	Continuous aeration.
2018-02-14	Start to control the process on the nitrate produced / ammonia reduced quota (11%)
2018-03-19	Foam problems
2018-04-04	Reached maximum load (1800 kgNH ₄ -N/d)

Sludge liquor treatment, zone 1

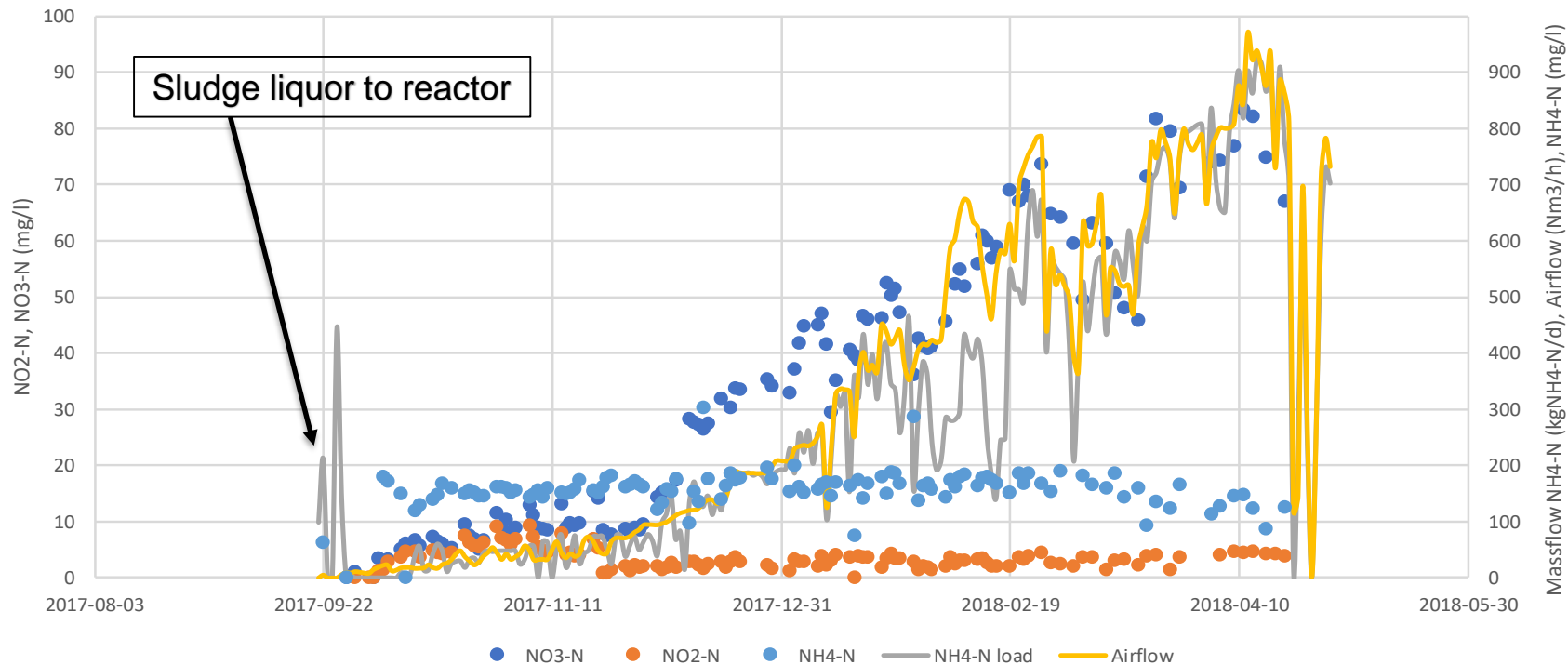


Results

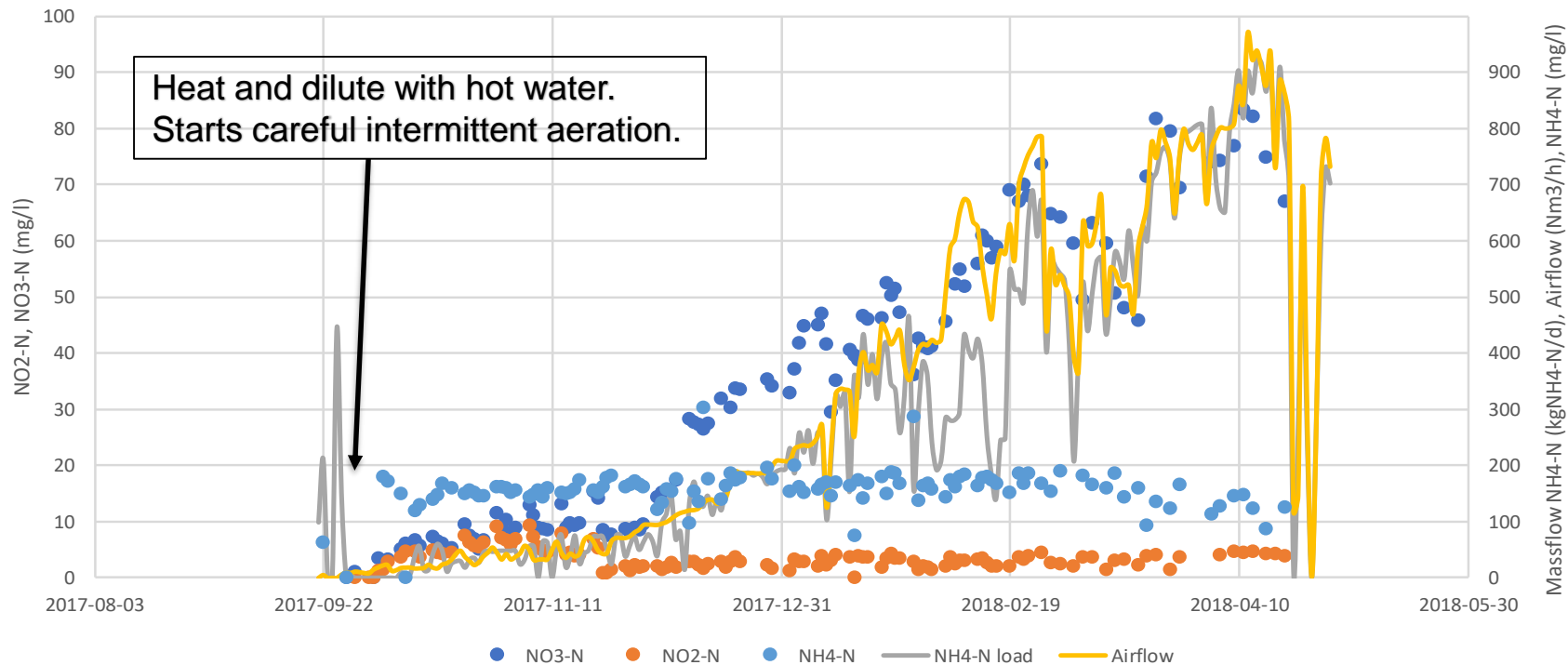
Sludge liquor treatment, zone 1



Sludge liquor treatment, zone 1

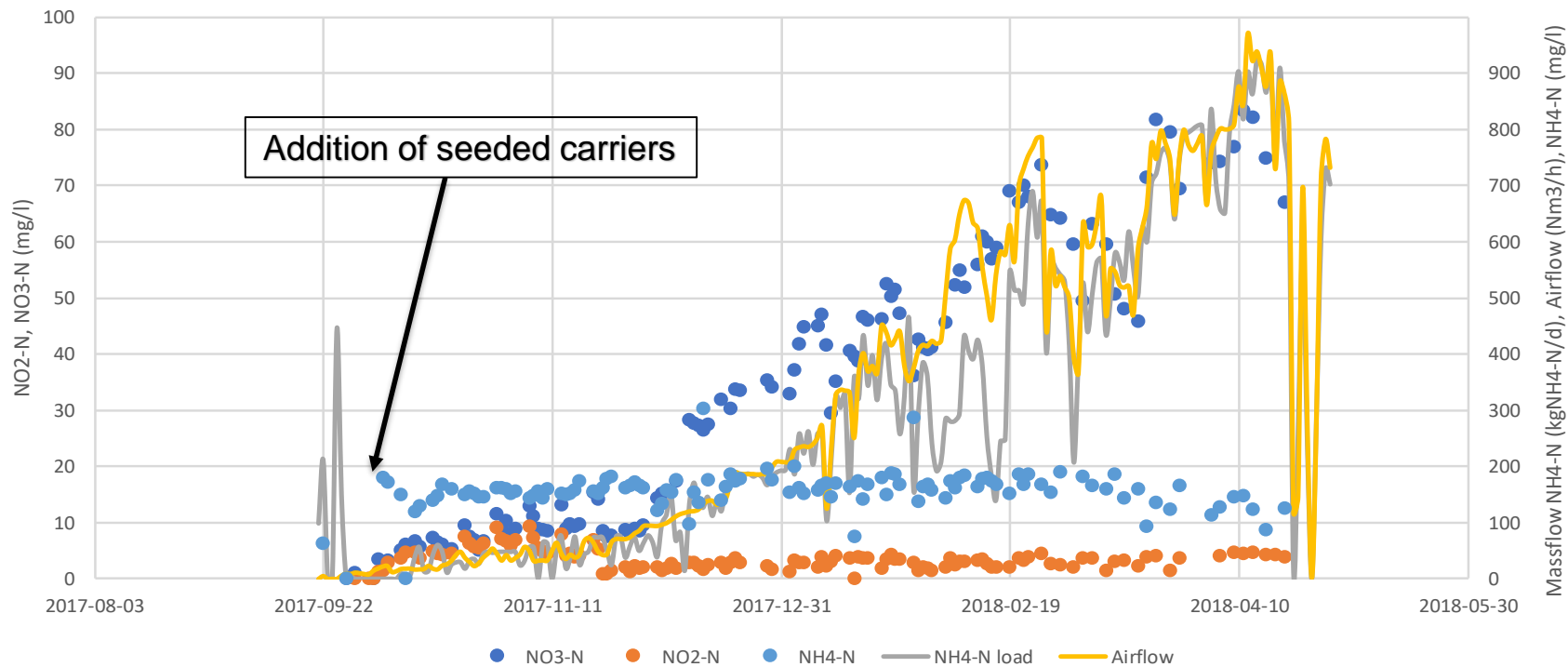


Sludge liquor treatment, zone 1



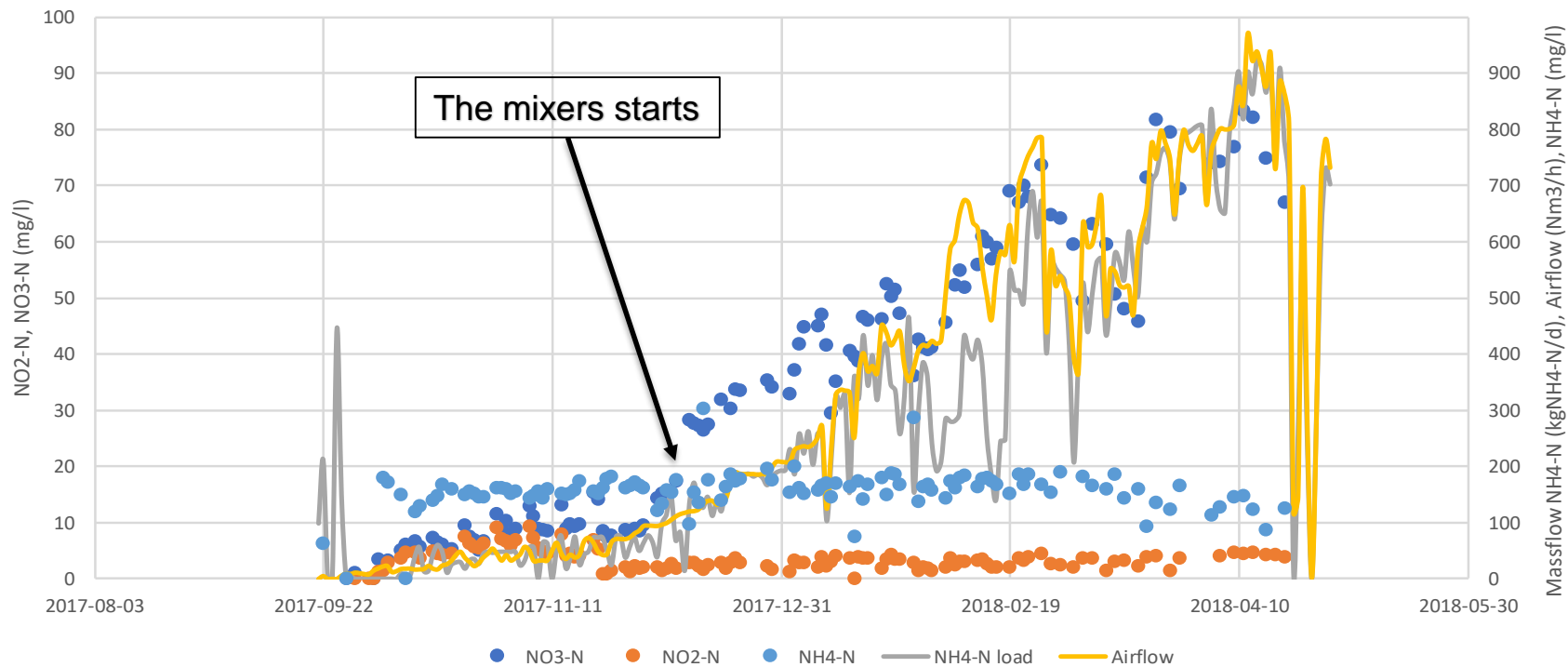
Results

Sludge liquor treatment, zone 1



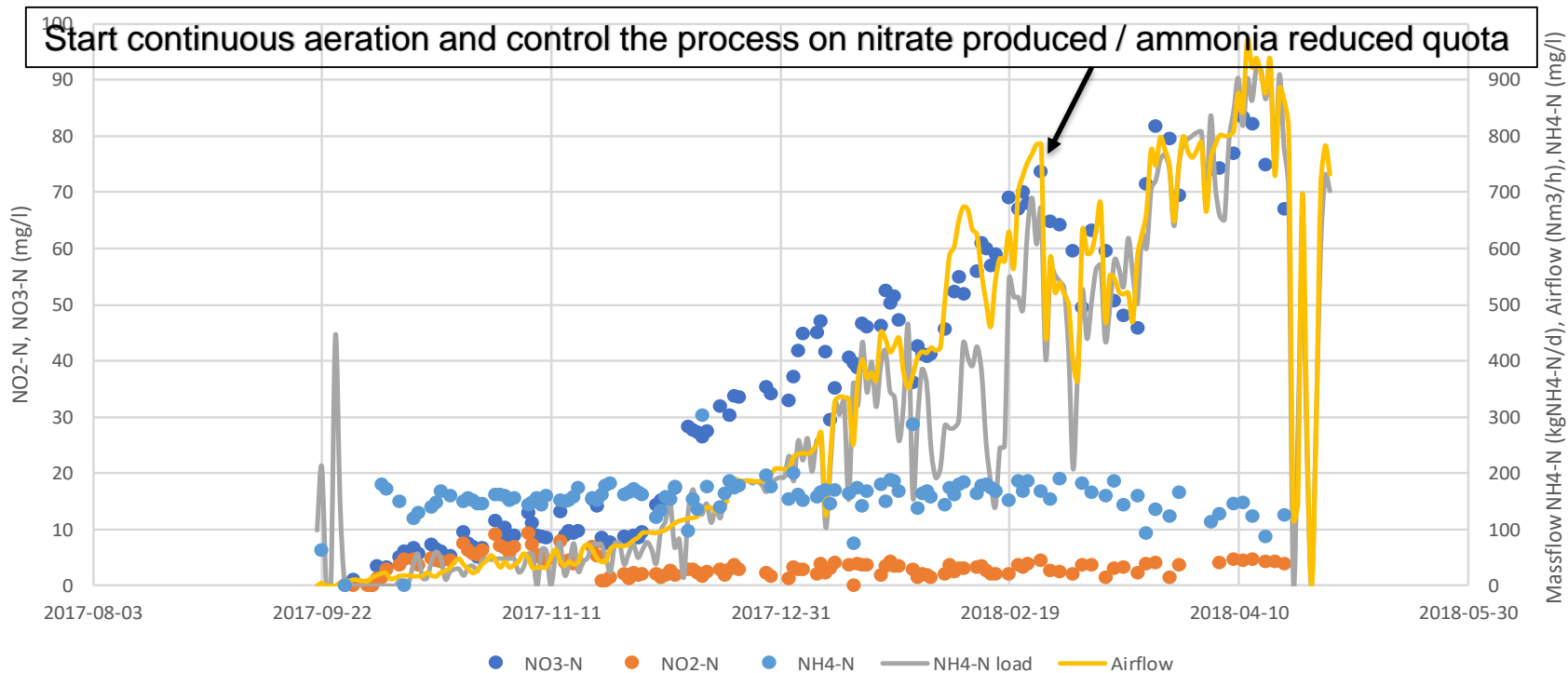
Results

Sludge liquor treatment, zone 1



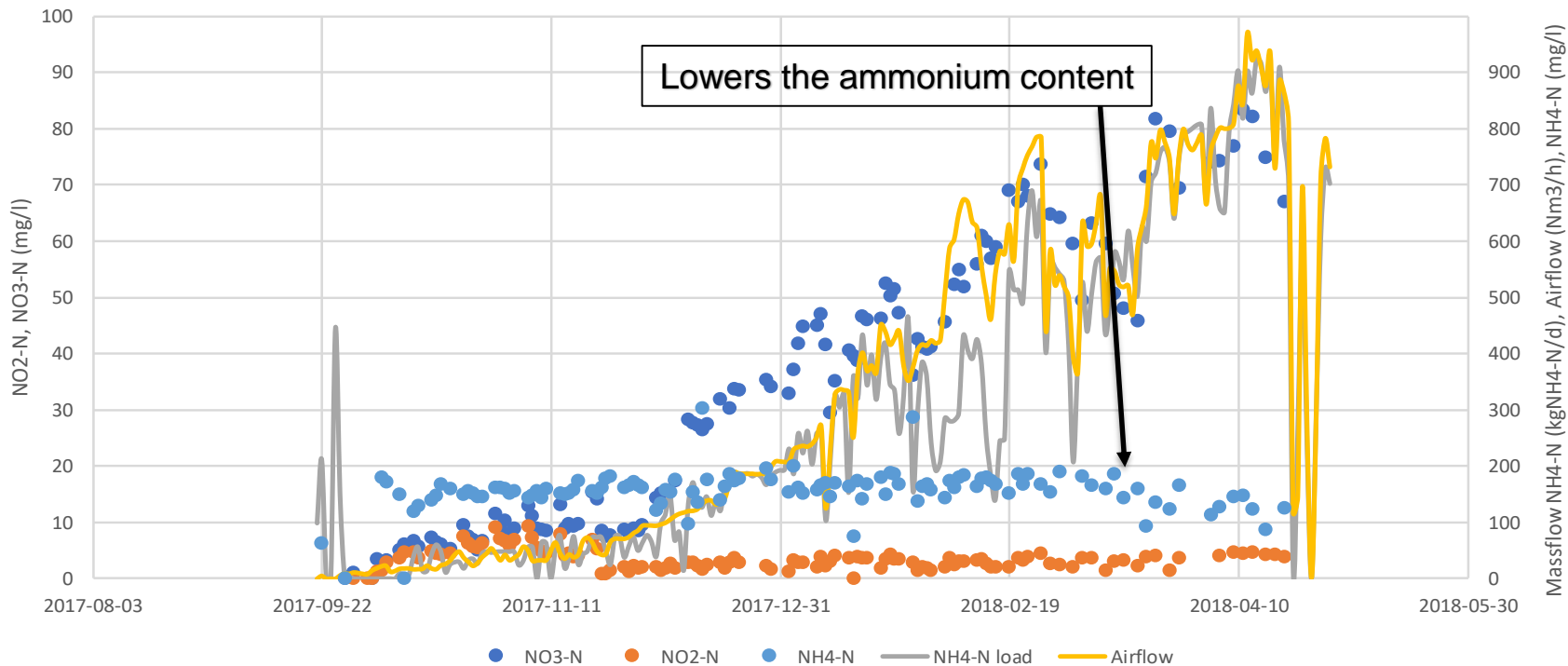
Results

Sludge liquor treatment, zone 1



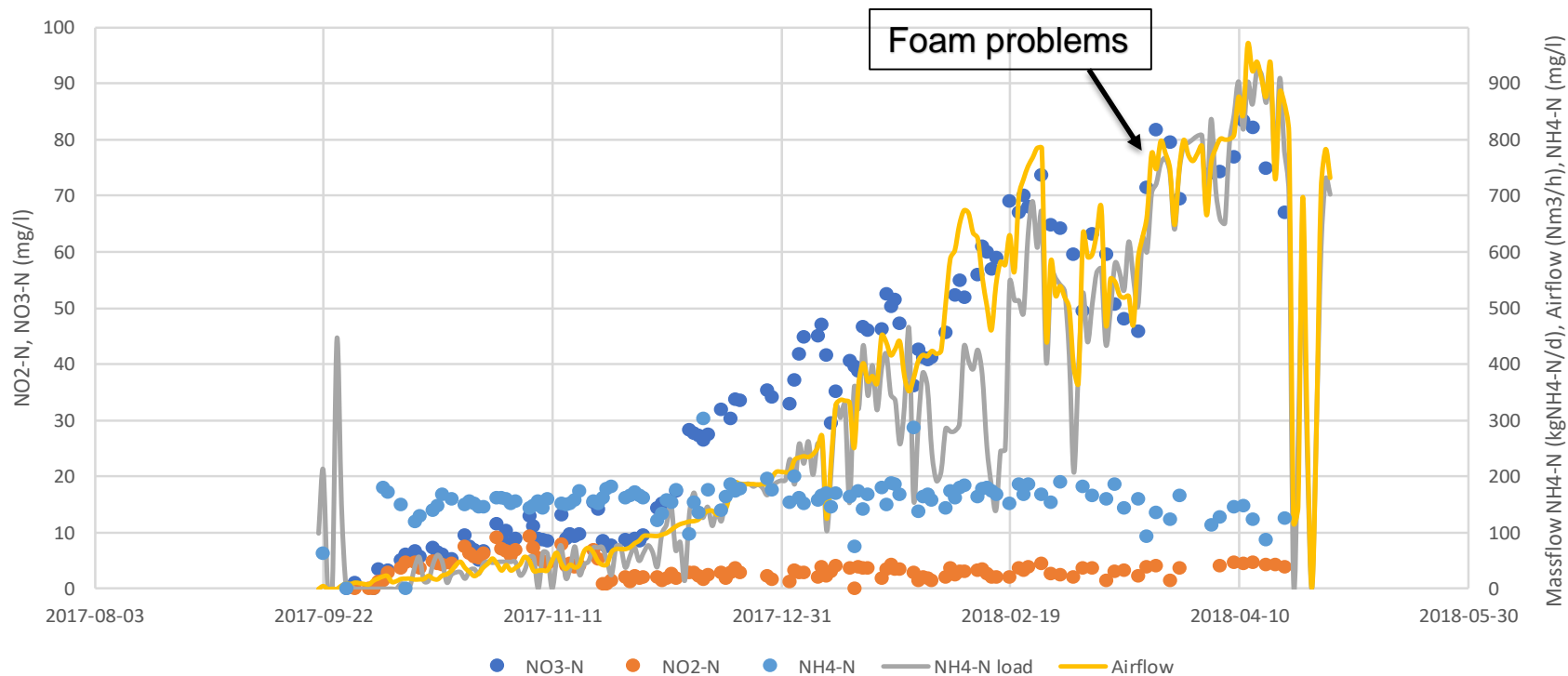
Results

Sludge liquor treatment, zone 1



Results

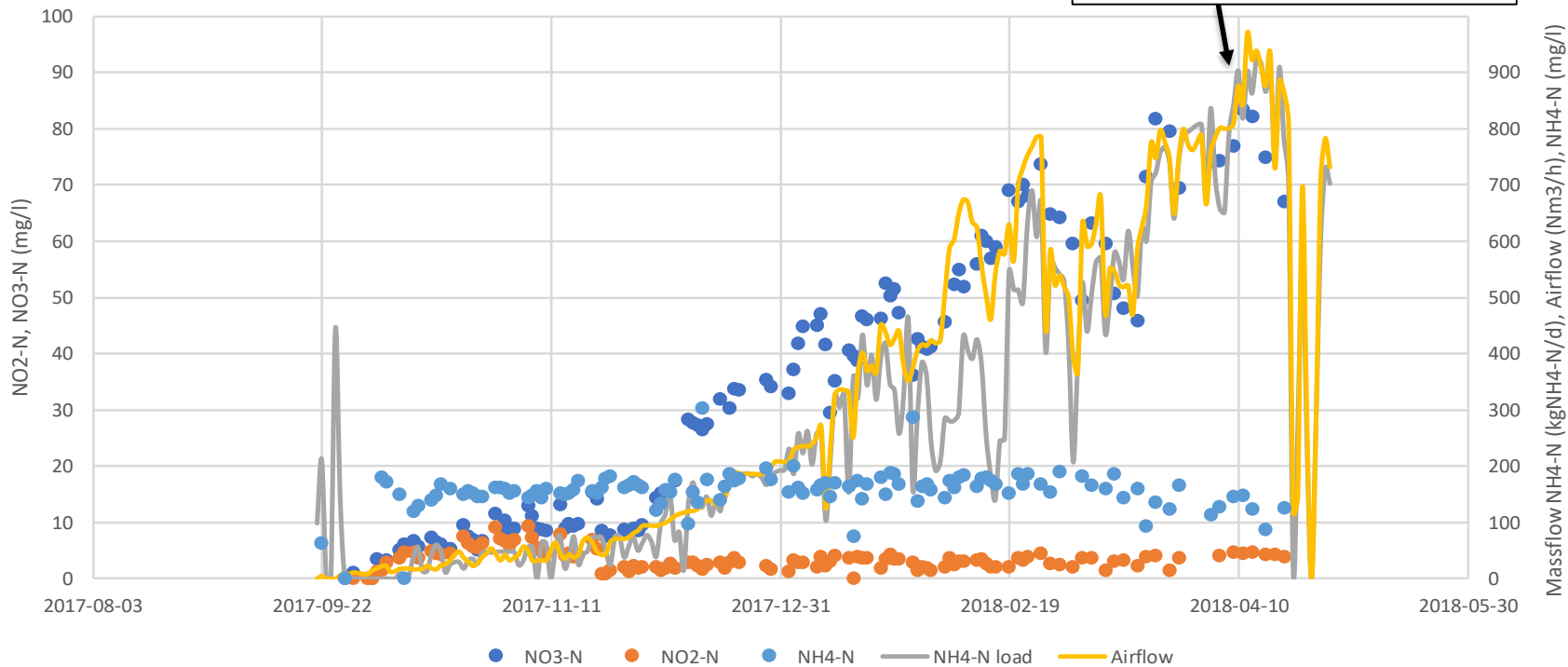
Sludge liquor treatment, zone 1



Results

Sludge liquor treatment, zone 1

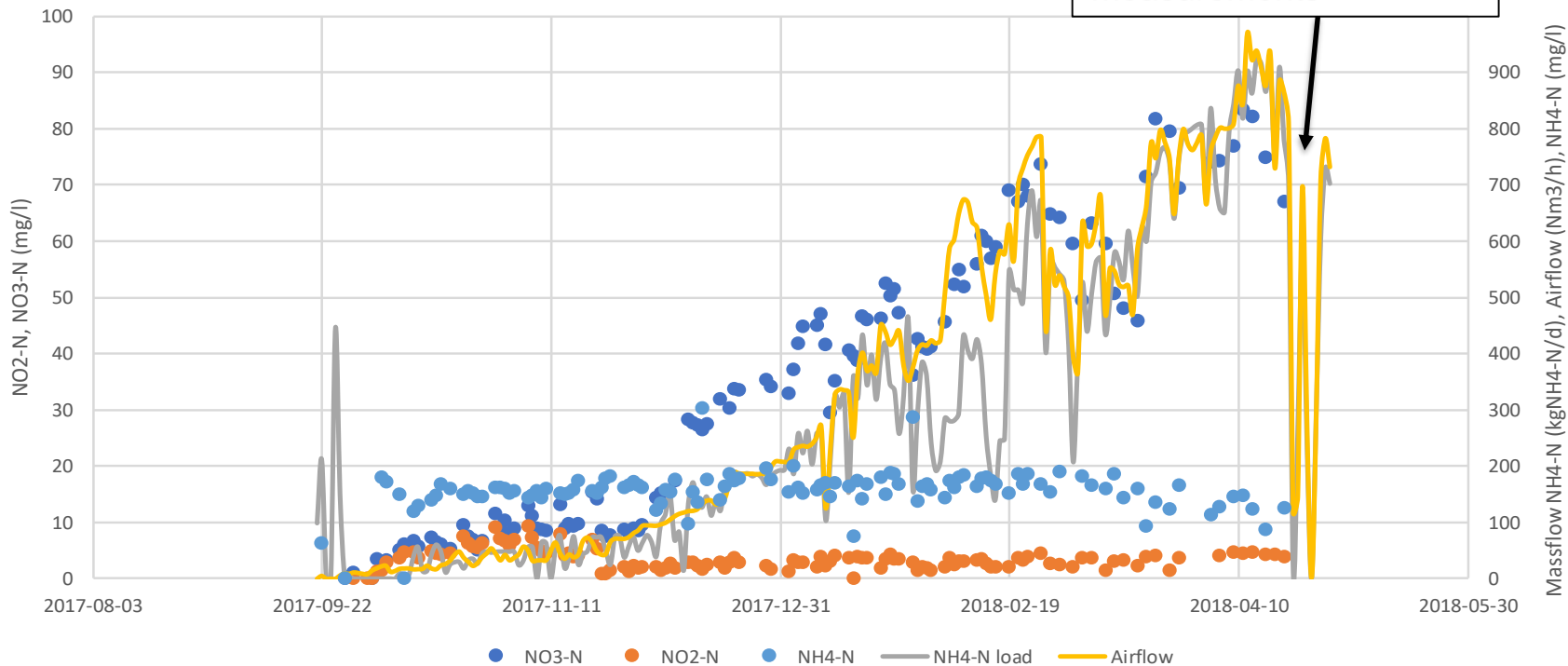
Reached maximum load?



Results

Sludge liquor treatment, zone 1

Planned stop of online measurements



Sludge liquor treatment

april 2018

	Ammonium load, kg/d		Ammonium concentration		Nitrate, kg/d		Nitrate concentration		Air flow		Dissolved oxygen		Nitrogen removed		Nitrate produced / removed ammonium		pH
Inlet	1150	kgNH4/d	1044	mg/l													
Zone 1	681	kgNH4/d	124	mg/l					709	Nm3/h	0,64	mg/l	953	kgN/d	5,9	%	7,0
Zone 2	644	kgNH4/d	112	mg/l			56	mg/l	620	Nm3/h	0,66	mg/l					
Zone 3	131	kgNH4/d	109	mg/l			63	mg/l	1	Nm3/h	0,09	mg/l					
In outlet	124	kgNH4/d			74	kgNO3/d											

Energy consumption		Energy consumption per nitrogen removed		Energy consumption per ammonium removed		Total treated sludge liquor flow		Treated sludge liquor		Nitrogen removed		Ammonium removed	
1189	kWh/d	1,2	kWh/kgN	1,2	kWh/kgNH4-N	45	m3/h	74	%	83	%	89	%

Problems during start-up

- Problems with low temperature in the beginning due to a low feed of sludge liquor.
 - Technical water is used for heating
- Parallell on-going project to switch from centrifuges to screw presses.
 - Breaks in sludge liquor feed.
 - Sometimes high levels of SS in the sludge liquor
 - * Clogging of pipes to instruments
 - * High levels of SS in the tanks
- Foaming
 - Clogging in the spray water system
 - Spray water doesn't give enough anti-foaming effect.
- Problems with level measurements.
 - Measurements with radar: due to foaming and coated with SS.
 - Measurements using pressure: due to gas/air in pipes before the meter.
- Moving of the lab to a new building at the same time as the start-up limits the number of samples that can be taken.

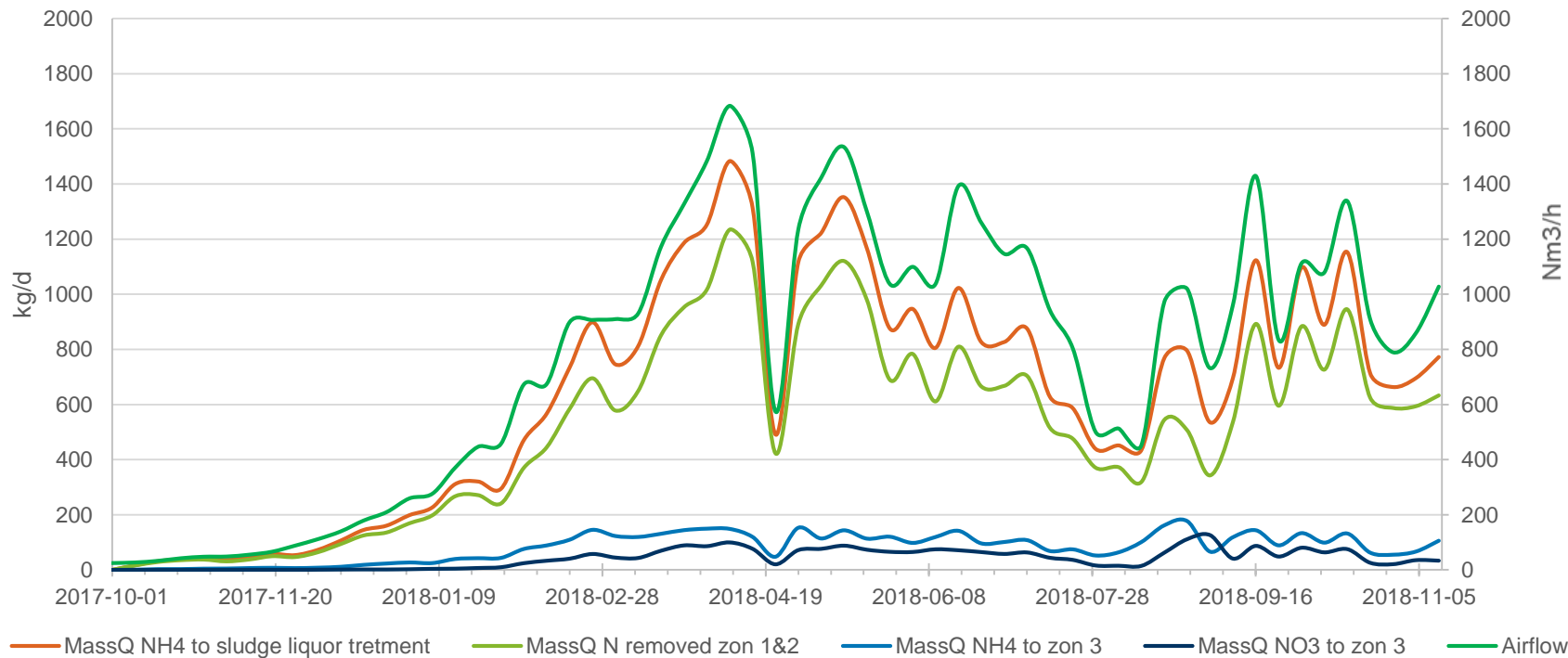


Design and load parameters

	Nitrogen load (kg/d)	Tank volume (m ³)	Fill rate of carrier (%)	Nitrogen load (kg/m ³ *d)	Nitrogen load (g/m ² *d)	
1 line zone 1, 2 and 3	Ca 1800	1800	50	1,00	2,50	Design 3 zones
1 line zone 1 and 2	Ca 1800	1300	40	1,38	4,33	Max start-up
1 line zone 1 and 2	Ca 1300	1300	40	1,00	3,13	Design 2 zones, Alt1
1 line zone 1 and 2	Ca 1040	1300	40	0,80	2,50	Design 2 zones, Alt2

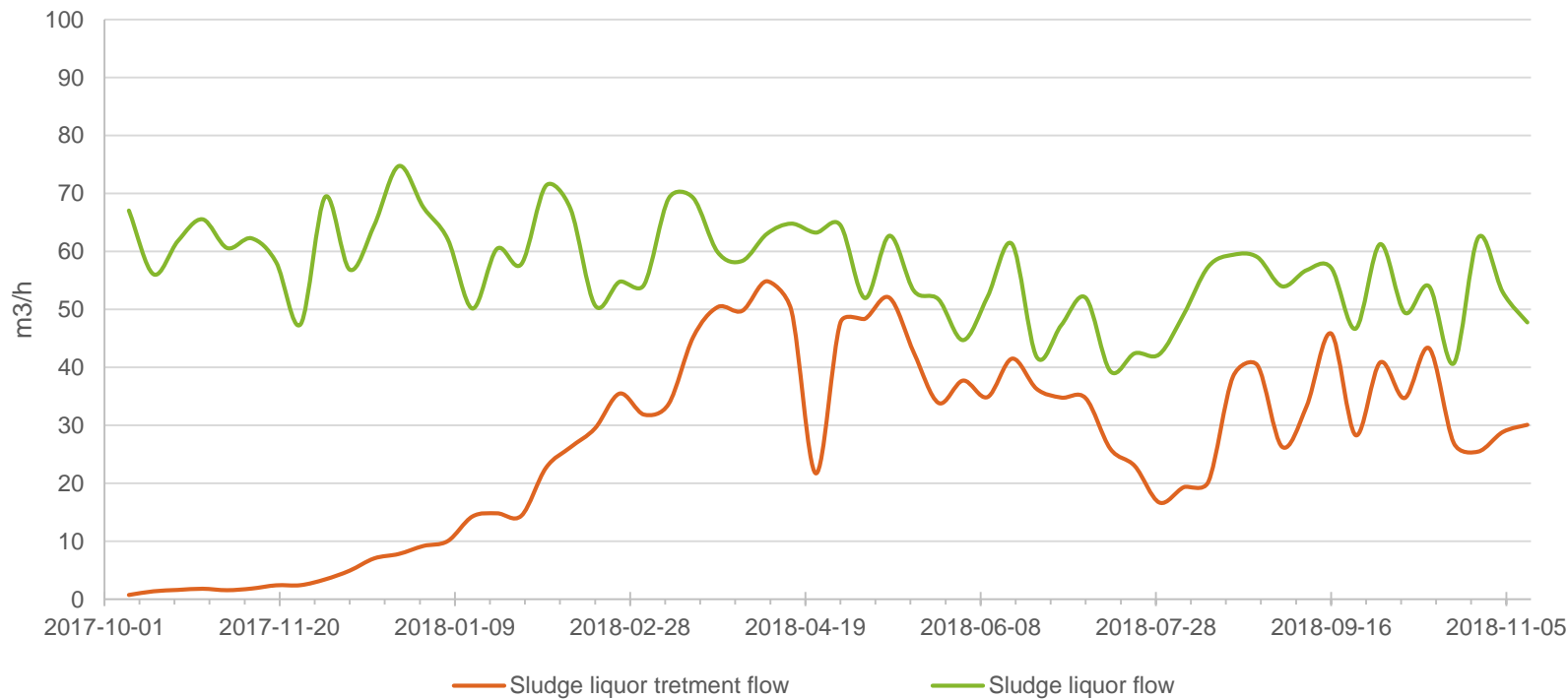
Results

Sludg liquor tretment



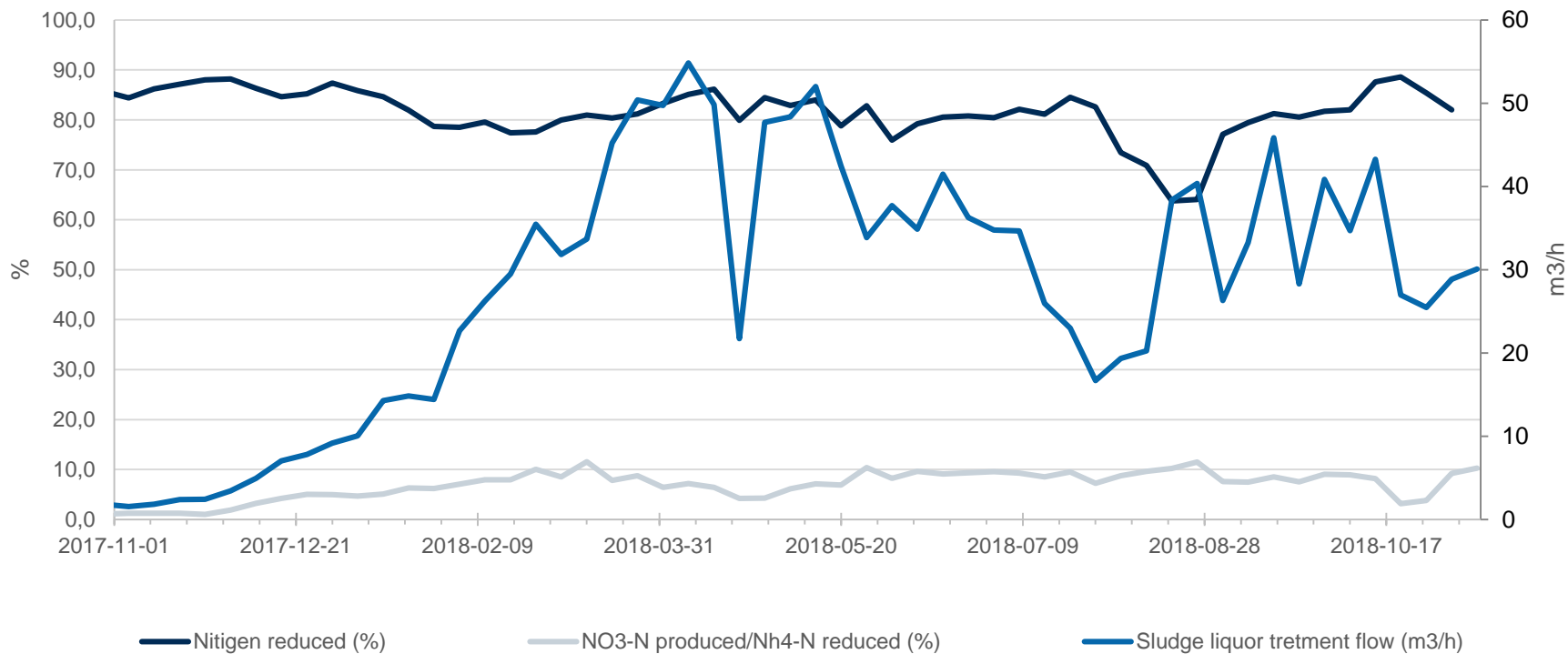
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Sludg liquor tretment



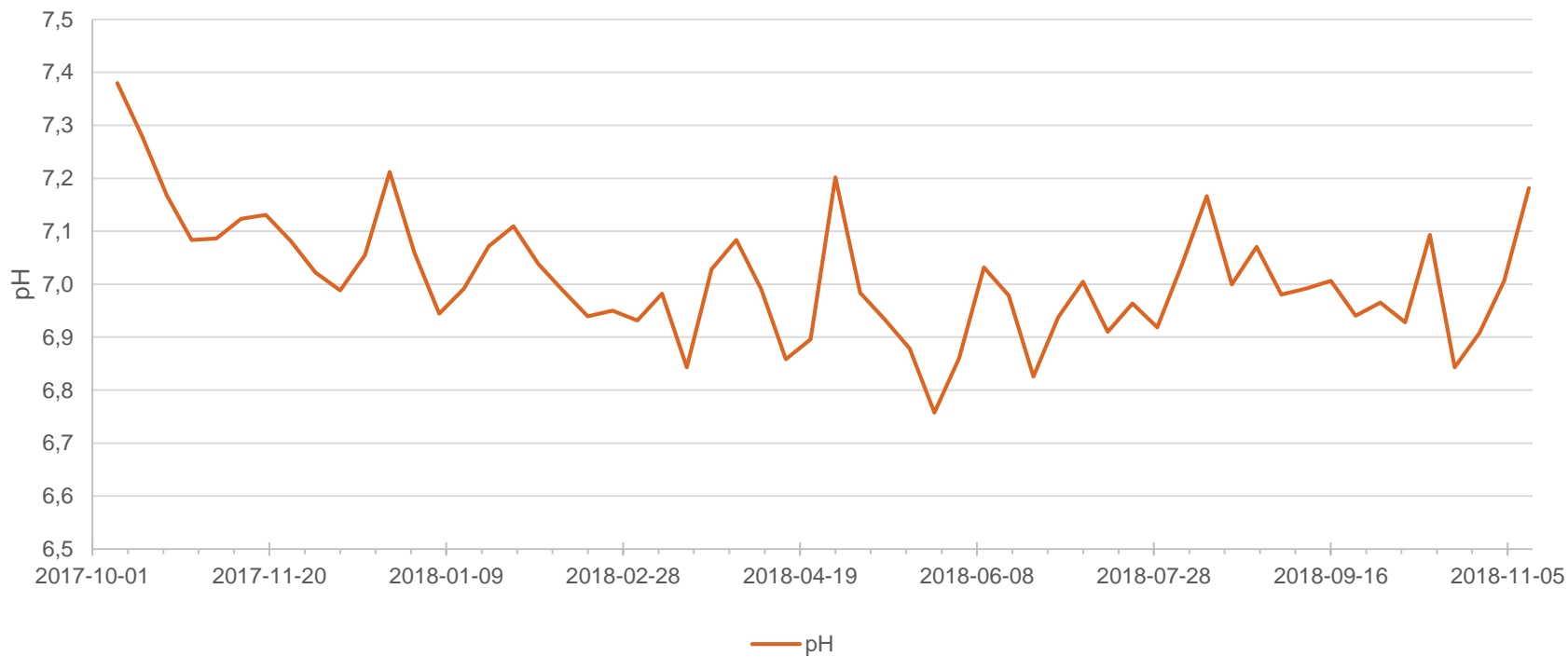
Results

Sludg liquor tretment



Results

Sludg liquor tretment



Problems after start-up

- Breaks in sludge liquor feed.
- Sometimes high levels of SS in the sludge liquor
 - * Clogging of pipes to instruments
 - * High levels of SS in the tanks
- Problems with DO measurements in zon 1.



Conclusions

The sludge liquor treatment is able to treat the dimensioned load.

Robust function of the process.

Foam problems occur at high loads at startup.

The instrumentation has worked as expected, except for level measurements and DO measurements in zon 1.

The mixers is only required at low airflow to achieve sufficient mixing.

The nitrate concentrations have been lower than 11% of reduced ammonium.



Questions?

