

# Supersaturation of gasses in RAS systems

N<sub>2</sub>, O<sub>2</sub>, CO<sub>2</sub>

NMBU: 2<sup>nd</sup> Nordic Workshop 2018

Dr.med.vet Thomas Clausen

# RAS

Re-use of water.

Accumulation of waste and toxins

High fish density and small water exchange

Necessary to add oxygen

# Water

Groundwater

Drainage water

Sea water (salt)

Be aware of:

Temperature

O<sub>2</sub>

CO<sub>2</sub>

Nitrogen N<sub>2</sub>

Iron

Water amount L/sec

pH



# Why is N<sub>2</sub> dangerous to fish?

- N<sub>2</sub> diffuses faster over the gills than O<sub>2</sub>.  
Supersaturation due to accumulation.
- Emboli = air bubbles in the blood.
- Bleeding in the gills
- Bad feed conversion, stress, and raised mortality.
- Secondary infections.

# Bleedings due to N<sub>2</sub>





# Nephrocalcinosis (CO2)



# Treating of freshwater

Do nothing

Aeration by airlift

Trickling filter

Low pressure diffuser



# Groundwater degassing





# Groundwater degassing





# Treatment of "used" water:

Airlift, 2-4meter

Bio-filter, with or without air/O<sub>2</sub>

Trickling filter

Adding liquid oxygen ?



# Bio-filter

Watch out for sludge collecting areas

Good aeration or oxygenation

Lack of  $O_2$  can give  $N_2$  by denitrification.

Moving bed filter.

Watch out for the depth

# Aeration and oxygenation of used water

Trickling filter: Good but demands a lot of space, and lifting the water min. 2 m

Airlift: Good oxygenation, but what about N<sub>2</sub>. Be aware of depths more than 2 m.

Diffuser: Good for oxygenation and degassing. Low pressure (80cm).

Very important with small bobbles!!!



# Low pressure diffusing



# What can we measure?

CO<sub>2</sub>: The free CO<sub>2</sub> should be measured.

Gives a snapshot of amount. Can change..

O<sub>2</sub>: easy to measure

Total gas: easy to measure.

N<sub>2</sub>: Calculated or measured directly

(Oxyguard TGP) But the equipment can be effected by liquid O<sub>2</sub>!!!



# N2 affected by liquid O2

	Gas trial N2 versus liquid O2								,00 mg/l
28. september 2016								1	kalibrering
	Temp	pH li	CO2 %	CO2	% ilt	mg O2	Total gas	Nitrogen	
Groundwater	10	7,0	522%	4 mg/l	40%		101	117,9 %N2	
Groundwater + O2	10	7	522%	4 mg/l	130%		104	96,5 %N2	
Groundwater -O2	10	7	522%	4 mg/l	0%		92	117,6 %N2	

# Signs of supersaturation

Dark fish, exophthalmos

Fish in the surface

Swollen swim Blatter

No appetite

Organs look normal

Microscope:

Bobbles in mucus and  
gill-capillary (O<sub>2</sub>)

Bleedings in gills.(N<sub>2</sub>)

Along the kidney we see  
2 light red stripe



# Why is the degassing failing?

No exchange of air: Trickling filter covered

Size of bubbles= low water contact.

Under dimensioned aeration. 1:5m<sup>3</sup>?

High water speed in/into level tank.

Air-bobbles to pump/cone... can happen on the pressure site in pipes...

# Highspeed water and bubbles





# Air into O2-cone

Gas								
20. december 2016								
,00 mg/l 1kalibrering								
	Temp	pH	Alkali nitet	CO2 %	CO2	% ilt	mg O2	Total gas Nitrogen
Værksted efter risle	8	7,0		851%	7 mg/l	81%		101 106,3 %N2
Skov m kegle+ilt	8	7		729%	6 mg/l	205%		121 97,2 %N2
Skov u kegle u. ilt	8	7		729%	6 mg/l	25%		108 131,0 %N2
Skov u kegle m pulver	8	7		729%	6 mg/l	0%		105 134,2 %N2

# Questions?????

[tcfishvet@hotmail.com](mailto:tcfishvet@hotmail.com)