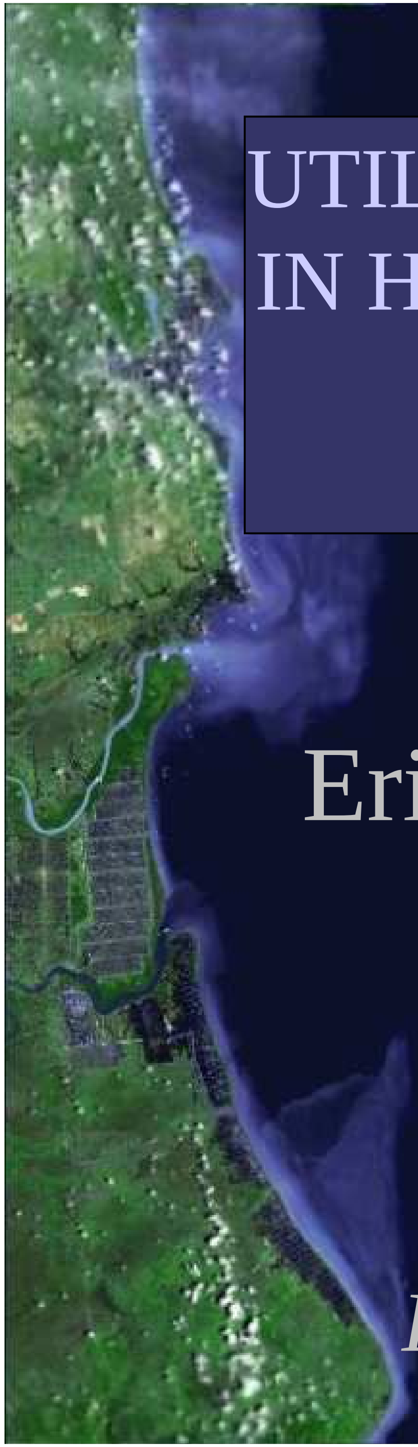

UTILISATION OF A BIOFLOC REACTOR IN HYPERINTENSIVE PRODUCTION OF SHRIMP *Litopenaeus vannamei* WITHOUT WATER EXCHANGE

Eric De Muylder & Daan Delbare

CreveTec

eric@crevetec.be

www.crevetec.be

In cooperation with ILVO, Oostende

Introduction

The interest in intensive culture of shrimp without water exchange is increasing because it gives the possibility to farm shrimp anywhere.

The heterotrophic system, whereby waste from shrimp is recycled through the production of bacterial proteins (bioflocs) seems to be the solution.

However, different approaches are possible.

Bioflocs are basically the same as activated sludge from waste water treatment plant.

Introduction

Shrimp are able to cope with high biofloc densities. However, the conversion of ammonia into biofloc proteins results in a build-up of bioflocs because of poor conversion of those biofloc proteins into shrimp biomass. The bioflocs therefore start to nitrificate the ammonia into nitrates, which accumulates into the culture tanks and reduces the possibility to re-use this water for future production cycles. This nitrification also decreases the pH, which makes it necessary to adjust pH regularly. To solve this problem, a pilot culture tank was set up with two additions: A meiofauna-protecting substrate to favor the conversion of bacterial biofloc into digestible meiofauna and a central bioreactor with the possibility of denitrification.

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Observations

Activated sludge from an aerobic water treatmant plant is basically the same as bioflocs, but it is operated differently, because it contains no live animals.

Bioflocs can cope with other water quality parameters which enables them to operate at lower oxygen levels (1-2 ppm) and higher sludge densities (MLSS from 3-5 g/L). Tanks are aerated heavily.

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Observations

Shrimp need a higher oxygen level (>4 ppm), lower sludge densities (MLSS up to 1 g/L) and less movement of water.

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Mass balance in biofloc systems

Most shrimp biofloc systems use low protein feeds in combination with adding a carbon source to alter the C:N ratio to 10:1, or even 20:1. This enables the heterotrophic bacteria to grow fast and take all nitrogen from the water and faeces as building blocks for proteins. This process uses oxygen and results in a high biofloc production.

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Mass balance in biofloc systems

While tilapia is able to digest bacteria though its acidic stomach, shrimp can cope with a high biofloc density, but are not able to digest bacterial proteins.
As a result, bioflocs are building up in the system and use a lot of oxygen.
At a certain point of time, the excess bioflocs have to be removed from the culture tanks.

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Low protein feeds ?

Using starch from the feed as carbon source is expensive. It is cheaper to use high quality feed with a correct protein content and maybe reduce the feeding rate. Than add a cheaper source of carbon to balance the C:N ratio.

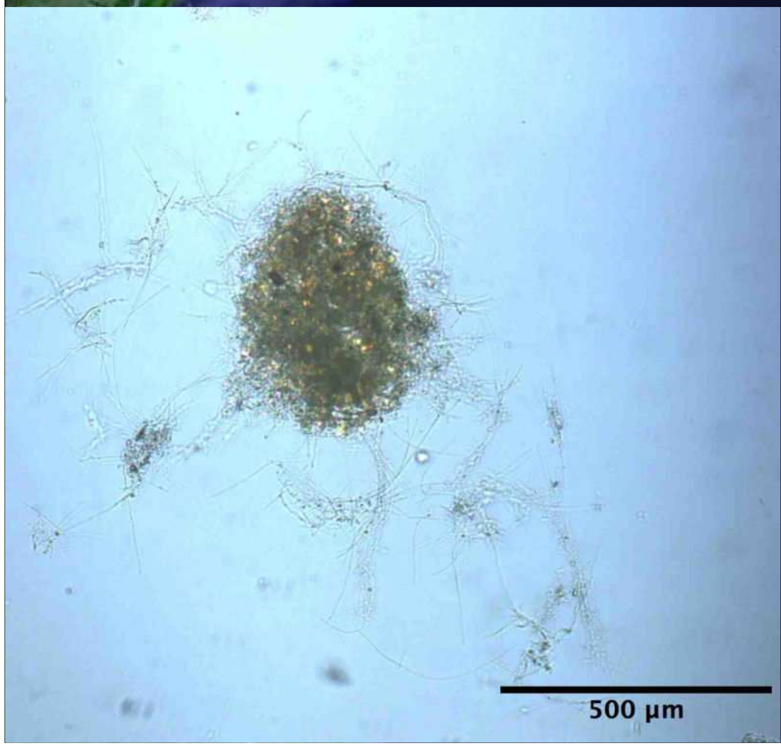
Cost of starch in feed
= cost of raw material
+ production cost of
feed

Importance of C:N ratio ?

What happens if the C:N ratio is less than 10 ?

Bioflocs are very flexible and apart from heterotrophic bacteria will also contain nitrifying bacteria.

Nitrifying bacteria will oxydize part of the surplus TAN in nitrite and nitrate.



This process also requires oxygen.

It uses alkalinity and reduces the pH.

Result: accumulation of nitrates in the culture tanks and pH drop: NaH2CO3 has to be added to buffer the pH.

Approach

- High quality feed (35 % Protein)
- Lower feeding gift
- No addition of sugar or another carbon source
- Concentrated bioflocs in central "Biofloc reactor"
- Possibility for denitrification

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System setup

Culture tank of 2,1 m³
Central reactor equipped with aeration and mixing
Meiofauna protecting substrate

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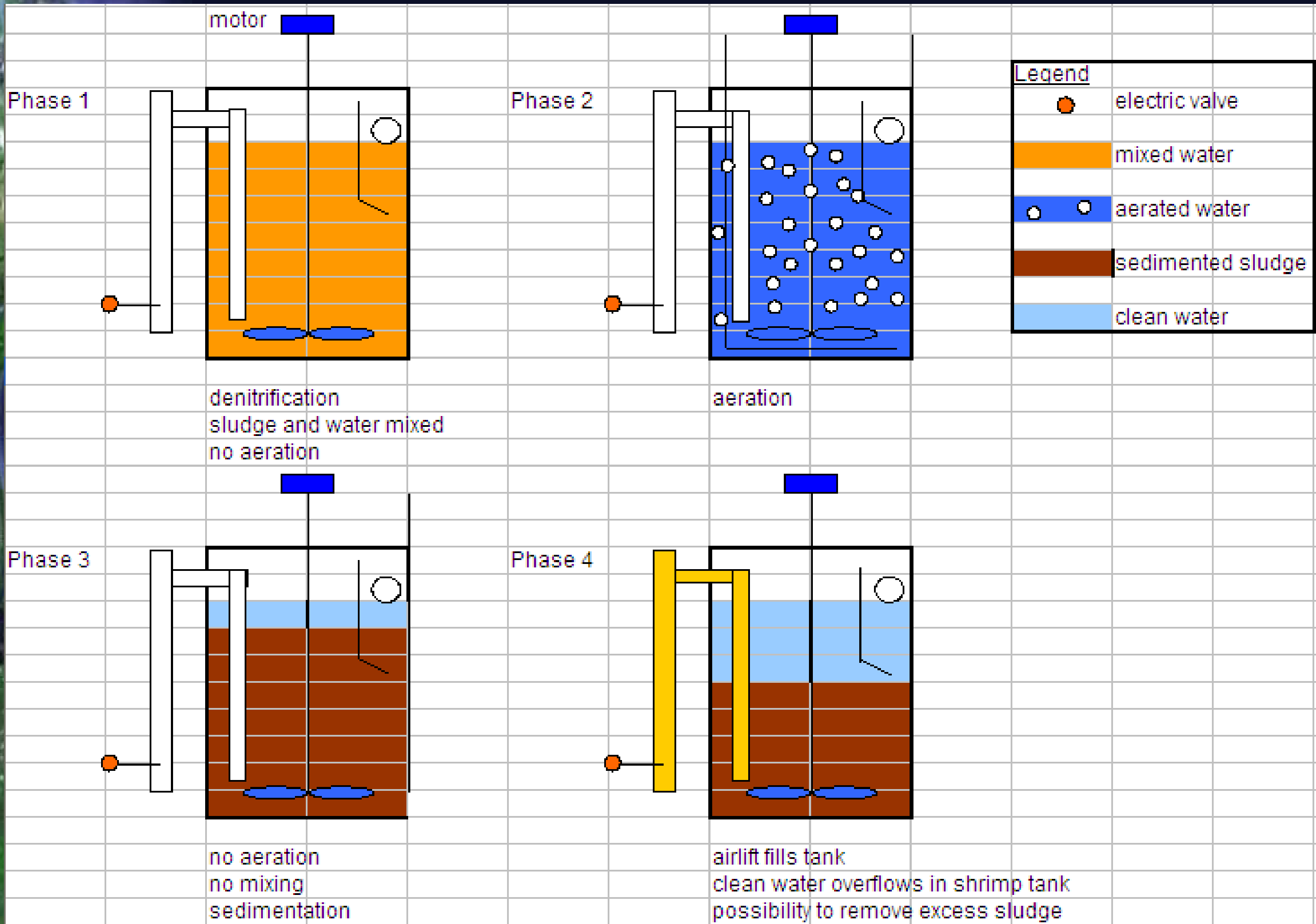
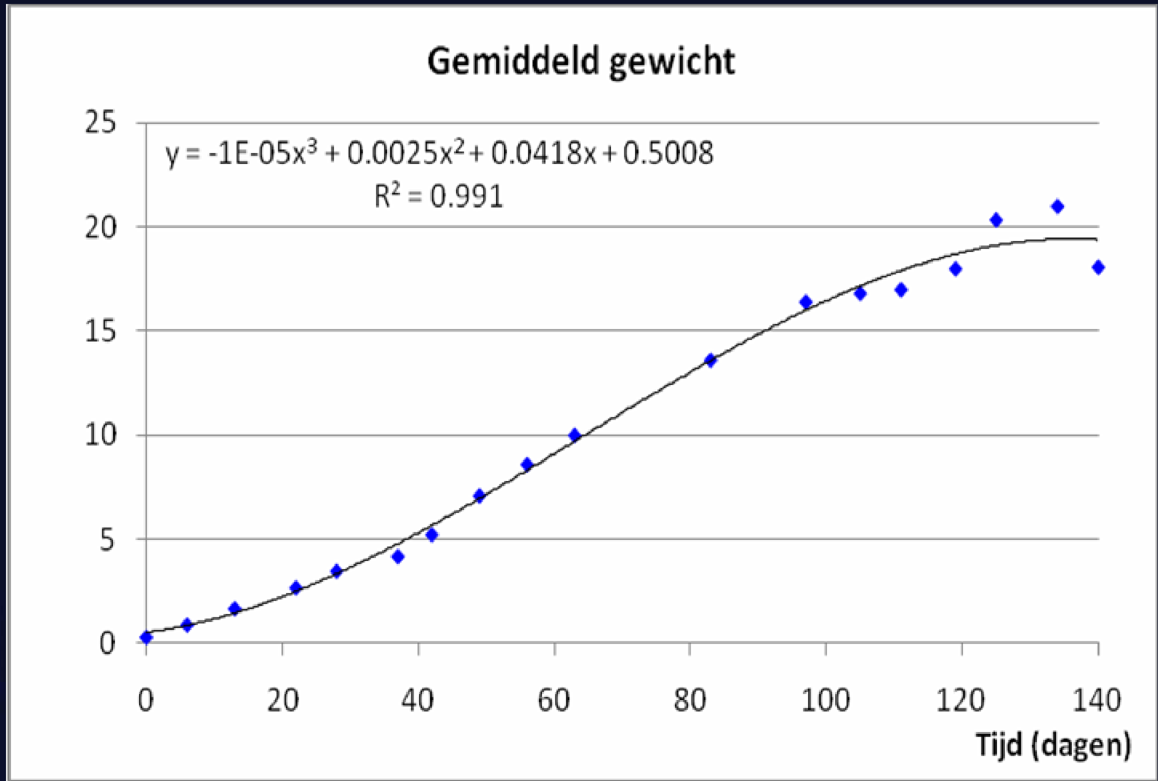
System setup



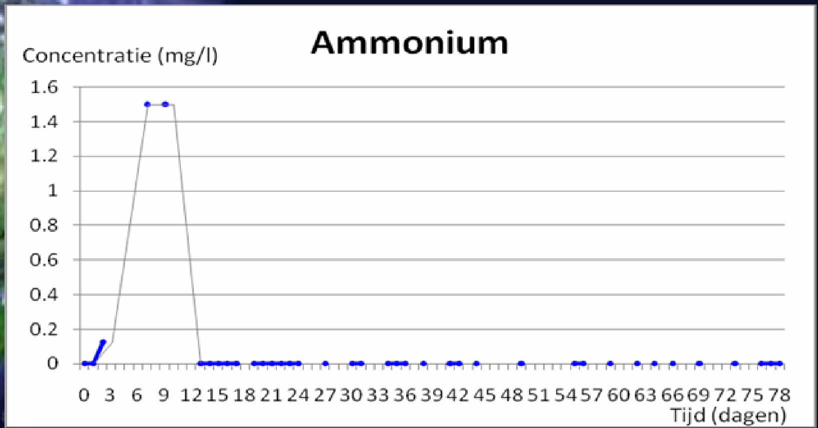
Results – Shrimp growth

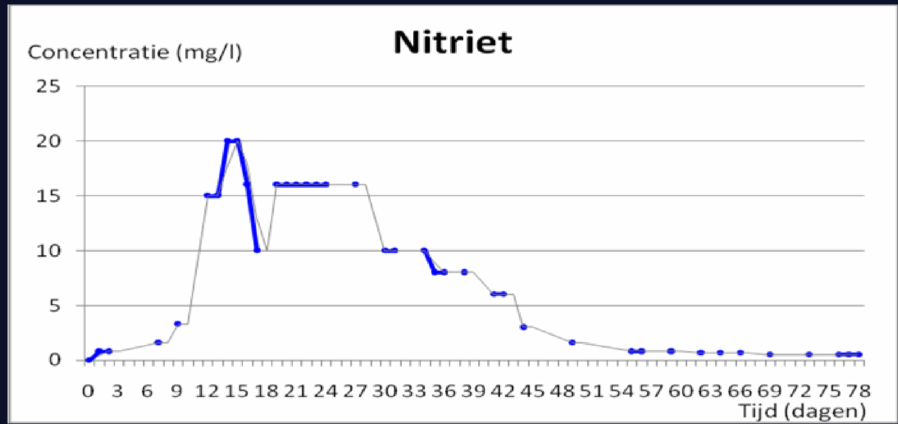


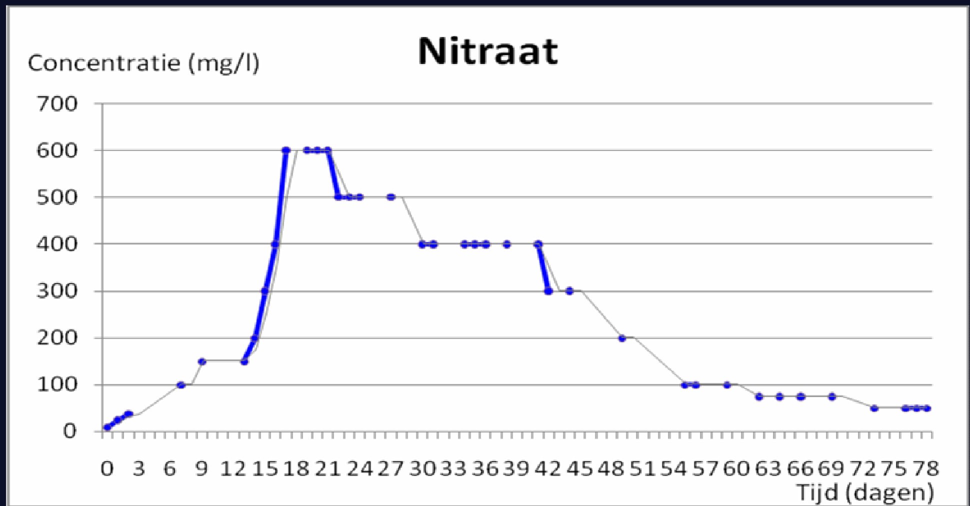
Final harvest: 11,6 kg, partial harvest 5 kg

Total: 8 kg/m³ per cycle

Results – Nitrogen







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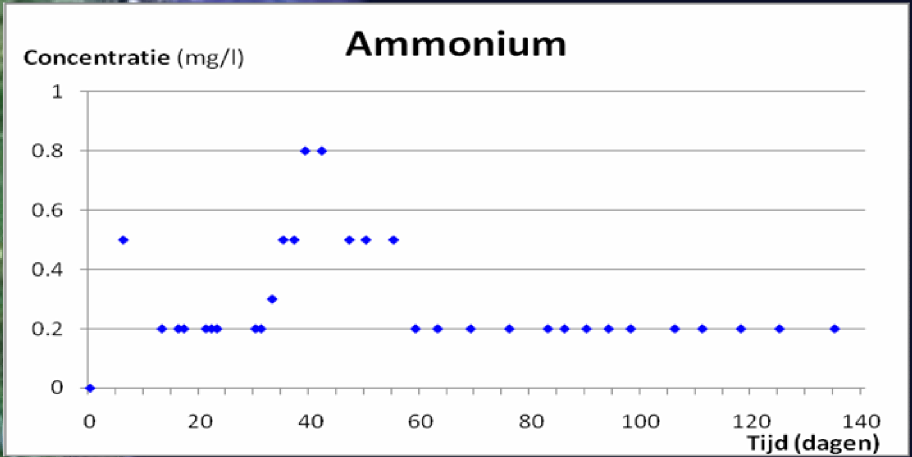
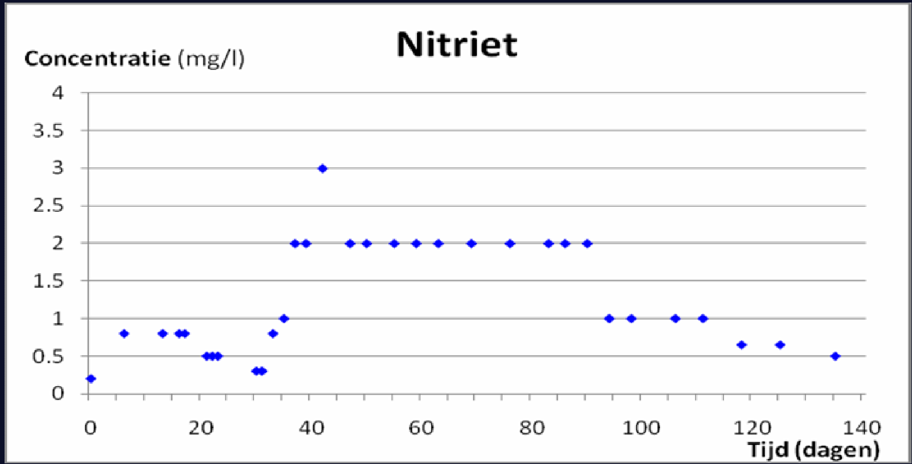
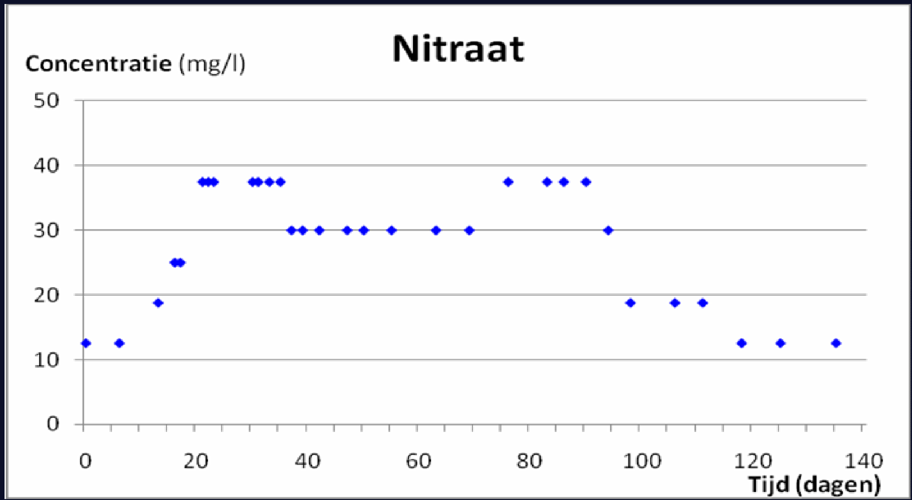
Results – Nitrogen







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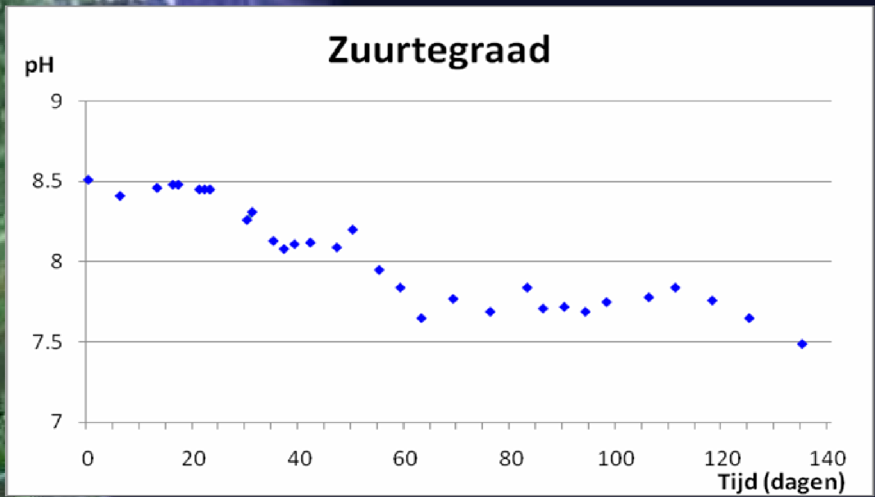
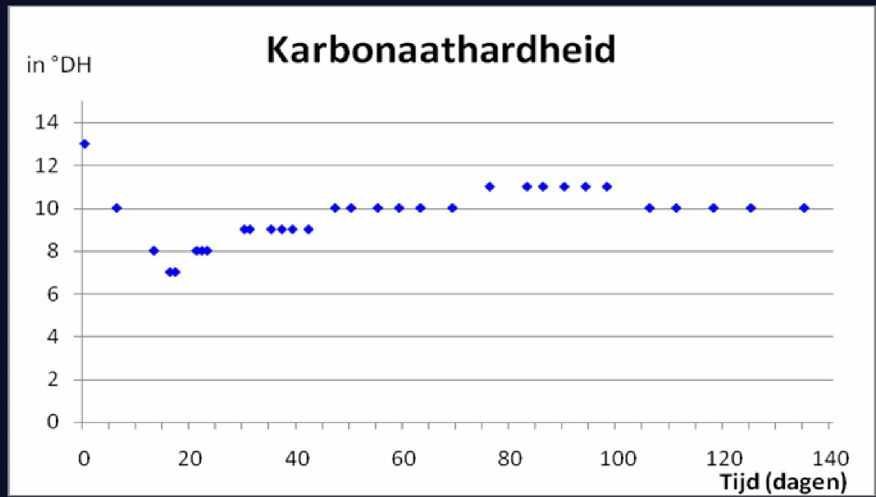
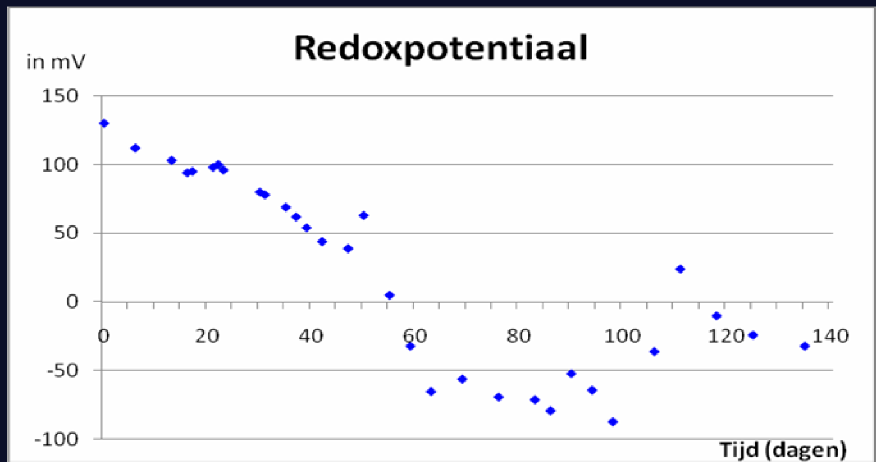
Results – water quality







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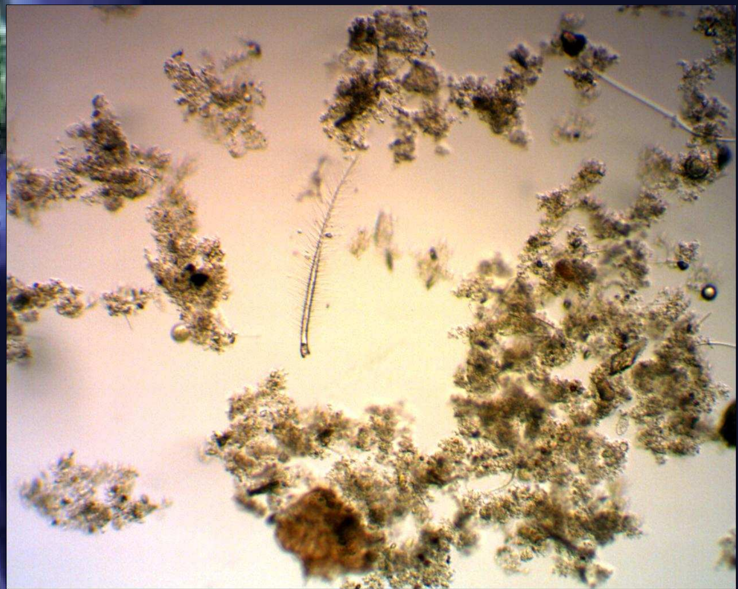
Advantages of a central reactor



Flexibility: heterotrophic production of bacterial proteins, nitrification, denitrification

Always keep bioflocs in your system, even when shrimps are harvested

If you want to add sugar, you can do it in the reactor without risk of oxygen drop in the culture water

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Conclusion

Shrimp can be produced without exchange of water

Without addition of sugar or buffers

A combination of nitrification and denitrification is able to maintain water quality parameters

The internal carbon from sedimented bioflocs and shrimp faeces provide enough carbon for the denitrification

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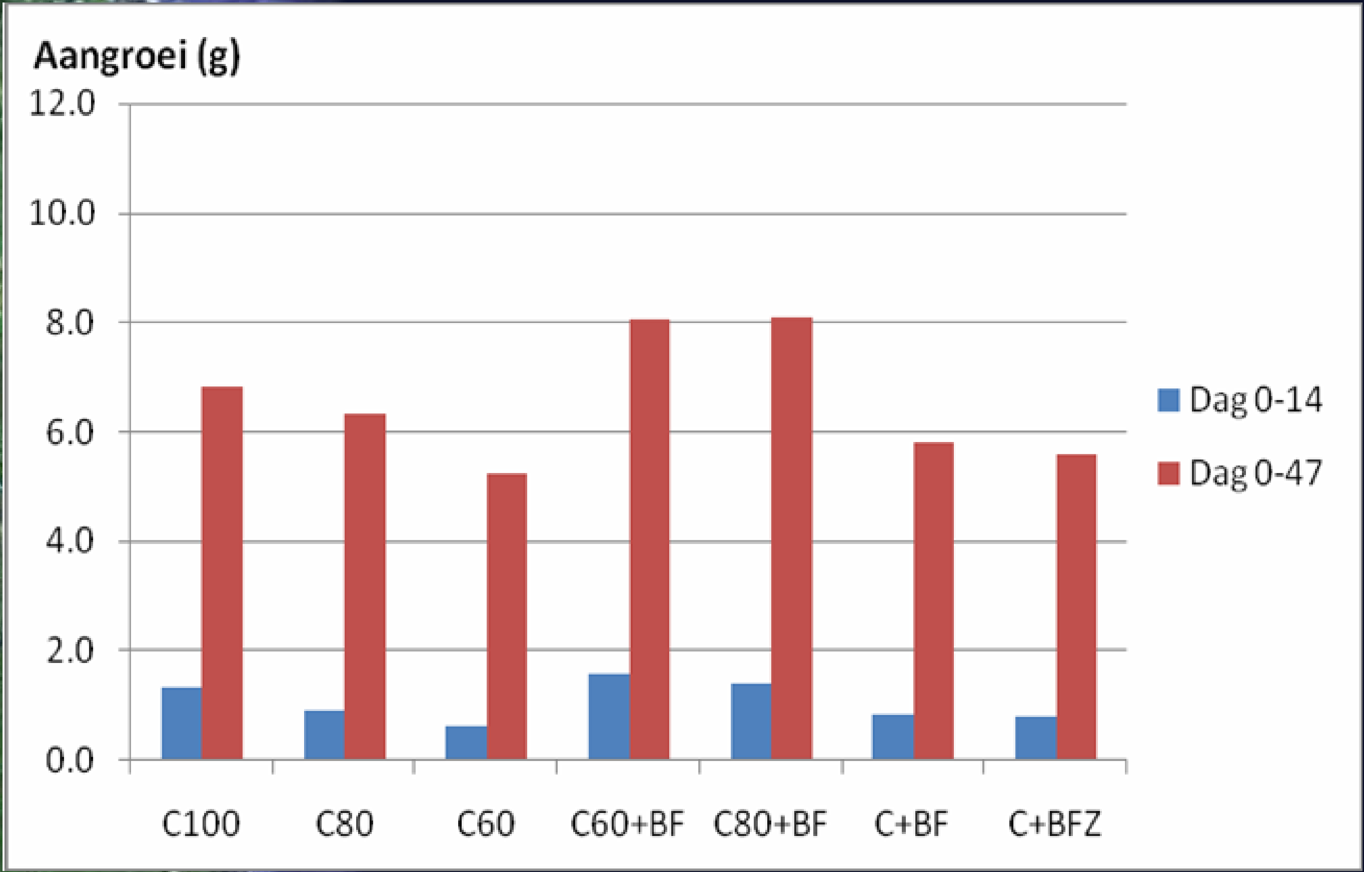
Results – Growth experiment



C100: 100 % feed
C80: 80 % feed
C60: 60 % feed
+BF: bioflocs in water
C+BF: Bioflocs in feed
C+BFZ: Bioflocs acidified in feed

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Thank you for your attention

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