

Biofloc applications in Virginia

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Indoor (urban) aquaculture

Each comes with pros
and cons



**Recirculating systems
(nitrifying bacteria)**



**Biofloc
(heterotrophic bacteria)**

What is biofloc?...

A living (microbe-based) system that is created by adding organic carbon directly to the water that favors the growth of a certain type of bacteria (heterotrophs)

The bacteria multiply quickly because of the sugar, and use nitrogen (ammonia and nitrite that is excreted by the fish) as building blocks for their growth

Several implications

- The removal of ammonia and nitrite cleans the water (makes it cleaner for fish)
- No need for filters or water exchanges (water becomes the filter)
- Bacteria secrete mucus that “flocs” anything in the water (plankton, uneaten feed, etc.) into larger particles that can be consumed (healthy on demand supplemental feeds)
- Improves feeding efficiencies and thus reduces feed costs



Bioflocs quickly form and MUCH faster / efficient at removing toxic ammonia



One day later after adding sugar

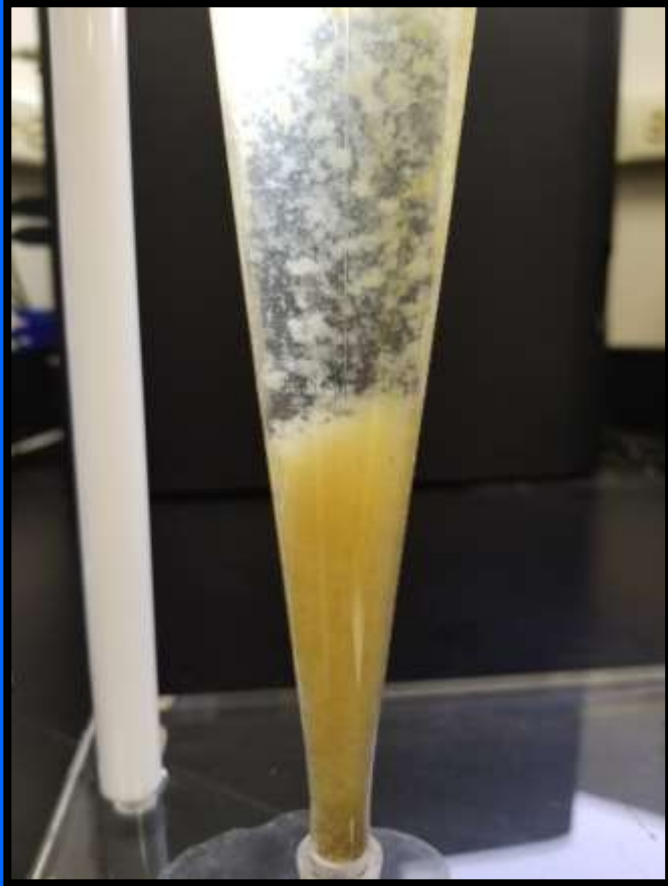


Minutes after adding sugar, dissolved oxygen can decrease (due to bacteria respiring when converting ammonia + nitrite to biomass)



Bioflocs maturing

The more bioflocs accumulate, the more important it is for aeration



Young bioflocs



Mature bioflocs



Bioflocs accumulating

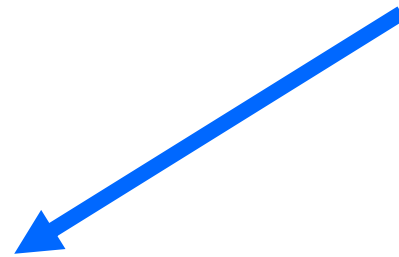
Living system



Two living types

1. Animal being cultured
2. Biofloc (bacteria, microalgae, zooplankton, etc.)

Need high amounts of aeration: 4 times more than clearwater system



Disruptions to power / aeration will quickly plummet (much faster than in a clearwater system)



Necessary items to set up biofloc



- Tank or culture unit
 - Shrimp / shrimp feed
 - Water and marine salt (if not freshwater)
 - Water quality kits
 - Sugar
 - Aeration
-



Types of carbon



Molasses

Water-soluble, fast utilization by bacteria to produce bioflocs, increases water turbidity to reduce microalgae (if desired): BUT, not working as good as sugar



Sugar

Water-soluble, fast utilization by bacteria to produce bioflocs, can quickly remove ammonia but also decrease dissolved oxygen



Complex carbohydrates

Produce nutritious bioflocs; largely water insoluble - delays in bacterial utilization due to being less soluble

Daily protocol

- ❑ Measure dissolved oxygen and pH
 - ❑ Should be above at least 4 mg/L and pH above 7
- ❑ Feed 5% shrimp body weight daily: shrimp grow fast ($\approx 0.6 - 0.9$ grams/week) so need to increase amounts over time
- ❑ Add sugar

How much?...

Often added at a carbon to nitrogen ratio of 15 - 20

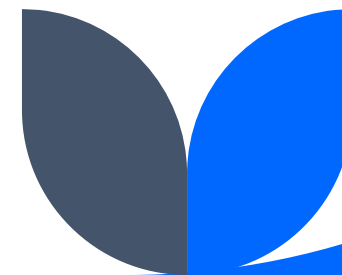
1. How much feed was added yesterday
2. Based on water quality

Adding based on previous day's feeding

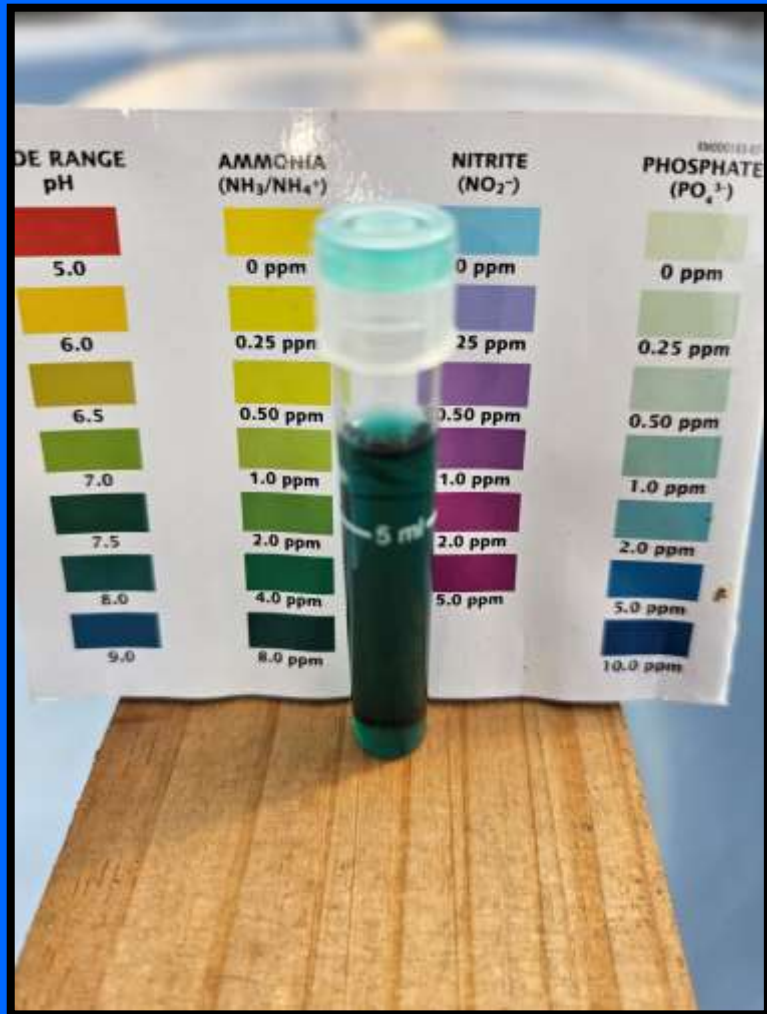
Calculation based on how much nitrogen is added

	Variables	Amount of protein added (g)	Actual N (g)	N in water (excreted)	Amount of carbon	Total amount of carbon to add
3						
4						
5						
6	Amount of food (g)	65				
7	Protein content of food (%)	30	19.5	3.12	2.34	35.1
8	Desired C/N ratio	15				
9	Amount of carbon in sugar	40				
10						
11						
12						
13	Explanations in red		16% of protein is N	75% of N ends up in water		Adjusted for pure carbon
14						

- Amount of food added
- Amount of protein in the food
- Desired carbon to nitrogen ratio



Adding carbon based on water quality



If tank is 1000 L and ammonia is 8 mg/L, then would have 8 grams of ammonia in tank

If wanting a C/N of 20,
then multiply 8 x 20 =
160

Sugar is 40% carbon

$(160/0.4) = 400$ grams of sugar

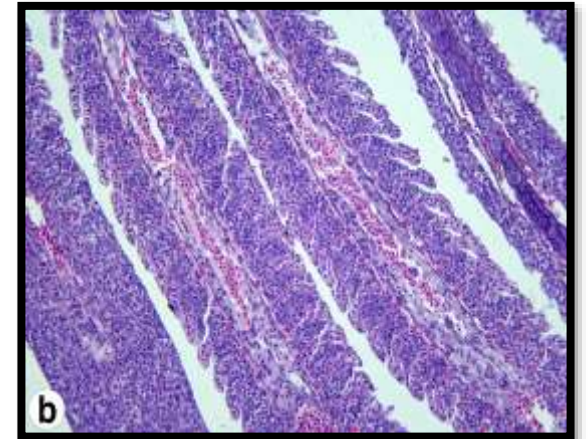
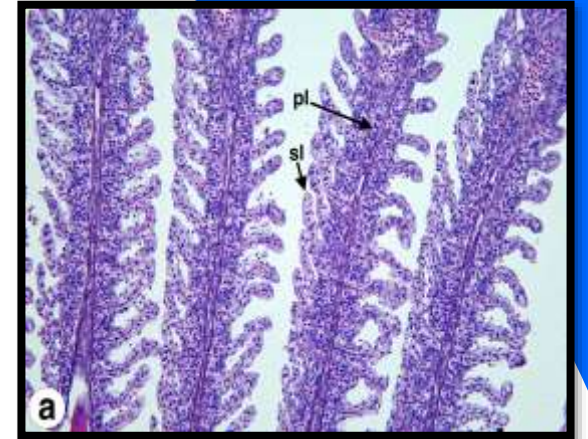


Solids management

Shrimp and prawns will continuously consume bioflocs: BUT, bioflocs will still gradually accumulate

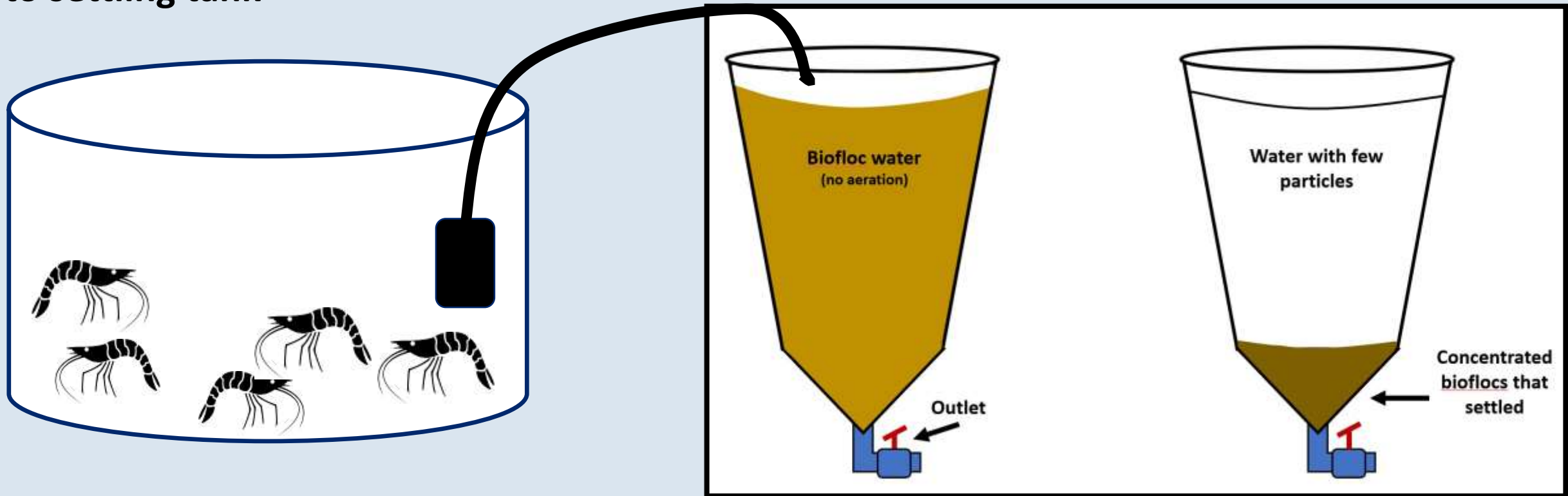
TDS above 500 mg/L or turbidity above 40 NTU, respectively, causes decrease to gill function

Can be measured as “Total dissolved solids” (TDS) or “turbidity”

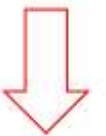
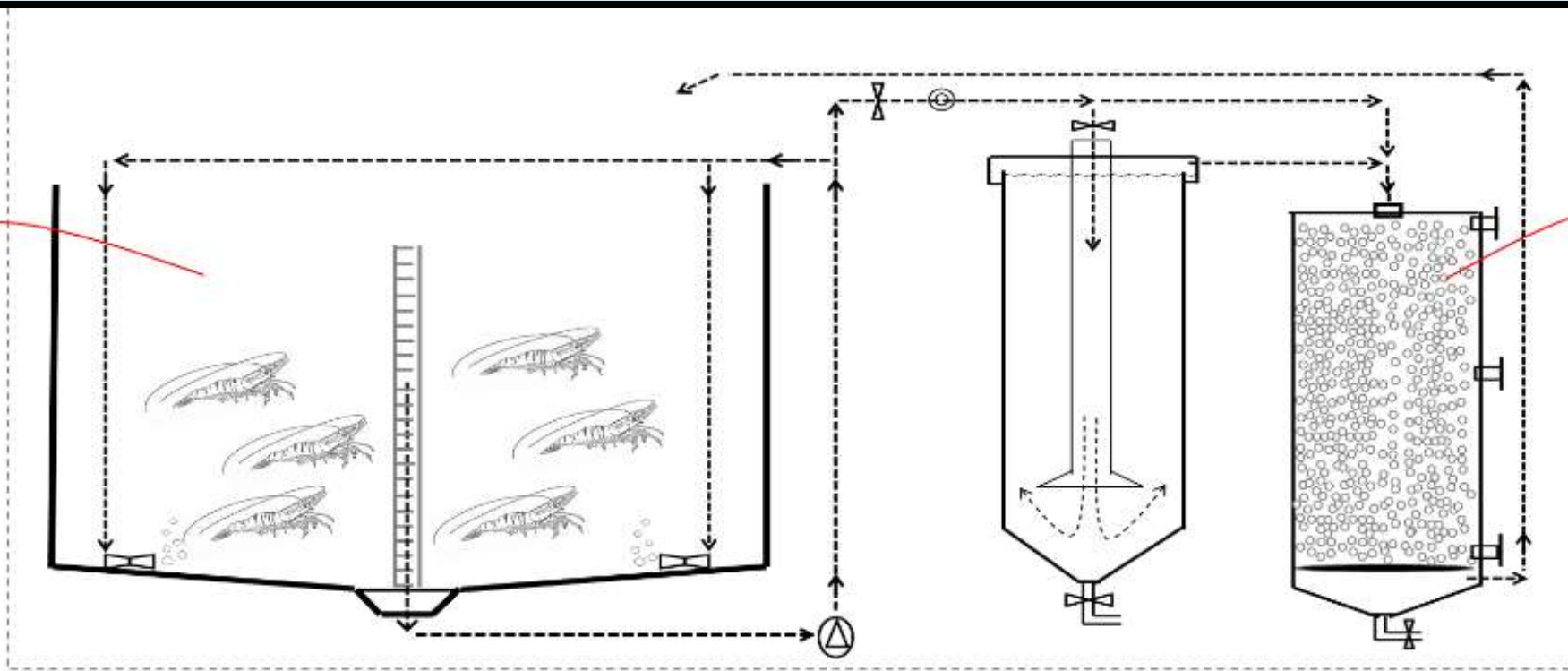
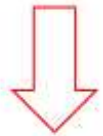
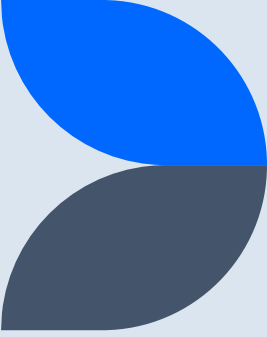


Solids management: manual way

Submersible pump to pump
to settling tank



Hybrid biofloc system: continuously removes bioflocs while also have a “biofilter” to reduce ammonia



Shrimp and prawns especially suitable



White shrimp
(*Litopenaeus vannamei*)



Tiger shrimp
(*Penaeus monodon*)



Giant freshwater prawn
(*Macrobrachium rosenbergii*)

Shrimp can effectively collect and consume bioflocs (small particles)
Biofloc in some ways mimic natural environment they use during early development

Shrimp culture

Suggested to work with white shrimp (*Litopenaus vannamei*) first



Numerous hatcheries (Texas and Florida) can ship postlarvae directly

Under good conditions, shrimp can achieve market size in 4 months



What about fish??



Bluegill
(*Lepomis macrochirus*)



Tilapia
(*Oreochromis* spp.)



Channel catfish
(*Ictalurus punctatus*)

Younger staged fish can consume bioflocs

Bluegill and catfish: better for ponds

Tilapia: need to be cultured in tanks (not ponds), but clearwater might be better option

Production using biofloc technology a proven method...BUT...



Does require daily (or very least 5 days out of week) work

Adding feeds

Adding sugar

Measuring water quality

If something goes wrong, it's a bigger problem with bioflocs than clearwater, but hybrid systems helps reduce risk

Try not to put all eggs in one basket

Biofloc fish farming: Failure in oxygen supply can lead to huge loss, Biofloc fish farming, Biofloc meaning, Biofloc fis...

Visit >

Adoption by community



Program with Mattaponi tribe in West Point, VA



Setting up demonstration site with middle school (Augusta county) in December

Recently contacted by small business in VA who are producing shrimp to local community

Thank you

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