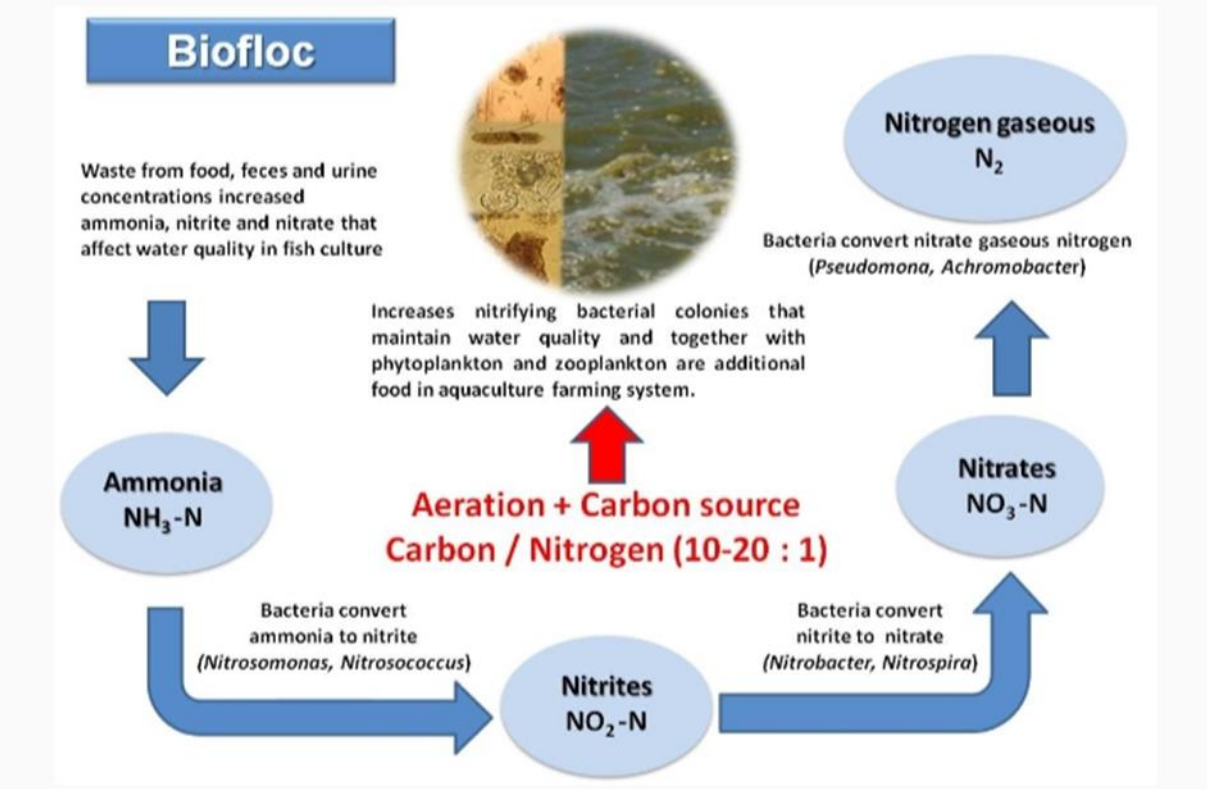
Biofloc Fish Farming



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Biofloc Technology

What is the Biofloc?

Biofloc is a heterogeneous aggregate of suspended particles and variety of microorganisms associated with extracellular polymeric substances. It is composed of microorganisms such as bacteria, algae, fungi, invertebrates and detritus.

What is the Biofloc Technology?

The Biofloc Technology is as an environmentally friendly aquaculture technique based on in situ microorganism production. Fish and shrimp are grown in an intensive way (minimum of 300g of biomass per square meter) with zero or minimum water exchange. In addition, continuously water movement in the entirely water column is required to induce the biofloc formation. Nutrients in water (in accordance with a known carbon to nitrogen ratio of 10-20:1 will contribute naturally to a hetero-trophic microbial community formation and stabilization.

These microorganisms play three major roles:

1) maintenance of water quality, by the uptake of nitrogen compounds generating in situ microbial protein

2) nutrition, increasing culture feasibility by reducing feed conversion ratio (FCR) and a decrease of feed costs
3) competition with pathogens

The Biofloc Technology is considered the new "Blue Revolution" since nutrients can be continuously recycled and reused in the culture medium, benefited by the minimum or zero-water exchange. Also, the sustainable approach of such system is based on the high production of fish/shrimp in small areas. In addition, the biofloc is a rich protein-lipid natural source of food available in situ 24 hours per day due to a complex interaction between organics matter, physical substrate, and large range of microorganisms. This natural productivity plays an important role recycling nutrients and maintaining the water quality. The consumption of biofloc by shrimp or fish has demonstrated in numerous benefits such as improvement of growth rate, decrease of FCR, and associated costs in feed.

As shown in above figure microorganisms play a key role in the Biofloc Technology/System. The maintenance of water quality, mainly by the control of bacterial community over auto-trophic microorganisms, is achieved using a high carbon-to-nitrogen (C:N) ratio, since nitrogenous by-products can be easily taken up by hetero-trophic bacteria. High carbon-to-nitrogen ratio is required to guarantee optimum Hetero-trophic bacteria growth, using this energy for maintenance (respiration, feeding, movement, digestion,etc) but also for growth and to produce new bacterial cells. The stability of zero or minimal water exchange depends on the dynamic interaction among communities of bacteria, micro-algae, fungi, protozoans, nematode, rotifer, etc. that will occur naturally. Such consortia of microorganism will help on the water quality maintenance and recycling wastes to produce a high-value food.

One current practice in the Biofloc Technology is the use of commercial bacteria consortia (probiotics).

The main reasons of probiotics used in the Biofloc Technology are

1. help to stabilize the heterotrophic community and to compete with autotrophic microorganisms (mainly in the initial phases),
2. help to recycling the organic matter, and
3. control solids and TAN levels.

Advantages of Biofloc Technology

Efficiently improves land and water use efficiency.
Nearly zero water exchange.
Biofloc system reduces environmental impact.
Biofloc is an eco-friendly culture system.
Biofloc system enhances growth performance, survival rate, low Feed Convetion Ratio (FCR) and in less area high productivity.
Reduces water pollution and the risk of introduction and spread of pathogens.
Biosecurity is high.
It reduces the use of protein-rich feed and the cost of standard feed.
Biofloc system reduces the pressure on capture fisheries that means the use of cheaper food fish and trash fish for fish feed formulation.
Less than 1% of the fish in biofloc gets the disease.

Disadvantages of Biofloc Technology

Start-up period required.
Increased energy requirement for mixing and aeration.
Reduced reaction time because water respiration rates and elevated.
Alkalinity supplementation required.
Increased pollution potential from nitrate accumulation.
Inconsistent and seasonal performance for sunlight-exposed systems.

Water Preparation

Preparation of water for 10000 litre biofloc tank.

1. Wash the biofloc tank with potassium permanaganate or any anti-fungal detergent then clean with fresh water and let dry the biofloc tank for one day.
2. Fill the half biofloc tank with fresh water from borewell. Don't use water from under ground tank or well.
3. Check the aeration system in tank that water circulating properly or not, if water is not circulating properly, adjust the air stone location, set the required air pressure and bubble. Now keep aeration minimum 2 days so harmful chemical will removed if any in fresh water.
4. Now measure and control water parameters like DO (Dissolved Oxygen), pH, TDS and Salinity within desired range.
   After 8 hours of aeration in biofloc tank, DO (Dissolved Oxygen) level should be greater than 6 ppm.
   pH should be between 7.4 to 8.
   If TDS level
   Less than 300 ppm then Excellent water,
   300 to < 600 ppm then Good quality water,
   600 to < 900 ppm then fair quality water,
   900 to < 1200 ppm then poor quality water,
   Above 1200 ppm then unacceptable water.
   Salinity according fish species. Below 0.5 ppt salinity is good for growth for all fish except tilapia. For tilapia 0.7 to 1 ppt salinity is good. Salinity for tiger and vanammei shrimp should between 0 to 12 ppt.
5. If pH is less than 7.4 then add 100 gm $CaCO_3$ and leave the water for minimum 2 hours, after that check that pH is between 7.4 to 8 then again add 100 gm $CaCO_3$ and check again after minimum 2 hours, repeat this till pH reach between 7.4 to 8. Remember that during this step aeration must be ON.
6. After maintaining required level of pH between 7.4 to 8, wait for at least 4 hours, now take 10-15 litre water from tank and add 200 gm probiotic and 1 kg molasses into it and mix it well. Now spread this mixture (probiotic+molasses+water) in biofloc tank water when temperature is between 22℃ to 30℃. To grow up probiotic bacteria let add 250 gm molasses daily for next two days. Within three days floc will produce.
7. Check the salinity and add raw salt as needed to culture the fish species. Maintain salinity 0.3 to 0.5 ppt for good growth for all fish species except tilapia. For tilapia 0.7 to 1 ppt salinity is good. Salinity for tiger and vanammei shrimp should between 0 to 12 ppt. As per fish species you going to culture, calculate how many grams or kg raw salt is required from calculations section.
8. Now after following all the above steps you can stock the fish, but before stock the fish seed you need

to sanitize the fish seed properly. See more details on how to select seed, sanitize and stock the fish in "**Seed Selection, Sanitize & Stocking**" section.

9. To maintain floc level between 15 ml to 40 ml following steps are essential.
   On the 10th day, when the first (probiotic+molasses) was added to the water, take 50 liters of water in a 100 liter capacity drum, keeping the pH of the water between 7.4 and 8, 100 g probiotics and 1 kg of molasses Mix the well and prepare the FCO (Fermented Carbon Organics) by giving full aeration. Within two days the FCO will be ready to use. On the 12th day, a little FCO add to the biofloc tank during day time **in 1 hour intervals**. If you add FCO to the biofloc tank together, the DO will suddenly decrease and the stocked fish will not survive.
   Repeat the process of making FCO on the 22nd day as shown above and add the FCO in the biofloc tank during the day **a little at 1 hour intervals** on the 24th day.

Best water parameters

1. Alkalinity: Always maintain it in range of 120 to 280 ppm.
2. Dissolved Oxygen (DO): more than 5 ppm is optimum, but best if between 6 to 9 ppm.
3. Floc density: Optimum range 15 ml to 40 ml, but best in range of 25 ml to 40 ml. Maximum level of floc density is consume more oxygen and it occlusion on fish gills.
4. Hardness: Around 600 ppm is optimum.
5. Nitrate (NO_3^-): It's a slow poison. Should be less than 150 ppm. But best keep less than 50 ppm.
6. Nitrite (NO_2^-): Should be less than 0.3 ppm. But best keep less than 0.1 ppm.
7. pH 7.4 to 8 ppm is good for better growth.
8. Salinity: 0.3-0.5 ppt salinity is good for growth for all fish except tilapia. For tilapia 0.7 to 1 ppt salinity is good. Salinity for tiger and vanammei shrimp should between 0 to 12 ppt.
9. TAN (Ammonium(NH_4^+)+Ammonia(NH_3)): 0 ppm is good but not more than 0.5 ppm.
10. TDS (Total Dissolved Solids): more than 600 ppm is essential, but best to have around 1500 ppm.
11. Temperature: Temperature 22℃ to 34℃ is optimum. But 26℃ to 34℃ is best range.

Seed Selection, Sanitize & Stocking

How to select fish seed, sanitize and stock fish seed in the biofloc tank?

Take care of the following during selection of fish seed:

1. All fish seed should be of equal size.
2. The size of the fish seed should be larger than 2 inches.
3. There should be only one kind of fish seed. No other kind of fish seed should be mixed.
4. The body of the fish should be shiny and clean.
5. The fish seed should be agile. Who react to touch And floats comfortably in the opposite direction of the water.
6. The body of the fish seed should be complete. Take 15-20 fish seed and check that it is of same type. There should be no disease.
7. Fish seed should be brought only in the morning or evening.

Sanitize and stock fish seed:

1. Before the fish seed are sanitized, The polythene bag that the fish seed have been brought into, without opening the same polythene bag, should be kept for 15 to 20 minutes in the water to be stocked after sanitized, so that when we open the polythene bag, there is no water temperature difference between

the biofloc tank water and the polythene bag.

2. To sanitize the fish seed, make solution of 30 liters of water by adding 2 grams of potassium permanganate, light red water will be formed, then dip 2 or 3 times fish seed in solution with the help of fish net. Remember do not leave the fish seed in solution.
3. Then make solution 25 liters of water by adding 500 grams of salt in another vessel, Now dip fish seed in salt solution with the help of fish net. If the fish seed is healthy, put them in a direct biofloc tank. If not healthy, make a another solution of 1 kg of salt in 1000 liters of water, then put the fish seed in it for 2 or 4 days. Change a little water every day.
4. Once a floc is formed in the biofloc tank, only the fish seed should be placed in, for this, the biofloc tank water should be prepared beforehand. Remember that the fish seed has to be fed after 1 day or 12 hours after it is stocked into the biofloc tank.