

SATHYABAMA UNIVERSITY



DEPARTMENT OF BIOTECHNOLOGY
SCHOOL OF BIO & CHEMICAL ENGINEERING

MARINE ALGAE SCRUBBER

Submitted in Partial Fulfillment of the requirement for the award of Bachelor of Engineering / Technology degree in Biotechnology

By

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DEPARTMENT OF BIOTECHNOLOGY

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Joel k senu (39230020), Nanda kumar R(39230028), Tamil selvam S (39230052), who carried out the project entitled "MARINE ALGAE SCRUBBER" under the supervision of DR.KIRUTHIGA B and DR.DAWN

Internal Guide

External Guide

Head of the Department

DR. V RAMESH KUMAR

Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

I Tamil Selvam S hereby declare that the Project entitled MARINE ALGAE SCRUBBER done by me under the guidance of Dr Kiruthiga (internal) and Dr Dawn (external) at Sathyabama Institute of Science and Technology is submitted in Partial fulfilment of the requirement for the award of Bachelor of Engineering / Technology degree in Biotechnology

DATE:

PLACE:

Signature of Candidate

ACKNOWLEDGEMENT

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I convey my thanks to Dr. V Ramesh Kumar, Dean, School of Bio and Chemical and Head of the Department, Dept. of Biotechnology for providing me necessary support and details at the right time during the progressive reviews.

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ABSTRACT

Algae scrubber is an additional filtering device used in marine ornamental tank and marine fish farms. The major work of the scrubber is to reduce the Ammonia, Nitrate, Nitrite, Phosphate and Balanced pH. Ammonia is the major threat to the marine inverts and fishes. Scrubber is a compact container contains a pipe showering water on a plastic mesh inoculated with algae culture. A high spectrum light is added to the scrubber for the photosynthesis of the algae. As we are showering water on the algae it gets more surface area for respiration.

Every healthy ecosystem requires a balanced environment. Weekly water tests are invaluable to making sure your aquarium's levels are in check. Understanding water chemistry and maintaining optimum levels of key nutrients, minerals and other indicators will protect marine life and allow the organisms in your care to thrive and radiate. Below are the key parameters to monitor in saltwater reef aquaria.

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INTRODUCTION

A marine aquarium is an aquarium that keeps marine plants and animals in a contained environment. Marine aquaria are further subdivided by hobbyists into fish only (FO), fish only with live rock (FOWLR), and reef aquaria (In India reefing is banned).

Fish only tanks often showcase large or aggressive marine fish species and generally rely on mechanical and chemical filtration. FOWLR and reef tanks use live rock, a material composed of coral skeletons harboring beneficial nitrogen waste metabolizing bacteria, as a means of more natural biological filtration.

Marine fishkeeping is different from its freshwater counterpart because of the fundamental differences in the constitution of saltwater and the resulting differences in the adaptation of its inhabitants. A stable marine aquarium requires more equipment than freshwater systems, and generally requires more stringent water quality monitoring. The inhabitants of a marine aquarium are often difficult to acquire and are usually more expensive than freshwater aquarium inhabitants.

An algae scrubber filters water by moving water rapidly over a rough, highly illuminated surface, which causes algae to start growing in large amounts.

Algae scrubbers allow saltwater, freshwater and pond hobbyists to operate their tanks using natural filtration in the form of primary production, much like oceans and lakes.

BASICS OF MARINE TANK

During the early days of marine aquaria, saltwater was collected at local beaches. Natural saltwater contains many unwanted organisms and pollutants. Aquarium literature of the time suggests that the most commonly kept marine fish were the percula clownfish(Nemo fish), small brakish water Puffers and scats, jeweled blennies, and blue damsels. Aquariums were equipped with large air compressors, and were heavily aerated and filtered (primarily with under gravel filters, a norm for some time).

An ever-growing number of hobbyists experiencing the inconvenience of gathering natural sea water and the concurrent development of analytical chemistry techniques led to research into the chemical composition of sea water. Synthetic salt mixes were developed to replicate the chemical environment of the tropical ocean, including trace elements and salts. This advance made marine fishkeeping popular in areas without access to clean sea water.

Air driven, counter-current protein skimmers and reliable submersible electric heaters were invented in Germany. Various advances in filtration included trickle and hang on filters, both allowing a more natural equilibrium in the aquarium environment. The advancement of fluorescent lighting technologies to provide higher output, along with metal halide lighting, enabled the first reef tanks, making it possible to keep corals and other invertebrates without natural sunlight.

More efficient chemical testing allowed aquarists to understand the chemical properties of aquariums. By the 1980s, a biologically-based understanding of how to maintain an artificial ocean environment brought more successful and widespread marine fishkeeping.

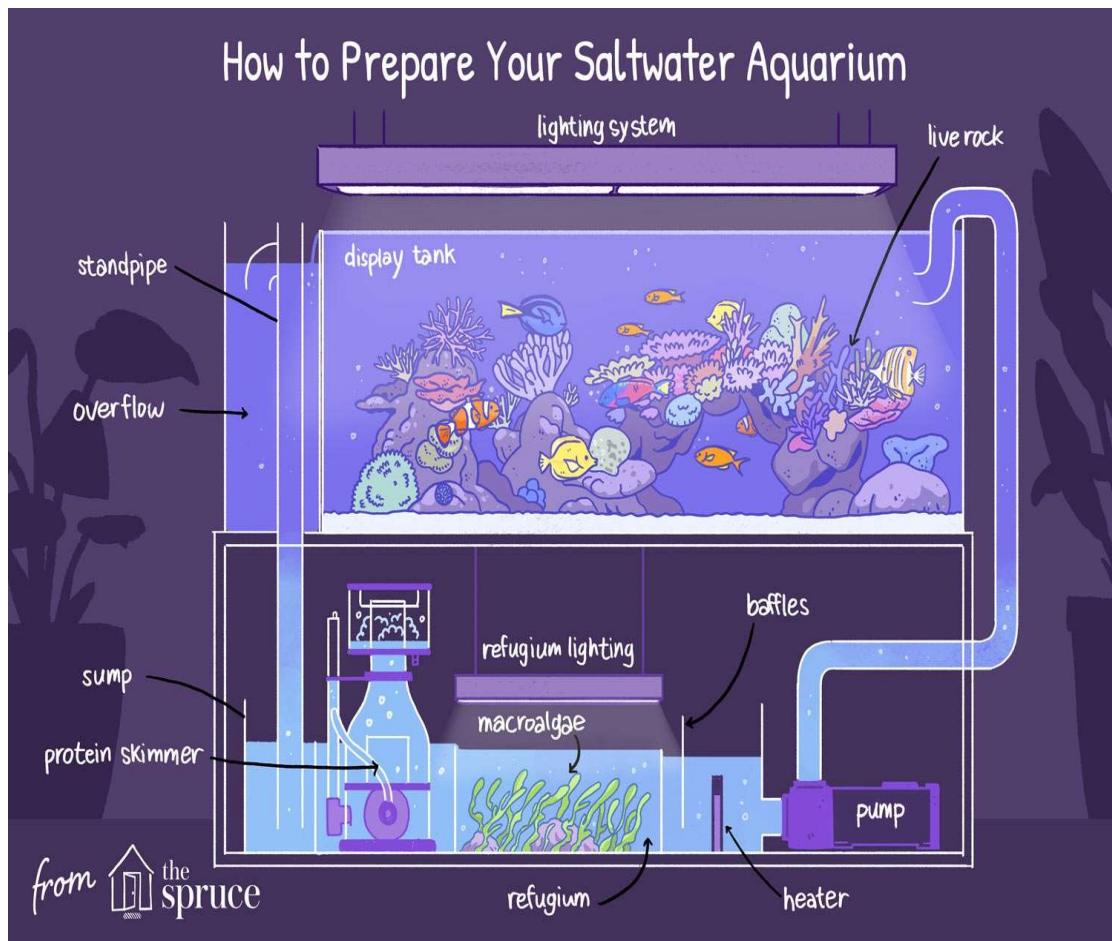


fig 1

OUTCOME

We can create Ammonia, Nitrite and Nitrate free and always fresh marine environment for the Marine fishes that we are keeping in an aquarium.

The major threats for the marine fishes are the Ammonia, Nitrate, Nitrite, Phosphate and ph.

The algae that are used in the Scrubber can be fed to the livestock.

Remove Disease Causing algae from the Aquarium by taking up the nutrients and other elements which support the Growth of bad Algae's.

The purified water can used for planting (contains small amount of ammonia which is good for the plants to grow).

These algae can be used as an Indicator

- If the color of the algae is slightly yellow in color, then it is iron deficient which can be addressed
- If the color the algae is slightly brown in color, then its diatom which must be removed

WATER CHEMISTRY

Nutrients

- Ammonia
- Nitrite
- Nitrate
- Phosphate

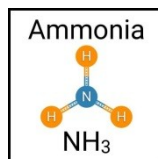
Minerals

- Carbonate & Bicarbonate(KH)
- Calcium
- Magnesium

Environmental Indicator

- pH
- Alkalinity
- Salinity
- Temperature

AMMONIA



Ammonia is a toxic nitrogenous compound released when anything organic breaks down. A large amount of decomposition [e.g. from a carcass (dead animals) or uneaten food] can cause ammonia to spike. Specialized bacteria (Nitrosomonas, Nitrospira, Nitrosococcus, and Nitrosolobus) convert ammonia to nitrite.

Saturated Ammonia Level:

Ammonia levels above 0.25 ppm can suffocate fish, coral and invertebrates in a matter of hours. It is typically present in new tanks and should be cycled out completely before animals are slowly introduced.

Ways to decrease:

- Dilution via water change
- Ammonia neutralizers such as Seachem Prime
- Biological filtration (add heterotrophic bacteria like Prodigio to speed up biofilter development)
- Aquatic plants absorb and benefit from ammonia

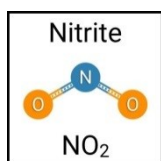
Low Ammonia Level:

No issues arise from too little ammonia, except when cycling a new tank. Ammonia is necessary at first to fuel the development of bacteria that convert ammonia to nitrite.

Ways to increase:

- Add a carbon source (e.g. food, animal waste, or other organic matter) and allow to decompose

NITRITE



Nitrite is a toxic nitrogenous compound produced by bacteria as part of the nitrogen cycle. Specialized bacteria convert nitrite to nitrate.

Saturated Nitrite Level:

Nitrite will reduce the amount of oxygen in fish's blood, and levels above 1 ppm can be lethal in a matter of hours. It is typically present in new tanks and should be cycled out completely before animals are introduced incrementally.

Ways to decrease:

- Dilution via water change

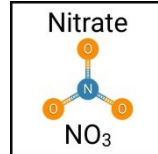
- Nitrite neutralizers such as Seachem Prime
- Biological filtration (add heterotrophic bacteria like Prodigio to speed up biofilter development)
- Add aquarium salt to reduce nitrite toxicity

Low Nitrite Level:

Ways to increase:

- No issues arise from too little nitrite.

NITRATE



The last and least toxic of the nitrogenous compounds, this nutrient is beneficial in small amounts, encouraging plant and algae growth. It is converted from nitrite by specialized bacteria.

Saturated Nitrate Level:

Nitrate levels above 30 ppm can be lethal to aquatic animals in a matter of hours. More nitrate will also lead to more algae growth.

Ways to decrease:

- Dilution via water change
- Use an algae scrubber as part of your filtration system
- Biological filtration (add heterotrophic bacteria like Prodigio to speed up biofilter development)
- Add Marine-Pure blocks or dry rock to provide a habitat for denitrifying bacteria within anoxic zones
- Dose liquid carbon (NO₃:PO₄-X or distilled white vinegar)

- Aquatic plants absorb and benefit from nitrate

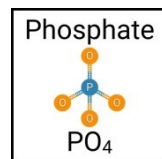
Low Nitrate Level:

A lack of nutrients will reduce algae growth. While this might enhance colour, it will also result in coral fragility because coral derive glucose and essential amino acids from algae.

Ways to increase:

- Increase feeding
- Increase Bio load
- Dose potassium nitrate (KNO₃)

PHOSPHATE



Phosphate is a nutrient that supports photosynthesis, a vital process to the algae living inside coral.

Saturated Phosphate Level:

Too much phosphate can increase the potential for nuisance algae growth, discolour coral due to increased zoo xanthellae, and inhibit coral calcification (growth).

Ways to decrease:

- Dilution via water change
- Use an algae scrubber as part of your filtration system
- Use filter media like granular ferric oxide (GFO) or lanthanum chloride
- Add heterotrophic bacteria like Prodigio
- Dose liquid carbon (NO₃:PO₄-X or distilled white vinegar)

Low Phosphate Level:

A lack of phosphate is usually of little concern unless it corresponds to a lack of nutrients in general. While dosing potassium phosphate would increase only phosphate, it's typically better to increase other nutrients as well by:

- Increase feeding
- Increase bioload
- Dose amino acids like AcroPower

pH

pH is a general environmental indicator that is the cumulative result of many different chemicals and compounds (especially alkalinity /KH). It is a measure of the acidity or basicity of water. Because water enters fish down to their very cells through osmosis, a change in pH of the water causes a change in pH of their blood. Regulating their internal pH takes time and energy, which is why fluctuations are dangerous to fish, even if the pH remains in the recommended range. pH should be maintained constant to a 1/10 precision (e.g. constantly 8.2, not swinging between 8.1 and 8.3).

Standard pH Level

It is usually a battle to keep pH levels high enough in a reef aquarium. However, pH levels can be toxic if too high. Ways to decrease:

- Add soda water
- Dose distilled white vinegar
- Drive in CO2 gas through aeration (a function of protein skimmers)

Low pH Level

Low pH levels can disrupt biochemical reactions and inhibit calcification. The best ways to increase pH is to drive out CO2 because it acidifies water.

- Use an algae scrubber as part of your filtration system (algae absorbs CO2)

- Use a CO2 scrubber hooked up to a skimmer

LIGHT SOURCE

As the culture is algae we should provide light source for carrying out photosynthesis. Here we are using combination of red and blue LED's (50% of red light with wavelength 630 to 700nm and 15% of blue light with a wavelength 400 to 495nm). This colour combination look Magneta visually.

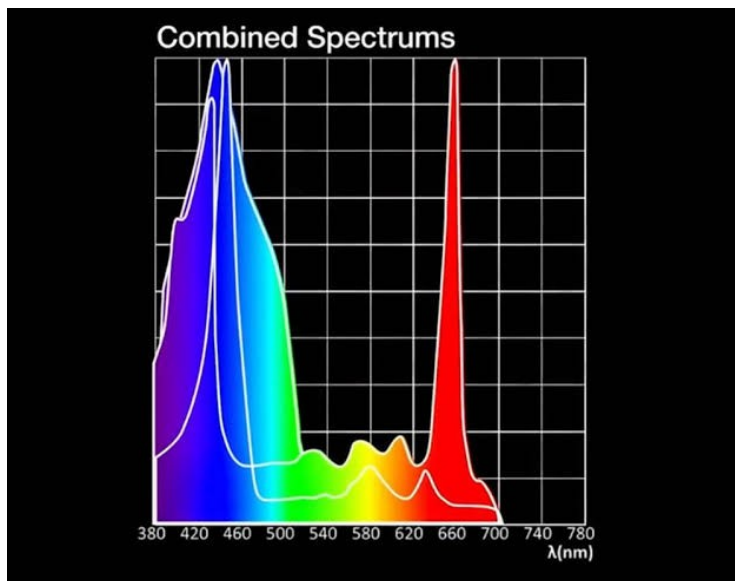


Fig 2; Magneta Wavelength

MATERIALS REQUIRED

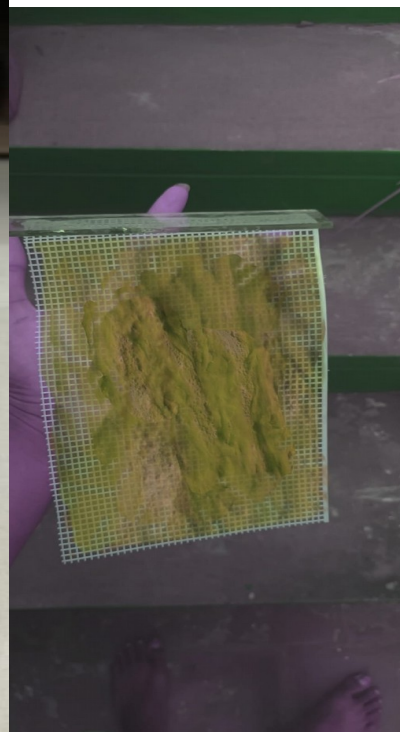
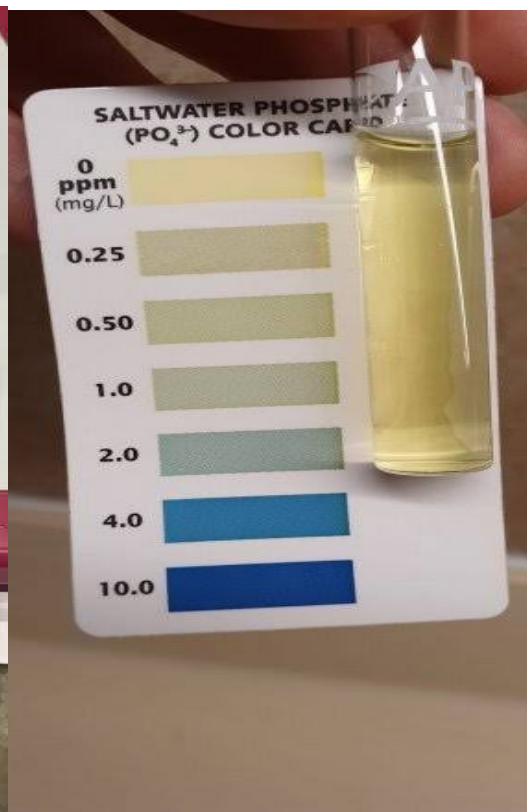
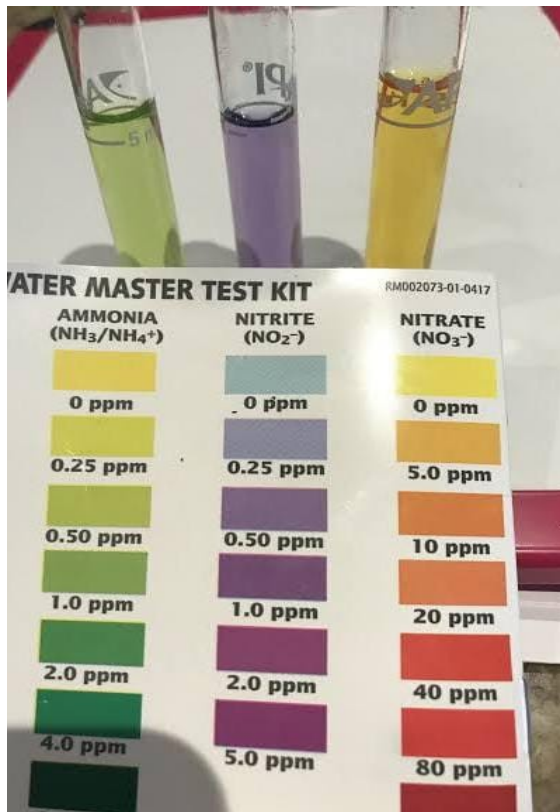
- 4mm Glass (2 x 1)
- Rubber pipe
- Silicon gel
- Matured Marine Tank
- High Spectrum LED Lights
- LDR SENSOR (for light sensing)
- 100 K ohm Resistor
- BC 547 Transistor
- Motor
- A Plastic Mesh
- PVC Pipe with holes in it
- Marine Algae
- pH meter
- TEST KITS
 1. Ammonia
 2. Nitrate
 3. Nitrite
 4. Phosphate

RESULT

The Results were Observed to be as follows

	AMMONIA	NITRITE	NITRATE	PHOSPHATE	pH
BEFORE SCRUBBER	0.5ppm	0.5ppm	20ppm	2ppm	7.5
AFTER SCRUBBER	0.25ppm	0.25ppm	5ppm	1ppm	7.5

TABLE 1



CONCLUSION

We were able to produce system which can control the ammonia, Nitrate, Nitrite, Phosphate and pH all in one system.

The major advantages of our product over the conventional methods are as follows

- Cheap
- Compact in size than Refugium
- Efficient
- Can be used in Nano marine tanks
- Avoid growth of Nuisance creating Crustaceans and Algae's

REFERENCES

- BASIC OF MARINE TANK: https://en.m.wikipedia.org/wiki/Marine_aquarium
- FIG 1 source: https://www.google.com/search?q=marine+tank+with+sump&client=ms-android-samsung-ss&prmd=sivn&sxsrf=ALiCzsaiuiU2tddi6KY5fh5ZDGag7ox4lw:1651163162802&source=lnms&tbn=isch&sa=X&ved=2ahUKEwicvKOOlrf3AhVtRmwGHXtBCqQQ_AUoAnoECAIQAg&biw=384&bih=777&dpr=2.81#imgsrc=8aVy-Smte_jQCM
- Water Chemistry: <https://aqualabaquaria.com/pages/reef-aquarium-water-testing-chemistry-guide>
- Scrubber Guidelines: <https://www.bulkreefsupply.com/content/post/brstv-setup-guide-clearwater-algae-turf-scrubber>
- FIG 2 Source: https://www.google.com/search?q=magenta+light+spectrum&client=ms-android-samsung-ss&prmd=ivsn&sxsrf=ALiCzsbfcVyyBBXz7KEtixCA0G8lhNC_sw:1651162629924&source=lnms&tbn=isch&sa=X&ved=2ahUKEwiamZeQILf3AhVNxTgGHYaXBREQ_AUoAXoECAIQAQ&biw=384&bih=777&dpr=2.81#imgsrc=wP9wslc2NKjS0M