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An Alternative Approach of Treating Waste Water with Algal Biomass

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Abstract: Water is inevitable and of course the Elixir of life, it finds it way when wake to seep in all common men's life. Due to modernization and population explosion it gets polluted and need to be treated to find its other way in domestication such as irrigation and others excludes potability. Though many conventional methods are available, methods of biological treatments are quite different and enhances the vitality of Biological substances to utilize the chemical components for their life. Such an attempt is the alternative approach of treating Waste Water with Algae.

Keywords*: Potabiity, Poution, Algae***.**

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I. INTRODUCTION

➢ *Water*

Water is a clear, tasteless, and odorless liquid that is essential for all living things. It covers most of the Earth, about 71%, and is found in oceans, rivers, lakes, glaciers, and underground. Water is made of two hydrogen atoms and one oxygen atom (H_2O). It also exists in different forms as liquid (like in rivers), solid (like ice in glaciers), and gas (like steam from boiling water). This constant reformation of water in the environment is called the water cycle.

➢ *The Water Cycle*

When the sun heats up water from oceans, rivers, and lakes, turning into vapor (gas) that rises into the sky. Condensation occurs when the water vapor cools, forming clouds in the atmosphere. Precipitation occurs when the clouds become heavy, make water to fall back in to the earth as rain, snow, or hail. Collection and Absorption occur when water returns to oceans, lakes, or underground reservoirs, where it can be reused.

➢ *Conservation and Protection of Water*

Water is the foundation of life, supporting everything from our bodies to the environment. However, it is not unlimited, Pollution and its overuse are reducing its availability. By preventing pollution, we can ensure that the future generations can also access to clean and safe water as us.

➢ *Understanding Pollution*

Pollution occurs when detrimental substances enter the environment. These damaging substances are known as contaminants. Contaminants can be naturally occurring, like volcanic ash, or generated by human actions, such as waste or discharge from industries. Contaminants degrade the purity of air, water and soil. Results from emissions produced by industries, vehicles, burning waste, and chemical processes. Contributes to respiratory illnesses, lung disorders, and climate change. Major contaminants: Carbon emissions, nitrogen-based compounds, sulfur particles, and airborne dust. Occurs when toxic substances, waste materials, and untreated sewage flow into water bodies such as rivers, lakes, and seas. Leads to the spread of waterborne infections and disrupts marine ecosystems.

➢ *The World Health Organization (WHO)*

The World Health Organization (WHO) recognizes pollution as a significant danger to both public health and the natural world. It negatively impacts the air we inhale, the water we consume, and the soil we rely on, leading to severe health complications and environmental destruction. WHO has been actively researching the detrimental effects of pollution on human well-being and has established guidelines to minimize its global impact.

To tackle pollution on a global scale, WHO has introduced several key initiatives aimed at protecting environmental and human health. It has set international air quality standards to help governments regulate pollution levels. Through clean air programs, WHO encourages nations to adopt sustainable energy sources and reduce reliance on fossil fuels. The organization also works to enhance water safety and sanitation systems to prevent waterborne diseases. WHO invests in research and monitoring to analyze the health risks associated with pollution and provides valuable data for

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policymakers. Additionally, it conducts public awareness campaigns to educate communities on how to minimize pollution in their everyday live.

➢ *The Need for Urgent Action*

Pollution remains a critical challenge that requires urgent attention and collective action. WHO emphasizes the importance of implementing effective policies, sustainable practices, and technological advancements to reduce environmental contamination. By addressing pollution at its source, nations can safeguard human health, protect ecosystems, and ensure a healthier future for generations to come.

II. AIM & OBJECTIVES

As per the statement of WHO the scarcity of Fresh water is majorly due to the Manmade pollution and alterations in its native Hydro cycle of the atmosphere. Hence there is a need for the investigation of newer Contemporary techniques for its recycling.

In this present study we aim the above by determining

- pH
- TDS
- Nitrate Concentration
- Phosphate Concentration &
- Minimal Microbial Growth Concentration

III. MATERIALS AND METHODS

➢ *Sludge Collection*

Sludge was collected from Ariyamangalam, Tiruchirappalli District, a highly polluted region. Mud samples and sludge were taken from a waterlogged site, and the gravity thickener was filtered using a mesh and stored in a polymer container for further processing.

➢ *Substrate Preparation*

The collected sludge was stored in a polymer container and subsequently transferred to 250 mL conical flasks (mini-reactors) for incubation. The sludge is added with measured volume of distilled water to achieve the desired concentration before being sterilized through autoclaving at 120°C to eliminate unwanted microorganisms.

➢ *Algal Strain Culture*

Spirulina platensis was obtained from Spiru Bazaar, a State Government Organization in Illupur, Pudukkottai District. It was cultivated in an organic medium that supports growth and maintained in an incubator-shaker at 37°C maintaining 110 RPM to ensure optimal growth conditions.

➢ *Incubation*

Aseptically, 1ml of sludge and 1ml of Spirulina, along with 1ml of sludge and 0.5 mL of *Spirulina* were transferred into sterilized mini-reactors in duplicate. The inoculated mini-reactors were labeled SP 1:1 and SP 0.5 *(S. platensis)*, while sterile sludge served as the control. The mini-reactors were incubated in an incubator-shaker at 37°C maintaining 110 RPM for one week, with an electric bulb serving as the light source.

IV. DETERMINATION OF pH & TOTAL DISSOLVED SOLIDS (TDS)

10 ml of the sludge sample was analyzed for pH and dissolved solids. The pH of the sludge sample was measured using a pH meter, which indicated a pH of 9, classifying it as basic. For TDS measurement, an empty conical flask was first weighed, and 10 ml of sludge was added. Then the flask was placed in a water bath until all water evaporated, leaving only solid residue. The dried sludge was then weighed using an analytical balance to determine the solid content.

V. DETERMINATION OF NITRATE

➢ *Preparation of Reagents*

- *Nitrate Standard Solution:*

0.722 gm of potassium nitrate (KNO_3) was dissolved in 1l of distilled water (1 ml = 0.1 mg NO_3-N). Standard solutions were prepared in the concentration ranging from 0.1 to 1 mg / l NO_3-N.

- *Brucine-Sulfanilic Acid Solution:*

1 g of brucine sulphate and 100 mg of sulfanilic acid were dissolved in 70 ml of hot distilled water, followed by 3 ml of concentrated HCl, then diluted to 100 ml

- *Sulfuric Acid Solution:*

500 ml of concentrated H_2SO_4 was added to 75 ml of distilled water and then cooled to room temperature.

➢ *Procedure*

- A standard calibration curve (0.1 to 1 mg/ l NO_3-N) was prepared and distilled water served as a blank.
- About 5 ml of the sample was placed in a 50 ml beaker.
- To it 1 ml of Brucine-Sulfanilic Acid Solution was added.
- 10 ml of sulfuric acid solution was added along the beaker's sidewall and mixed well.
- The beakers were kept in the dark for 10 minutes.
- After 10 minutes, about 10 ml of distilled water was added to it.
- The solution was then allowed to cool in dark for 20-30 minutes.
- The Optical density of the sample was then measured at 410 nm in a colorimeter.
- If the sample concentration exceeded the calibration curve, it was diluted with distilled water.

VI. DETERMINATION OF PHOSPHATE

➢ *Preparation of Reagents*

- *Ammonium Molybdate Solution:*

25 gm of ammonium molybdate was dissolved in 175 ml of distilled water. About 280 ml of con H_2SO_4 was added

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to 400 ml of distilled water and cooled. The two solutions were mixed then diluted to 1l.

- *Stannous Chloride Solution:*

2.5 gm of stannous chloride was dissolved in 100 ml of glycerol by steady heating in a water bath.

- *Standard Phosphate Solution:*

0.22 gm of pre-dried anhydrous dipotassium hydrogen phosphate (K_2HPO_4) was dissolved in distilled water and then diluted to 1l (1 ml = 50 mg PO_4^{3-}-P). Standard solutions were prepared in the concentrations ranging from 20 to 200 mg/L PO_4^{3-}-P.

➢ *Procedure*

- A standard calibration curve (10 to 200 mg / l PO_4^{3-}-P) was prepared.
- About 50 ml of filtered water sample was taken in a conical flask and if the sample is colored or with colloidal impurities, a spoonful of activated charcoal was added and filtered. If the color still persist, about 2 ml of perchloric acid was added, evaporated and diluted to 50 mL with distilled water.
- About 2 ml of ammonium molybdate solution and 5 drops of stannous chloride reagent were added to the sample, appearance of blue color indicates the presence of phosphate in the sampe.
- Sight After 5 minutes but before 12 minutes, optical density was measured at 690 nm using colorimeter.
- If the sample concentration exceeded the standard curve, it was diluted with distilled water.

VII. RESULTS & DISCUSSION

The Sludge thus collected was subjected to treatment with *Spirulina* by concluding the following parameters of the Sludge in concern

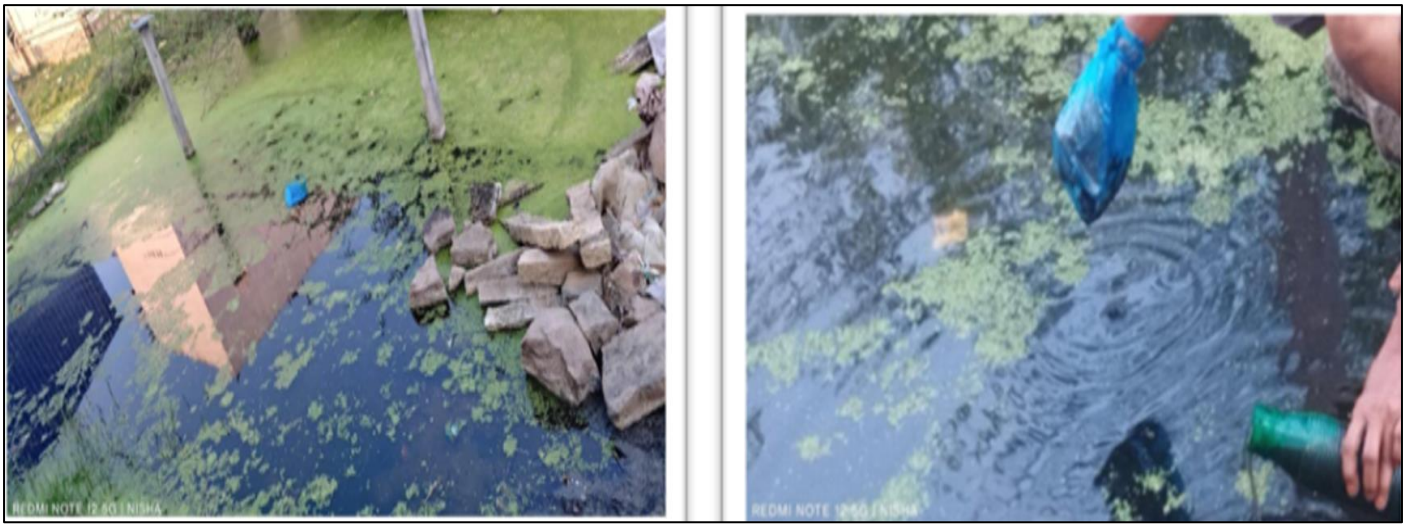

Fig 1 & 2 Collection of Sludge Sample

- pH
- TDS
- Nitrate Concentration
- Phosphate Concentration

➢ *pH*

The pH of the Sludge sample is measured then and then at regular intervals from Day 1 to the end of the study

Table 1 Measurement of pH

Parameter	Day	Concentration of Spirulina in Sludge	
		1/1 Concentration	1/2 Concentration
pH	Day 1	10.2	10.2
	Day 3	9	8.6
	Day 6	6.3	7.6
	Day 9	4.2	3.2

The lower pH in wastewater treatment indicates an increase in acidity, potentially due to the accumulation of acidic substances or the breakdown of organic matter by the Multiplying Algal mass, which is a negative impact but can be setted right by further treatments eithchemically with Calcium Hypochlorite which detoriates and decolorizes the sludge or by biological treatment in Oxidation ponds

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➢ *TDS (Total Dissolved Solids)*

The TDS of the Sludge sample is also measured then and then at regular intervals as pH from Day 1 to the end of the study and recorded.

Table 2 Measurement of pH

Parameter	Day	Concentration of Spirulina in Sludge	
		1/1 Concentration	1/10 Concentration
TDS	Day 1	4.48 gm	4.48gm
	Day 3	3.5 gm	4.1gm
	Day 6	3.1gm	3.7 gm
	Day 9	2.5gm	3.4 gm

The High TDS in wastewater treatment indicates an increase in accumulation of Mineral salts & Metals, by the Multiplying Algal mass, which indicates the positive approach in treatment of the sludge

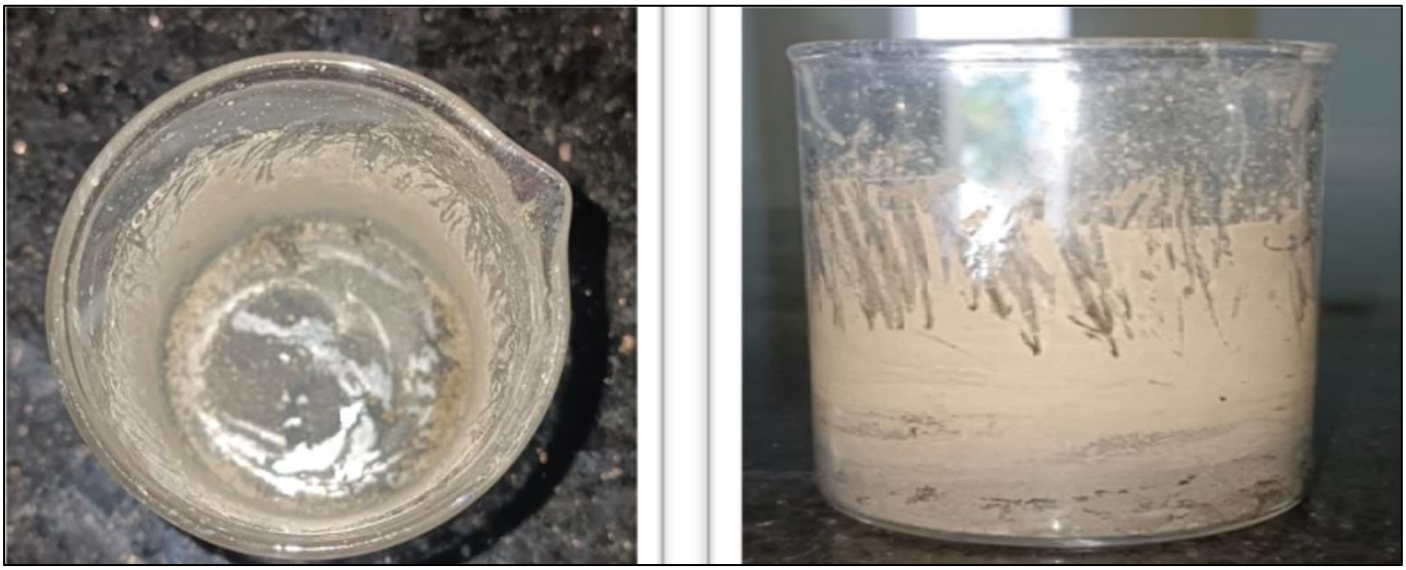

Fig 3 Determination of Nitrates & Phosphates

Table 3 Measurement of Nitrates

Parameter	Day	Concentration of Spirulina in Sludge	
		1/1 Concentration	1/10 Concentration
NO2	Day 1	100µgm	100µgm
	Day 3	94µgm	100µgm
	Day 6	88µgm	94µgm
	Day 9	72µgm	89µgm

Table 4 Measurement of Phosphates

Parameter	Day	Concentration of Spirulina in Sludge	
		1/1 Concentration	1/10 Concentration
PO4	Day 1	75µgm	75µgm
	Day 3	74µgm	75µgm
	Day 6	67µgm	71µgm
	Day 9	55µgm	69µgm

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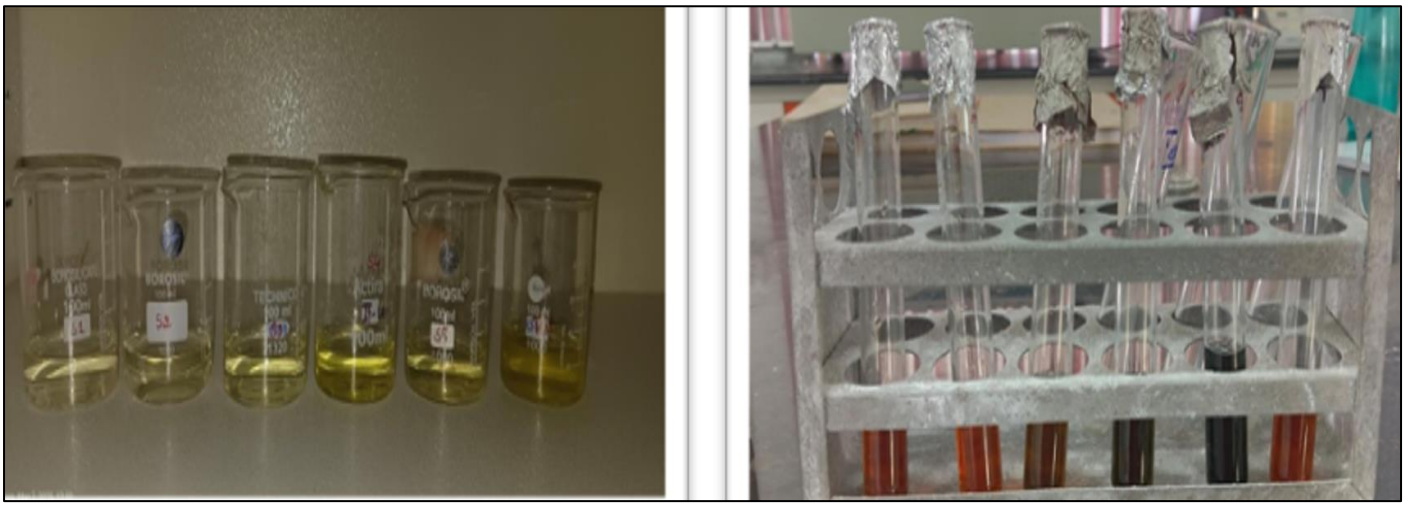

Fig 4 Test indicating the Presence of Nitrates & Suphates

After each three days interval of incubation, samples were collected from each mini-reactor and the concentration of Nitrate (NO_3-N) and Phosphates (PO_4^{3-}-P) were determined based on the standard calibration curves. Optical density values were recorded, and concentrations were calculated accordingly. Results were analyzed to assess the removal efficiency of Spirulina platensis in wastewater treatment.

Lowering nitrates in wastewater treatment indicates successful removal of a potential pollutant and a step towards cleaner water, often achieved through biological processes like denitrification or chemical reduction.

Lowering phosphates in wastewater treatment indicates successful implementation of processes to remove phosphorus, preventing eutrophication and protecting water quality for both aquatic ecosystems and human use.

➢ *Repeated Assessment of pH*

Finally, the treated sludge is added with Calcium Hypochlorite and agitated for continuous 5 days to check whether the pH in both the concentration differs, it shows slight variations in pH, tending to change alkaline.

Table 5 Measurement of pH (Day 14)

Parameter	Day	Concentration of Spirulina in Sludge	
		1/1 Concentration after Day 9	1/2 Concentration after Day 9
pH	Day 14	6.3	5.3

➢ *Microbial Assessment*

Simultaneously a culture analysis with Nutrient Agar was performed with both the concentration of treated sludge, where null colonies were identified, which indicates the absence of microbial survival

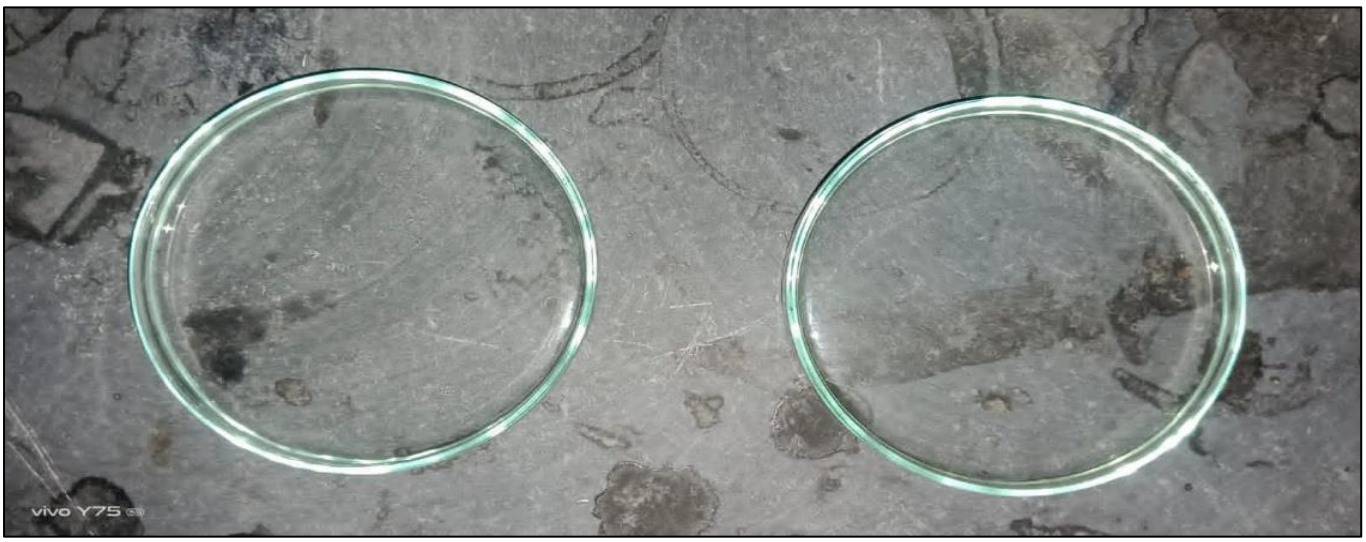

Fig 5 Measurement of Microbial Viable Count

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VIII. CONCLUSION

Hence, from the performed study of Waste water treatment assisted by ***Spirulina*** at different concentration, we wish to conclude the following

- The pH of the treated waste water decreases due to the breakdown of organic matter by the Multiplying Algal mass, and turns Acidic and that is then setted right by chemical treatment with Sodium Hypochlorite or other Alkali metals
- The decrease in TDS shows confidentiality in the treatment of Wastewater. The decrease is due to the accumulation of Mineral salts & Metals, by the Multiplying Algal mass
- The decrease in the concentration of Nitrates & Phosphates shows the removal of potential pollutants stepping towards cleaner and clearer.
- The Nil Microbial assessment with Nutrient Agar Media proves the water to be free from Minimal microbial content
- Though it is free from Microbe, Clear and turns Alkaline with subsequent Chemical treatment with Alkali elements the treated water is not POTABLE, it can only be used for domestic purposes like washing and irrigation

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