TO STUDY THE POTENTIAL OF MICROALGAEIN WASTEWATER TREATMENT & ITS EFFICIENCY FOR ENERGY PRODUCTION

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Abstract - Physicochemical or biological (non-microalgal) methods for treating various types of waste water might not be efficient or energy-intensive. Microalgae are microscopic organisms that flourish in bodies of water that give them with the nutrients they need. Nitrogen, phosphorus, and other elements are commonly found in waste streams, which microalgae require for cell development. This paper shed the light on treatment of waste water using algae and also to check its efficiency for energy production.

We are making this project model for wastewater filtration. Up to 80% of surface water in India is polluted, owing mostly to untreated wastewater sludge. This research offers the growing of algae in urban wastewaters as a long-term solution for extracting nutrients from wastewaters and repurposing them. This study looks at the potential of microalgal wastewater treatment and the use of the resulting microalgal biomass as a renewable energy source.

Keywords—Wastewater, Microalgae, Energy

INTRODUCTION

Increased water consumption and a water shortage have resulted from global economic and societal growth. Although several wastewater treatment systems exist, each has its own set of disadvantages and benefits. As a result, it would be critical to choose one that could effectively purify the water. Microalgae may remove pharmaceutical compounds and pesticides from wastewater generated by industry and agriculture, according to recent studies. Because of its capacity to grow, digest, and endure hazardous situations in wastewater, microalgae is a adaptable organism for curing a wide range of liquid discharge. Microalgae are one of the most efficient renewable energy sources. It has the potential to grow swiftly and generate oil all year round. The use of microalgae biomass as a industrial material for biofuel manufacturing was first proposed, and it sparked a lot of attention. Microalgae are predicted to become an important source of amino acids, vitamins, and valuable by-products. Microalgae, farming is recognised to be the most profitable business in the biotechnology sector. It is a route that produces less trash, is ecologically friendly, and saves energy and resources.

LITERATURE REVIEW

Early studies of microalgae on wastewater were done to test their ability to aerate and treat wastewater. Most of this research was performed by William J Oswald and his fellow researchers at the University of California, Berkeley. HRAPs (High-Rate Algal Ponds) are specialised open pond systems for producing microalgae in order to remediate wastewater. The design of these systems was based on the observational growth of microalgae growing in natural pond systems as well as stabilisation ponds. Researchers started looking into wastewater-grown microalgae as a possible food source as well. The notion of employing microalgae to combine wastewater treatment and food production was briefly considered but abandoned for a variety of reasons. Furthermore, research can be done using microalgae grown in wastewater for energy generation began with the use of microalgae as a industrial material for methane synthesis and oxygen generators for biochemical fuel cells. While cheap energy prices spurred the adoption of these concepts, they did give academics with a basic knowledge of renewable energy generation decades later Microalgae would resurface as a major waste treatment research topic. Since then, many global efforts have funded in-depth research into the development of microalgae wastewater treatment. These efforts include utilising types of wastewater as well as integrating them with immobilised systems. The majority of this study has concentrated on growing microalgae on wastewater and then using it as a biofuel.

MICROALGAE

Microalgae are prokaryotic photosynthetic organisms. They may grow swiftly in fresh or saline water because to their unicellular or basic multicellular structure. They are particularly effective solar energy converters due to their basic cellular structure. Microalgae cells have easy access to water, CO_2, and other nutrients because they develop in an aqueous suspension. More than 3 lac species of microalgae exist. It's one of our planet's oldest living things. Both autotrophic and heterotrophic microalgae exist. As a source of carbon, autotrophs are inorganic molecules. Photoautotrophs derive their energy from light, whereas chemoautotrophs acquire their energy from the oxidation of inorganic compounds. Organic chemicals are used by heterotrophs in order to grow. Heterotrophs can be photoheterotrophs, meaning they get their energy from light, or chemotrophs, meaning they get their energy by oxidising organic compounds.

Fig- Microalgae

COMPOSITION OF TYPICAL WASTE WATER

Water channels are polluted by a variety of sources that vary in intensity and volume. The wastewater constituents reflects the lifestyles and technologies of the producing culture. It's a complex blend of organic and inorganic elements, as well as synthesised chemicals. More than half of the organic carbon in sewage is made up of carbohydrates, lipids, amino acids, proteins, and volatile acids. Inorganic components include large levels of calcium, sodium, chlorine, ammonium salts, potassium, sulphur, bicarbonate, phosphate, magnesium and heavy metals. Pollution can take many forms, including sewage discharges from cities and villages, discharges from production and industrial activities, runoff from farming land, and leachates from solid waste disposal facilities. Examples of various pollution sources. These polluted areas have challenges, and a remedy is being sought. We must explore the practicality of reuse of wastewater and resource reclamation due to scarcity of water, electricity, and food.

USE OF ALGAE IN WASTEWATER TREATMENT

- Over the last 50 years, biological wastewater treatment systems based on micro algae have grown in popularity, and wastewater treatment systems based on algae are now usually regarded to be as fruitful as traditional wastewater treatment systems.

- As a result of these qualities, wastewater treatment systems based on algae have emerged as a feasible low-cost substitute to complex, high-cost treatment systems, particularly for municipal wastewater purification.

- Algae may store extremely dangerous elements like selenium, zinc, and arsenic in their cells and/or bodies, therefore removing them from aquatic habitats.

- Radiation is another important cause of pollution, as some water contains radioactive materials naturally and others become radioactive as a result of contamination.

- Given algae's ability to clean a range of polluted streams, it's no surprise that algal technology in wastewater treatment systems is expected to grow in popularity in the future years.

REDUCTION OF BIOLOGICAL AND CHEMICAL OXYGEN DEMAND

As previously said, wastewater contains a variety of substances and microbes that might pollute a watercourse. Organic materials, inorganic materials, and microbiological contents can all contribute to wastewater pollution. Organic compounds in wastewater are made up of a wide range of substances, all of which contain at least one carbon atom. Carbon dioxide can be produced by oxidising these carbon atoms chemically or biologically. The Biochemical Oxygen Demand (BOD) test is used when biological oxidation is used, whereas the Chemical Oxygen Demand (COD) test is used when chemical oxidation is used (COD). To put it another way, BOD uses molecular oxygen as an oxidising agent to allow bacteria to transform organic matter to carbon dioxide and water. As an outcome, biochemical oxygen demand is a measurement of bacteria's respiratory requirement when metabolising organic materials in wastewater. Surplus BOD can decrease the dissolved oxygen in receiving water, resulting in fish deaths and anaerobiosis, thus it's important to get rid of it. In 1998, Colak and Kaya researched at the feasibility of using algae to cleanse biological wastewater. They discovered that the elimination of BOD and COD in household wastewater treatment was 68.4 percent and 67.2 percent, respectively.

ELIMINATION OF N AND P

Microalgae uses nitrogen and phosphorus, light and CO_2 to produce their own organic molecules through photosynthesis. Microalgae require a definite ratio of carbon, nitrogen, and phosphorus for optimal development. The ideal C: N: P ratio is around 106: 10: 1. High N:P proportion (about 30:1) indicate Phosphorous limitation, whereas low N:P ratios (around 5:1) indicate N-restriction (Darley, 1982). Based on normal wastewater amounts of these nutrients, phosphorus was shown to have a minor impact on microalgae development, whereas nitrogen did. Overall, wastewater contains high levels of nitrogen and phosphorus, which do not appear to be a problem for microalgae development. Carbon and light are more likely to restrict microalgae development in wastewater. Figure 2.4.1 shows how the availability of dissolved CO 2 in wastewater changes dramatically with pH. CO 2 is prevalent at lower pH levels. Algal growth is inhibited by low CO2 concentrations. However, since CO2 is constantly accessible as a byproduct of bacterial respiration, this is not a problem in wastewater treatment.

PROCEDURE

To prepare microalgae, we need to perform the following steps-

- As a base solution, we utilise sodium alginate and 1% $CaCl_2$. To begin, sodium alginate (Fisher Scientific) was gently swirled in lukewarm distilled water for 20 minutes before autoclaving at 121°C at 15 psi pressure.

- At one drop per second, a peristaltic pump (MASTERFLEX) was utilised to dropwise inject sterile alginate solution into CaCl2 solution from a height of 2.5 cm above.

- The 4 mm beads were maintained in the $CaCl_2$ solution for 30 minutes to permit the alginate to solidify completely.

- To remove any leftover $CaCl_2$, the beads were rinsed numerous times. Counting a known volume of alginate beads yielded the number of beads created. 100 cc of alginate solution yielded approximately 3000 beads.

- The beads were made with various amounts of alginate and calcium hardening cation.

- The beads were grown in Guillard's f/2 medium for 15 days and stirred vigorously using an orbital shaker. The results showed that increasing alginate and $CaCl_2$ concentrations improved bead stability.

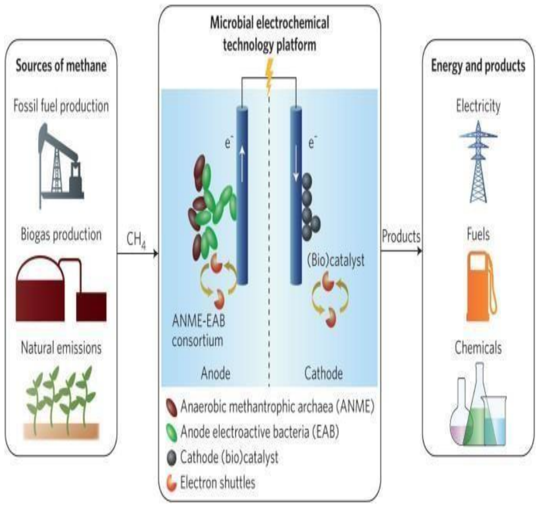
RENEWABLE SOURCES OF ENERGY

Renewable energy sources may be utilised again and again. Renewable resources include wind, geothermal energy, solar energy, hydropower, and biomass. Nonrenewable sources produce far more pollution throughout the harvesting and manufacturing of this resource. Solar energy is created by the sun. Solar panels are used by some homeowners to turn sunlight into power. Electricity is generated via wind turbines. Turbines resemble massive windmills. The Earth's crust generates geothermal energy. Engineers generate electricity by extracting vapour or quite heated water from the Earth's crust. Dams and rivers are used to generate hydropower. When water rushes over a dam, a turbine is engaged, which drives an electric generator. Biomass refers to natural materials like wood, dung, grain, and algal biomass from living creatures that are utilised as a source of energy.

FUTURE SCOPE

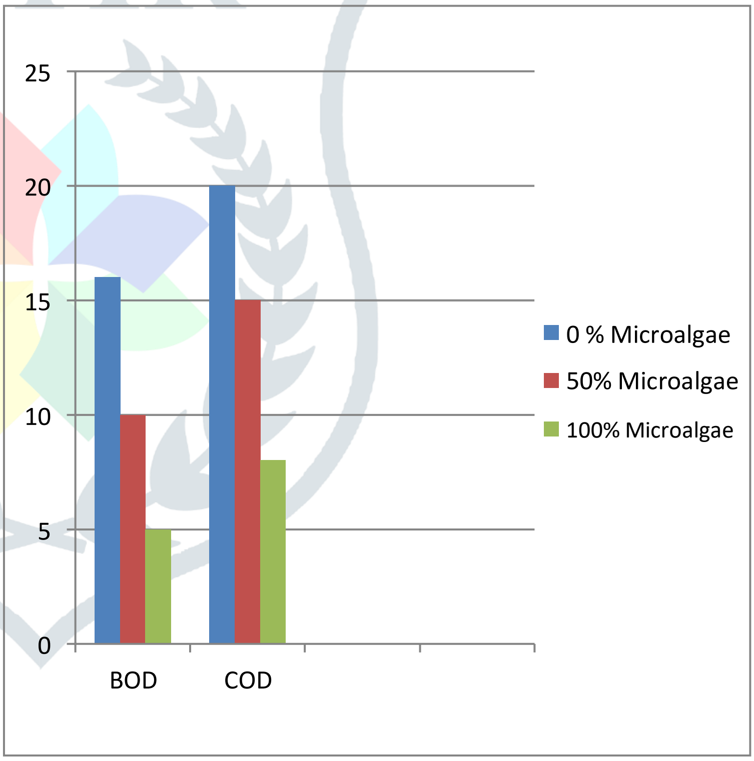
- Algae may be utilised to create power using a biophotovoltaic cell (BPV), which is a device that converts solar energy to electrical energy using a microbe.
- • The anode, cathode, and external circuit algae are located on the anode side. Since algae is able to carry out photosynthesis so we will provide the sunlight water and CO2 to algae.
- Algae will convert H_2O into H^+ and O_2 electron will be generated. This electron will move in via the external circuit to cathode from anode. The movement of electron will generate electricity. The electron will reach to cathode where h^+ and 0_2 combined to form water again.

The algae required for generate of electricity can be grown in lab.

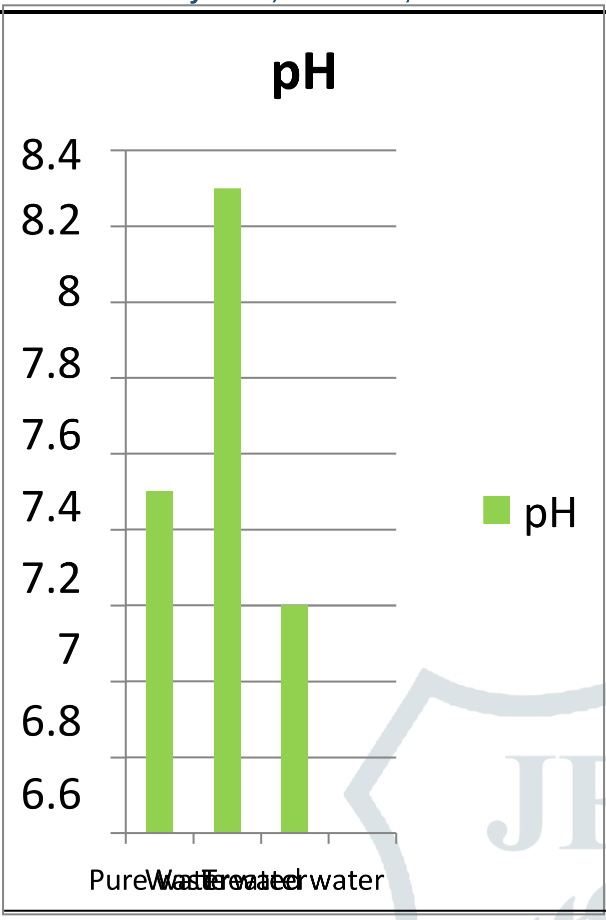


LABORATORY TEST & RESULT

In this experiment, we performed BOD & COD test of fresh water and sample water (treated water) and we got the following result :-



Graph of BOD & COD



Graph- pH level

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CONCLUSION

Algae may be utilised for a variety of applications in wastewater treatment.
a BOD reduction
b N and/or P removal
c Heavy metals are removed.
It becomes environmentally practical when microalgae is integrated into wastewater treatment.
To carry it out on a wide scale, technical breakthroughs are still required. On the anode side, it has an anode, cathode, and external circuit algae. Because of its quick developing rate, capability to adjust to various wastewaters, and ability to consume nutrients or expel pollutants from effluent, as well as carbon dioxide absorption, microalgal bioremediation of wastewaters might be very hopeful. Despite the huge potential of microalgal bioremediation of wastewaters, most of studies were restricted to indoor lab-scale microalgal growth research using a small number of strains to assess the removal ability of certain elements or chemicals. As a result, more research is needed to choose the best strain(s) from a larger range of algae species, as well as to understand treatment efficacy and long-term biomass productiveness in a large-scale outdoor setting under changing circumstances and wastewater qualities. The functions of individual microorganisms in microalgae–bacterial or microalgae–microalgae consortia necessitate a greater understanding of long-term outdoor functioning. The formation of a strain and application-specific energy-saving biomass gleaning are necessary for microalgal bioremediation of wastewater; in this instance, a self-subsiding strain or bioflocculating strain consortia should be generated. Furthermore, the collected microalgal biomass must be valued in a multi-product biorefinery plan to increase the economic feasibility and environmental sustainability of wastewater bioremediation.

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