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Emerging Bio-Strategy of Waste Water Treatment: Need of the Hour

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Abstract:

. The most exciting biomass in wastewater treatment application is microalgae. In a range of aquatic habitats, including lakes, ponds, rivers, oceans, and even wastewater, microalgae are the organisms that have the capacity to carry out photosynthesis. Even more successful treatment process can be use of bacterial-algal consortium because of their symbiotic interaction. Microalgae can sequester carbon and increase the growth of symbiotic aerobic bacteria by producing oxygen. In microalgae-bacteria consortia systems, microalgae can create a range of organic compounds that bacteria can consume. Limited availability and rising pollution of ground water, it has become critical to make the water reusable by eliminating pollutants. Apart from improving wastewater microalgae based treatment systems can also be utilized to make bio fuels and fertilizers. Wastewater has become both an environmental and an economical need; hence, its treatment is need of the hour.

Introduction

Microalgae are the organisms that have the ability to conduct photosynthesis and can be found in a variety of aquatic environments such as lakes, ponds, rivers, oceans and even wastewater. They can grow alone or in association with other species and endure a wide variety of temperatures, salinities and pH values as well as varying light intensities and circumstances in reservoirs or deserts. Microalgae can be a valuable source of carbon compounds for biofuels, health supplements , medicines and cosmetics. They can also be used in wastewater treatment.

Uncontrolled discharge of untreated residential and industrial wastewater contaminants into surface and subsurface water increases the levels of high BOD and COD. The metal processing and electroplating sectors are also adding different metals such as

Cadmium, Copper, Lead, Mangenese and Zinc. Because of the limited availability and rising pollution of ground water, it has become critical to make the water reusable by eliminating pollutants. As a result, wastewater treatment has become a need in terms of both the environment and a financial imperative (Khan *et al* 2018).

Interaction between Microalgae and bacteria

The use of algae to stabilize trash is gaining popularity around the world. Pond systems are both affordable and well known for their capacity to remove waste effectively. Pathogens and organic pollutants are two types of contaminants that can be found in the pond water (Zimmo*et al* 2002). Cyanobacteria and microalgae can serve a crucial function in pond system because they provide molecular oxygen to heterotrophic organisms. As a result, they assist the first stages of degradation (Cerniglia 1992). Microalgae are capable of removing nitrogen and phosphorus from wastewater with ease. Apart from improving wastewater microalgae based treatment systems can be utilised to make biofuels and fertilizers.

Microalgae are single cells that range in size from a few to dozens of micrometres. There are disparities between the size and structural function of microalgae. The biological removal of carbonaceous, nitrogenous, and phosphorus compounds from wastewater effluents using microalgae has been the subject of several studies. This has been done with several microalgal species on various types of wastewater, including municipal, agricultural, refinery, and industrial effluents, with varying levels of treatment efficacy and microalgae growth (Chiu et al 2015). Aquatic species during their different phases of development require various nutrients from a variety of microorganism. Microalgae containing high amount of eicosapentaenoic acid (EPA) or docosahexaenoic acid (DHA) (Chaetoceroscalcitrans, Isochrysisgalbana, etc.) are given during the developmental stage of young marine mollusks (Ran *et al* 2020).

In modern wastewater treatment applications, microalgae are the most fascinating and widely used type of alternative biomass (Acién*et al* 2016). The interactions between microalgae and bacteria are extremely complicated in natural habitat (Gonzalez *et al* 2000). Some bacteria can release hormones that encourage algal development. Microalgal consumption of CO2 is offering sequestration of Carbon and production of O2 is offering growth of symbiotic aerobic microbes by microalgae while treating waste water. Microalgae can produce a variety of organic molecules that bacteria can consume in microalgae–bacteria consortia systems. Algal cell walls contain a diverse range of functional groups that allow contaminants to adhere to the cell surface via a process known as biosorption(Spain*et al* 2021). This fast and reversible procedure is not dependent on the metabolism of the microalgae; therefore it can be used on living or dead biomass (Michalak*et al* 2013). However, their high production costs, microalgae are rarely used. A big financial outlay for the reduction procedure can also be accomplished by the use of media built on waste (Medina *et al* 2007). Moreover, a bacterial-algal consortium is useful as they develop a symbiotic relationship and make more profitable treatment process.

Advantages of microalga waste water treatment

Treatments based on microalgae have a lot of advantages. They do not require arable land for cultivation because they are an aquatic species. It means that microalgae cultivation does not have to compete for growing area with agricultural items. Fresh water, saline water, wastewater, and salt concentrations up to twice those of seawater can all be used well in algae culture (Satpal2016).

Several studies have proved that algal production aid in nutrient removal, despite the fact that it is difficult to compare the impacts of algal growth in wastewater treatment (Chawla et al 2020). The use of algae granules in synthetic wastewater has been shown to be extremely effective at removing phosphorus and recovering and reusing it from the resulting P-rich algae biomass. Microlage has been demonstrated to be a viable source of energy generation in addition to being efficient for CO2 collection and nutrient removal from wastewater (Arun*et al* 2020). Microalgae may use both organic and inorganic nitrogen, as well as nitrite and nitrates. The release of N_2O during the waste water treatment process is a result of the ambient conditions in which nitrogen removal occurs (Arun*et al* 2020). To remove inorganic N and P from waste water treated by algae, there is no need to switch between different operational settings, which reduce the treatment process' complexity and energy consumption. Infact, heavy metals and emerging pollutants like PPCPs may be removed using this technology (Pavithra*et al* 2020). Under tropical conditions, several aquatic or freshwater microalgae can be used to extract organic poisons (Hossain et al 2019). Green microalgae were utilised by Jimenez et al (2017) to remove 30-70% of PPCPs from home waste water. As a result, this wastewater treatment technique has a lot of attractive characteristics such as photosynthetic capability, fewer energy requirements and lower operating costs. Various heterotrophic bacteria decompose carbonaceous materials and produce oxygen via photosynthesis (Nguyen et al 2020; Mohsenpour et al 2021). It appears to be a feasible method to remove or alter pollutants from waste water, including nutrients, heavy metals, and other substances.

Conclusion

Organic pollutants are main contaminants of waste water including sewage, municipal and industrial waste water. These pollutants has found to increase levels of biological oxygen demand, chemical oxygen demand, nitrate, total phosphorus, total dissolved solid and total coliform in water bodies. Developed microalgae Bacterial consortium can degrade organic pollutants and can lower these levels below to the standards of pollution board. After that, treated water can be utilized for irrigation purpose.

References

Acién, F. G., Gomez-Serrano, C., Morales-Amaral, M.M., Fernandez Sevilla, J. M., Molina-Grima, E. (2016) Wastewater treatment using microalgae: how realistic a contribution might it be to significant urban wastewater treatment?*Applied Microbiology and Biotechnology*. 100: 9013–9022.

Arun, S., Sinharoy, A. (2020) Algae based microbial fuel cells for wastewater treatment and recovery of value-added products. *Renewable and Sustainable Energy Reviews*. 132: 110041.

Cerniglia, C. E. (1992) Biodegradation of polycyclic aromatic hydrocarbons. *Biodegradation*. 3:351-368.

Chawla, P., Malik, A. (2020) Selection of optimum combination via comprehensive comparisonof multiple algal cultures for treatment of diverse wastewaters. *Environmental Technology & Innovation*. 18: 100758.

Chiu, S. Y., Kao, C. Y., Chang, Y. B., Kuo, C. M. (2015) Cultivation of microalgal Chlorella for biomass and lipid production using wastewater as nutrient resource. *BioresourceTechnology*. 184: 179-189.

Gonzalez, L. E. and Bashan, Y. (2000) Increased growth of the microalgae Chlorella vulgaris when co-immobilized and co-cultured in alginate beads with the plant-growth- promoting bacterium *Azospirillumbrasilense*. *Applied Environment & Microbiology*. 66: 1527-31.

Hossain, N., Zaini, J., Azad, A. K. (2019) Elemental, morphological thermal analysis of mixed microalgae species from drain water.*Renewable Energy*. 131, 617-624.

Jiménez, Arnaldos M., Ferrer, E., Medina, F. and Contreras, S. (2017) Integrated processes for produced water polishing: enhanced flotation/sedimentation combined with advanced oxidation processes.*Chemosphere*. 168: 309-17.

Khan, M. I., Shin, J. H., Kim, J. D. (2018) The promising future of microalgae: current status,challenges, and optimization of a sustainable and renewable industry for biofuels, feed, and other products. *Microbial Cell Factories*.17: 36.

Medina, M.,Neis, U. (2007) Symbiotic algal bacterial wastewater treatment: Effect of food to microorganism ratio and hydraulic retention time on the process performance.*Water Science & Technology*. 55(11): 165-71.

Michalak, I., Chojnacka, K., Witek-Krowiak, A (2013) State of the art for the biosorption process-a review. *Applied Biochemistry & Biotechnology*. 170: 1389-1416.

Mohsenpour, Fatemeh S., Hennige, S., Gutierrez, T. (2021) Integrating micro-algae into wastewater treatment: A review.*Science of the Total Environment*.752, 142168.

Nguyen, Tam H., Yoon, Y. (2020) The application of microalgae in removing organic Micropollutants in waste water. *Critical Reviews in Environmental Science and Technology*.1-34.

Pavithra, Grace, K., Kumar, P. S. (2020) Microalgae for biofuel production and removal of heavy metals: A Review. *Environmental Chemistry Letters*.18(6): 1905-23.

Ran, Z., Kong,Fz.Xu. J, Liao, K.Xu X, Shi, P. (2020) Fad and Elovl expressions, fatty acidcompositions, and feed effects of three representative microalgae in Sinonovaculaconstricta (Lamrac 1818) at early development stages. *Aquaculture*.521: 735101.

Satpal ,Kambete A. K. (2016) Treatment of Municipal Sewage with Microalgae- A Laboratory based. *International Journal of Engineering &Technology*. 5(8): 415-417.

Spain, O., Sirin, S., Silva, M., Escudero-Oñate, C., Ferrando-Climent, L., Allahverdiyeva, Y., Funk, C. (2021) Wastewater treatment by microalgae.*PhysiologiaPlantarum*. 173(2): 568-78.

Zimmo, O. R., Al-Saed, R. M. (2002) Process performance assessment of algae-based and duckweed-based waste water treatment systems. *Water science & technology*. 45(1): 9