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Phycoremediation and Quality Analysis of Waste Water Using Diatoms

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Abstract: Water pollution is toxic to the aquatic life which is leading to the fast declining in the species diversity in the water bodies. Diatoms are microalgae which have great potency to live in the water which is highly contaminated water bodies, hence diatoms have ability to compelling such bioindicators that monitor the change in the environmental matrices very effectively which provide us the proper condition of the area whether the water is harmful for the survival of diatoms or not then where we collect the sample. Around the world researchers are trying to evaluate the effect of wastewater or contaminated water on the diatoms. The diatoms are very precious algae used in pharmaceuticals, for energy production, aquaculture feeding feedstocks. This review represents the effect of phytoremediation and the wastewater quality index based on the heavy metals, BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), lipid bodies in diatoms, morphological analyses, conduction of the wastewater.

Keywords **- Bioindicators, Phytoremediation, Wastewater, BOD, COD**

I. INTRODUCTION

Diatoms (Bacillariophyta) are the phytoplanktonic groups in the ocean or the other waterbodies and are among the most diverse classes of the organisms on the Earth (Mann & Vanormelingen, 2013). While the recent studies have already shown how the comparison of molecular and the morphological taxonomic units of diatoms can lead to other greater analytical precision (Malviya et al., 2016). Diatoms are algae that made of silica glass. The extreme number of diatoms in water bodies facilitates the removal of toxic pollutants from wastewater that originating from different sources, industries, agricultural aspects and other anthropogenic sources. This diatom-based review paper mainly focuses on the unique capabilities of diatoms in wastewater, and the concomitant with the generation of such efficient and valuable products. Diatoms algae have the potential to phyco-remediate various types of wastewater due to their efficient mechanisms and their adaptation strategies. Diatoms have developed various methods like biotransformation, the biomineralization, bioaccumulation and biosorption to counter heavy metal toxicity because this toxicity decrease the level of oxygen. Lipid body induction is also prevalent in diatoms, under the metal stress. Lipid bodies are typically increase in number, specifically in sizes. Metal toxicity also affect the diatoms sizes and cause deformities in the algae. Phycoremediation can be used to evaluate the diatoms to treat wastewaters. With this technology the advent of molecular and functional genomic tools, there has been active research that aims to improve the algal strains for bioremediation by enhancing their photosynthetic efficiency, adaptability, and the effect on diatoms with these parameters. Diatoms are very useful and efficient algae than other algae because these are sea jewels which provide the protection to the aquatic life because it works as indicator and purify the water, but sudden parameters in the wastewater bodies (figure 1).

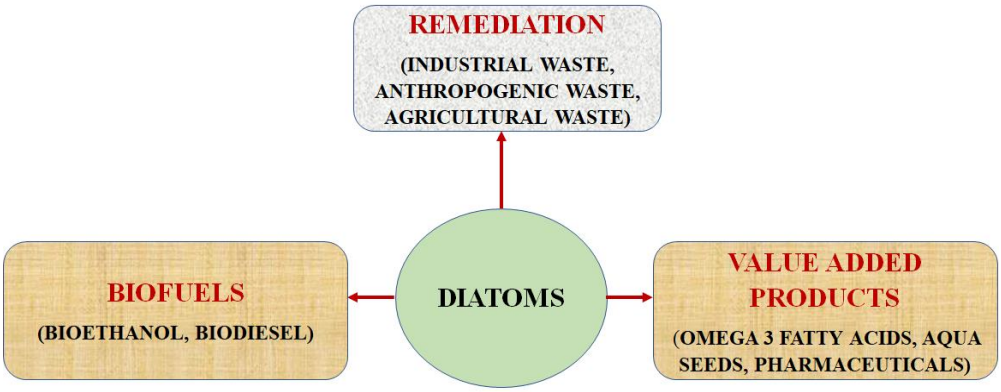

Figure 1. Applications of diatoms

1.1 Diatoms in wastewater

Diatoms are present in various waterbodies like lakes, ponds, sea etc. and also in the water that is pollutes and contaminated with various toxic and harmful substances. Diatoms are very well developed in the biomonitoring purposes since the last researches because these diatoms are providing the most important linkage in the aquatic ecosystem that which stipulating the flow of the energy, and the cycling of the materials, and reveal the water environment and its parameters that affect the organisms (Chen et al., 2016). Diatoms are actively participated in quenching of heavy metals and the wastewater remediation which is a great cause that leads to the environment pollution (Marella, Saxena, & Tiwari, 2020). Heavy metal in wastewater is very cost-effective approach with the filtration process. When heavy metals are accumulated with nutrients then they assist the bioremediation methods also. This method helps in the exclusion of heavy metals to maintain such equilibrium conditions in the wastewater, so it eliminate toxic effects in the wastewater which is very good for the survival of the algae and the aquatic life. There are lot of research needs to be done in the treatment of the wastewater when we test the more species and then study their capability of the heavy metal's removal from water bodies. The biological degradation of the heavy metal is quite challenging but not impossible because there are various methods to reduce the impact of toxicity from the wastewater by the phycoremediation methods (Xiong, Kurade, & Jeon, 2018).

1.2 Water quality analysis with diatoms

The water quality index should be analyzed by using the planktonic diatom index for monitoring the assessment of water quality (Hazuková, Johansen, & Sgro, 2019). The important physical variables are temperature and turbidity. The physical-chemical variables of the water are analyzed with the conductivity, pH and other total dissolved solids. Parameters like COD, BOD, TOC should be analyzed so we estimate the water quality whether it is compatible or not for the diatom survival. Water quality is the most important criteria for the testing of the sample in any expiring related to the water quality index. Diatoms are benthic algae that are survived even in the contaminant water but there are very high chances of their deformity in the morphological structures, variability in the size, shape, and even they are not able to provide their capable functions which are useful for the environment. In waterbodies for monitoring the pollution, then the several indices that applicable have been developed, such as the highly efficient index of Saprobity-Eutrophication (IDSE/5), which utilizes the diatom population in the terms of organic pollution (Sawaiker & Rodrigues, 2017).

II. PHYCOREMEDIATION IS IMPORTANT IN DIATOMS

Marine diatoms have high growth rate and the freshwater diatoms which have the groups of N and P and the high adequate amount of silicon is available (Tilman, Kiesling, Sterner, Kilham, & Johnson, 1986). The silicon availability can make diatoms consume N and P at the faster rate than the other species of algae. The domestic waste have less amount of silica than N and P (Ryther & Officer, 1981). Diatoms have good balance approach that shows the interplay of various nutrients which also include the trace metals in the community of phytoplankton and their response to the nutrient enrichment whatever they required. Diatoms are the best algae which have large sequesters of carbon dioxide, so these algae release more oxygen. If we balance the species composition of eutrophic system in water bodies so it promotes the growth of algal species like diatoms that increase the level of secondary productivity in most valuable food species, then we will be tackle with the nutrient limitation riddle. The Phycoremediation is the method defines where it restores the natural food chain of the ecosystem in the waterbodies and this is the best way to remove the nutrients. The waterbodies having their native bacteria which break down the nutrients. Diatoms consume the CO_2 and nutrients to release O_2. There is no any waste generation in this method.

III. MORPHOLOGICAL ABNORMALITIES IN DIATOMS SILICA BY HEAVY METAL CONTAMINATION IN WASTEWATER

The abnormalities in the diatoms are mainly caused by the environmental stress, the heavy metal contamination is the best cause for this**.** The abnormal cells in the diatom's community or the population of such species an give the both quantitative and temporal index of heavy metal contamination in wastewater. The high level of abnormalities of cells in diatoms due the scarcity of the nutrients, presence of osmotic pressure and the waste products. There are deformities like the deformed valve outline of the diatoms, changes in the striation pattern, the costae and the septae. The whole morphological structure is changed with different deformities when it occurs in the shape and size of the diatoms. Diatoms are changed with the heavy metal effect by change in the shape, size in the longitudinal and central area, modification in the raphae and the raphae canal system, the unusual arrangement of the colonies while forming the cultures. Diatoms are showing its mixed type form where the teratology which shows that each is independent of the other.

IV. HIGH LIPID ACCUMULATION IN DIATOMS USING WASTEWATER

Diatoms contains the lipid bodies which have different size and concentration in the cell. The lipid accumulation in diatoms is influenced only by the factors like, light, temperature, nutrients etc. the lipid content in diatoms is 22.7% which is average under the normal growth conditions, whereas under the stress it reaches the 44.6%. The lipid content is also very specific and vary in every different species of the diatoms (Hu et al., 2008). With the various researches we find that the diatoms as a mixed consortium, is grown using the wastewater that is untreated, then the diatoms in that by using untreated wastewater produced the biomass and lipid par, if that not higher then we using the treated wastewater for more high productivity of the lipid content in the diatoms.

V. CONCLUSION

This review paper concluded that the diatoms are very precious algae which have very efficient qualities than other algae**.** Diatoms is the algae which tackle the more than one problem, which is not carry by the chemical processes. When we growing the diatoms in using the wastewater which provide viable source for the production of biomass. Biomass leads to the various benefits like biofuels, antioxidants and anti-viral, anti-cancerous, anti-obesity, animal feed additives etc. For future aspects, the diatoms play a very potential role where we understand its research models, its mechanisms, new species that are still not investigated. There are some smart isolation techniques are developed which provide the speed recovery of diatoms to get rid from the polluted water. The maintenance of diatoms cultures is also based on the applications such as the aquaculture, bioremediation, phycoremediation, bioindicators etc. the diatoms which are growing are most sustainable and provide the economic benefit to meet the future demand of energy crises. Diatoms opens the numerous options that are very beneficial for the social and environmental benefits, like nutrient recycling, remediation, the ecosystem and water quality maintenance.

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