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TO REMOVE THE TOXICITY FROM THE WASTEWATER BY USING MICROALGAE

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ABSTRACT- *Rigorous research works are going on in the field of wastewater treatment. The recent research of wastewater treatment by using microalgae is also proving more effective in removal of toxicity from wastewater.*

Microalgae are known to sequester toxic compound. Discharge of toxic pollutant to wastewater collection system has increased concurrently with increased in industrialization. Micro algae are efficient absorber of toxic compounds. Bioaccumulation of metals by use of algae can be feasible method for remediating wastewater contaminated with metals. It is established that marine and fresh water algae are capable of taking various toxic pollutants from wastewater and accumulate it in their cells.

Algae are believed to be good accumulator of Zn. It can also accumulate the other heavy metals such as Cu (II), Pb (II) and Cr (III) as well as Ni (II), Cd (II), Co (II), Fe (II) and Mn (II). The living algal cell accumulate trace nutrient metals (such as Co, Mo, Cu, Mg, Zn, Cr, Pb and Se) intracellularlly by active biological transport.

This method of removing toxicity of wastewater by the use of microalgae is economical for removing toxic compound as well as some heavy metal, resulting in good quality of reusable effluents. Microalgae provide the solution for tertiary and quandary treatment, as it has an ability to use inorganic nitrogen and phosphorous for their growth. This is an environmentally sound alternative for the toxicity removal from wastewater.

Keywords- *Toxicity, Microalgae*

I. INTRODUCTION

Nowadays pollution associated problems are a major concern of society. Environmental laws are given general applicability and their enforcement has been increasingly stricter [2]. So, in terms of health, environment and economy, the fight against pollution has become a major issue. Today, although the strategic importance of fresh water is universally recognized more than ever before, and although issues concerning sustainable water management can be found almost in every scientific, social, or political agenda all over the world, water resources seem to face severe quantitative and qualitative threats [1]. The pollution increase as industrialization increases and imposes severe risks to availability and quality of water resources, in many areas worldwide.

To use microalgae for wastewater treatment is an old idea, and several researchers have developed techniques for exploiting the algae's fast growth and nutrient removal capacity. The nutrient removal is basically an effect of assimilation of nutrients as the algae grow, but other nutrient stripping phenomena also occur, e.g. ammonia volatilization and phosphorus precipitation as a result of the high pH induced by the algae. In addition to tertiary treatment, microalgae may provide heterotrophs in secondary treatment with oxygen. The increase in pH during photosynthesis also has a disinfecting effect on the wastewater [1].

Microalgae are known to sequester heavy metals. Discharge of toxic pollutants to waste water collection system has increased concurrently with society's progressive industrialization. Significant concentrations of heavy metals and toxic organic compounds have been measured in municipal wastewater [3]. Consequently, the ability of wastewater treatment systems to tolerate and remove toxicity is of considerable importance. Microalgae are efficient absorbers of heavy metals. Bioaccumulation of metals by algae may create a feasible method for remediating wastewater contaminated with metals [8]. On the other hand advantages of algae are that it may be grown in ponds with little nutritional input or maintenance.

The term microalgae refer to all algae too small to be seen properly without microscope, and often include both eukaryotic microalgae and the prokaryotic cyanobacteria [1]. The most important common feature of all eukaryotic microalgae and cyanobacteria is that they have oxygen evolving photosynthesis and that they use inorganic nutrients and carbon. Micro algal biomass can be used for hydrogen gas production, bioenergy conversion and production of pharmaceutical substances or food just to give some examples [2]. This paper is a compilation of reported experiences from wastewater treatment with microalgae. The aim is mainly to explain the most important factors that affect micro algal growth.

Bio-treatment with microalgae is particularly attractive because of their photosynthetic capabilities, converting solar energy into useful biomasses and incorporating nutrients such as nitrogen and phosphorus causing eutrophication [7].

Microalgal cultures offer an elegant solution to tertiary and quandary treatments due to the ability of microalgae to use inorganic nitrogen and phosphorus for their growth [4]. And also, their capacity to remove heavy metals, as well as some toxic organic compound, therefore, does not lead to secondary pollution. Amongst beneficial characteristics they produce oxygen, have a disinfecting effect due to increase in pH during photosynthesis.

The microalgae which exist in the freshwater environment and the oceans are important in global ecology, extremely efficient, and taxonomically diverse [6].These microalgae (phytoplankton) in the oceans live in an environment which comprises more than 70% of the earth's surface and is responsible for at least 32% of global photosynthesis.

Microalgae are so efficient at scavenging of metals from influent water, from contaminants in nutrients, or from atmospheric deposition into open ponds, that the biomass produced sometimes can contain amounts at the upper limit of metal content for food use [2].

II. MATERIALS AND METHOD

A. Procedure

The synthetic wastewater of about 5 liters was fed into the feed tank and by gravity it was fed into the rectangular reactor of 35 x 25 x 18 cm size [4]. The reactor was operated at room temperature. Each algae of initial dosage 60 g was fed to the reactor. Then the operating parameters were varied to find the optimum condition.

B. Optimization of number of days

The synthetic wastewater was fed to the reactor containing 60 g of each algae. No pH adjustment was made. Then at each day samples were collected and analyzed for the various parameters like pH, TDS, Turbidity, BOD, COD, Ammonia Nitrogen and Phosphate.

C. Optimization of pH

After optimizing number of days, the pH of synthetic wastewater was varied. The Synthetic wastewater with different pH was fed to the reactor with 60 g of each algae. The selected pH were 4, 5, 6, 7and 8. The samples collected after the optimized days were analyzed for the various Parameters.

D. Varying algal species

Oscillatoria and Chlorella algae of 60 g each were taken separately for treating with synthetic wastewater. Combinations of algal species of 60 g were also taken for the study simultaneously.

E. With aeration

After fixing optimum days and pH the synthetic wastewater was treated with Oscillatoria and
Chlorella algae separately of 60 g. Aeration of 9 l/min has been provided. The samples were analyzed after treatment. The same has been repeated with the combination of algal species.

F. Without Aeration

After fixing optimum number of days and pH treatment of algae with synthetic wastewater has been carried out without aeration. Here also combination of algal species has been taken for the
Treatment. Similarly individual algal species also has been taken for the treatment. Samples after
Treatment has been taken for the analysis of the parameters [4].

G. Varying algal dosage

The synthetic wastewater was treated with algal species of varying dosage after optimizing number of days and pH. Aeration has been provided.20, 40, 60, 80, 120 and 140g of each algal species were taken for the study. The samples collected after treatments were analyzed for the various parameters [4].

III. CONVENTIONAL TREATMENTS FOR REMOVAL OF HEAVY METAL

There are specific methods on removal of dissolved inorganic compound in wastewater through use of different unit operations:-

1. Carbon – Activated Sludge Adsorption.
2. Chemical Oxidation and Coagulation
3. Reverse Osmosis and Ultra filtration
4. Physico-chemical methods
5. Chemical Precipitation
6. Electrochemical Treatments
7. Biological Methods

A.Carbon- activated sludge adsorption:

Activated carbon is one of the most effective media for removing a wide range of contaminants from industrial and municipal waste water, landfill leachate and contaminated groundwater as the world's most powerful adsorbent; it can cope with a wide range of contaminants. Different contaminants may be present in the same discharge and carbon may be used to treat the total flow, or it may be better utilized to remove specific contaminants as part of a multistage approach[3].

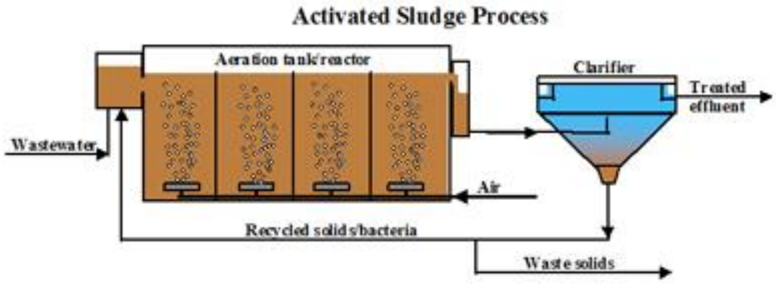

Fig.1- Activated sludge process

B. Chemical oxidation and coagulation:

This process involving oxidation and coagulation, for removal of color and chemical oxygen demand from synthetic textile waste water containing polyvinyl alcohol and a reactive dyestuff. The experimental variables studied include dosages of iron salts and hydrogen peroxide, oxidation time, mixing speed and organic content. The result show the color was removed mainly by Fenton oxidation.

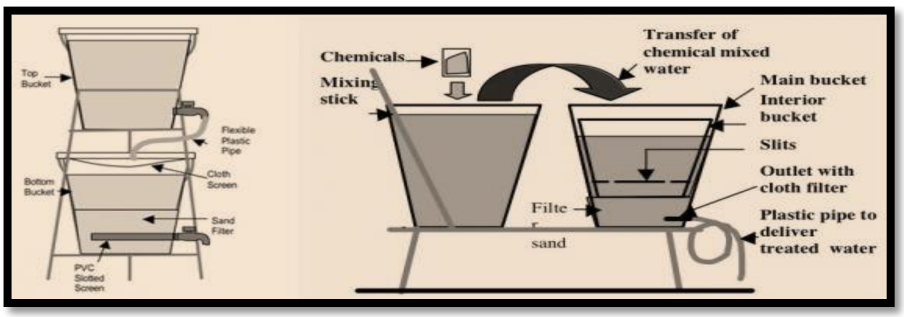

Fig.2- Chemical oxidation and coagulation

C. Reverse Osmosis:

It is a process in which heavy metals are separated by a semi-permeable membrane at a pressure greater than osmotic pressure caused by the dissolved solids in wastewater [3]. The disadvantage of this method is that it is expensive.

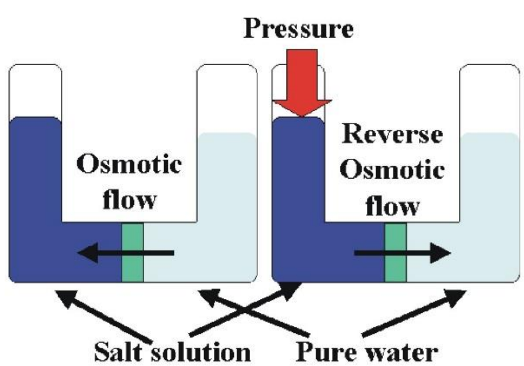

Fig.3- Reverse osmosis

Comparison of conventional process and algal process for removal of Toxicity

Algal processes ADVANTAGES	Conventional process DISADVANTAGES
Cost effective	High cost of construction
Low energy requirement	High energy requirement
Production of useful biomass	Required high area of land
Reduction in sludge formation	Requires mechanical device
Remove heavy metals	Complex technology
Algae contain more than 50% of oil in its biomass	Required technically skill
They provide much higher yields of biomass and fuels, 10-100 times higher than comparable energy Crops.	Low treatment efficiency
They can be grown under conditions which are unsuitable for conventional crop production.	Required man power for operation and maintenance

IV. SOURCE DISTRIBUTION OF HEAVY METAL IN DIFFERENT INDUSTRY

Industries	**Ag**	**Cd**	**Cr**	**Cu**	**Fe**	**Hg**	**Mn**	**Ni**	**Pb**	**Ti**	**Zn**
General industry and mining			X	X	X		X		X		X
Electroplating		X	X	X				X	X		X
Paint products			X						X	X	
Fertilizers		X	X	X	X	X	X	X	X		X
Insecticides and Pesticides				X		X					
Tanning			X								
Paper products			X	X		X		X	X	X	X
Photographic	X		X								

Fibers				X							X
Printing and Dyeing			X						X		
Electronics	X										
Cooling water			X								
Pipe corrosion				X					X		

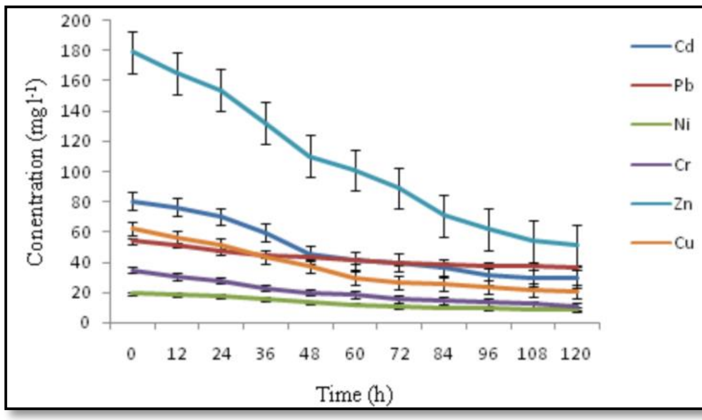

Fig. 1: The effect of *chlorella* on heavy removal

Figure 1 indicated that chlorella has removed 95% of Zn and Cd after 108 hours, and 90% of Cu after 60 hours of incubation. Moreover, 93% of Pb, Ni and Cr were removed after 36 hours of incubation. This indicates that biosorption efficiency towards Pb, Cr and Ni is higher than other elements.

V. CONCLUSION

Algae can be used in wastewater treatment for a range of purposes, including;
1. Reduction of BOD,
2. Removal of N and/or P,
3. Inhibition of coliforms,
4. Removal of heavy metals

The high concentration of N and P in most wastewaters also means these wastewaters may possibly be used as cheap nutrient sources for algal biomass production. This algal biomass could be used for:
1. Methane production,
2. Composting,
3. Production of liquid fuels (pseudo-vegetable fuels),
4. As animal feed or in aquaculture and
5. Production of fine chemicals.

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