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ALGAL BIOREACTOR FOR THE REMOVAL OF POLLUTION PARAMETER FROM SUGAR MILL EFFLUENT

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Abstract - *The waste water from sugar mill effluent consists of various undesirable compounds which cause environmental issues when it is discharged into the terrestrial land as well as the aquatic environment if untreated. The main objective of treating the waste effluent is to reduce the both organic and inorganic compounds by treating it with algae. Algae induced water treatments are implemented because of its inherent characteristics of in taking the inorganic compounds for their growth and thereby reduce the pollutants present in the wastewater. The species cyanobacteria are the algae which efficiently treats waste water. The sugar mill effluent is taken as sample. The process is applicable in both aerobic and anaerobic situations. By inoculating cyanobacteria in secondary treated sugar mill effluent the contaminants and the harmful substances are reduced from the subjected effluent. The various parameters like chloride, sulfate and pH contents are continuously monitored and the results will be accurate in reducing the pollutants from sugar mill effluent.*

Key Words: **Keywords: Algae, Pollutants, sugar mill effluent.**

1. INTRODUCTION

Water that is on the earth today is the same water that was here when the earth began. This is possible because of recycled water, both naturally occurring and as result of human technology. The earth naturally reuses its water; however, water recycling in the human population uses technology to speed up the process through practices like reusing waste water for purposes such as irrigation, flushing a toilet or filling up a ground water basin. Advantages of recycled water includes many times, recycling water not only prevents its removal from sensitive environments, but it keeps waste water from going into bodies of water such as ocean or rivers. Recycling water takes waste water such as sewage and reuses it, instead of routine it directly into the nearest river or ocean where it could spread pollution and disrupt the aquatic life.

Water treatment is a process used to remove contaminants from wastewater or sewage and convert it into an effluent that can be returned to the water cycle with minimum impact on the environment, or directly reused .the latter is called water reclamation because treated wastewater can be used for other purposes. The treatment process takes place in a waste water treatment plant (WWTP), often referred to as a water resource recovery facility (WRRF) or a sewage treatment plant (STD).pollutants in municipal waste water are removed or broken down. The treatment of waste water is part of the overarching field of sanitation

2. STUDY AREA

2.1 SCOPE

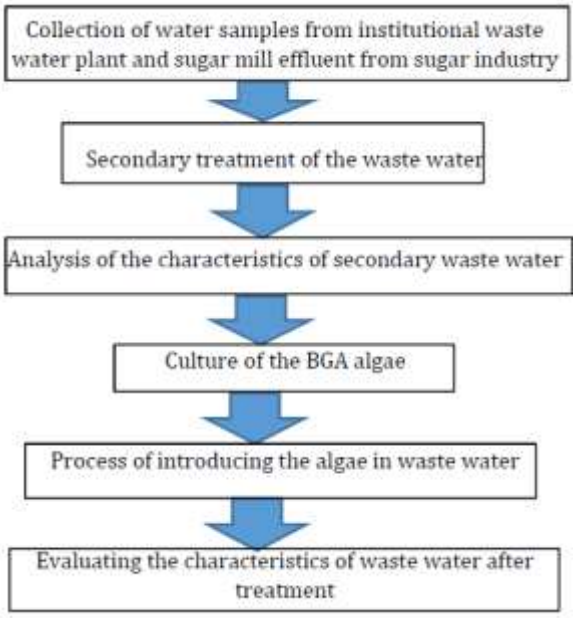
The scope of wastewater management with algae has evolved throughout history with changes in socioeconomic conditions, city structures, and the environment. Today, wastewater with algae infrastructure that is well planned and operated supports urban sanitation and related activities.

2.2 OBJECTIVES

Surface water is generally polluted by the activities of human as well as the animals. In order to purify them for further reuses some kind of treatment methods must be adopted. The process of implementing micro organisms in wastewater treatment reduces the cost of equipments, man power; space required for the treatment plant, energy resources and it gives significant and clear results when compared to the conventional methods of waste water treatment. Treating the sugar mill effluent with algae and reducing its pollutants is the main objective of this study.

3. MATERIALS AND METHODOLOGY

3.1 METHODOLOGY



3.2 BIOREACTOR

Bioreactors are the vessels/containers which provide biological, biochemical, and biomechanical requirements for the optimal growth of the fermenting microorganisms and/or biochemical reactions on the industrial scale for the synthesis of desired products. Efficient bioreactors are capable of maintaining the desired biological activity by controlling the temperature, pH, fluid velocity, shear stress, mass and heat transfer, O_2, CO_2, and nutrient supply, reaction rate, and cell growth. Bioreactors are used in all domains of large-scale industrial biotechnology where a large scale production is required.

3.3 AEROBIC CONDITION

An aerobic organism or aerobe is an organism that can survive and grow in an oxygenated environment. In practice, bioreactors are often pressurized; this increases the solubility of oxygen in water.in an aerobic process, optimal oxygen transfer is sometimes the rate limiting step. Oxygen is poorly soluble in water – even less in warm fermentation broths – and is relatively scarce in air (20.95%)

4. WASTE WATER CHARACTERISTICS

4.1 SUGAR MILL WASTE EFFLUENT

Sugar is the most important food supplement of our daily diet. During the production of sugar, large volume of water is used by sugar mills for processing, and produces large amount of wastewater. The sugar mill wastewater have color, organic compounds, low pH, high temperature, BOD, COD, total dissolve solid (TDS), sludge, press mud and bagasse etc. If this wastewater is released in the environment before the treatment, it will cause harmful effect on aquatic life, animals, plants, human being and also change the soil properties. Therefore, it is necessary to treat the wastewater before their disposal. Three important treatment methods i.e. physical, chemical and biological are employed to treat the wastewater. Biological treatment of sugar mill wastewater has several significant advantages over other available methods. Treatment of sugar mill wastewater mainly affected by pH and temperature of effluents, biomass during the reaction, reaction time, type and speed of reactions, aerobic or anaerobic conditions, presence of catalyst, inhibitor, nutrients and concentration of the sulfide and its other compound in the wastewater. The treated wastewater can be reused in the industry for processing and may also be used for fertile-irrigation for agriculture or other purposes like compost and biofertilizers within the limit prescribed by the Central Pollution Control Board. Reuse of treated effluent can reduce the fresh water demand in various sectors. Treated effluent contains well balanced chemicals with low toxic metal ion. The diluted treated effluent have shown significant increase in chlorophyll, carotenoids, total sugar, amino acids, protein contents and suitable for seed germination and seedling growth over the bore well water and undiluted treated effluent.

4.2 SECONDARY TREATMENT OF SUGARMILL EFFLUENT

The effluent collected from sugar industry must be treated as the experiment deals with secondary treated wastewater. The cyanobacterium is inoculated after the secondary treatment of sugar mill effluent. The sugar mill effluent is filtered through a layer of hypo sludge (waste collected from paper mill industry without the addition of any chemicals that is the pure powdered form of paper waste). Filtering the effluent is a form of secondary treatment and the output sugar mill effluent is collected for preceding the study with algae.

5. ALGAE

The majority of algae live in aquatic habitats. Yet, the word "aquatic" is almost limited in its ability to encompass the diversity of these habitats. These organisms can thrive in freshwater lakes or in saltwater oceans. They can also

endure a range of temperatures, oxygen or carbon dioxide concentrations, acidity and turbidity. For example, giant kelp are found more than 200 meters below the polar ice sheets, according to "Algae," while the unicellular green algal species *Dunaliella salina* is found in very salty, or hypersaline, environments such as the Dead Sea. Free-floating, mostly unicellular algae that live within illuminated regions of water are known as planktonic. Those that adhere to surfaces are known as benthic algae. Such algae grow on mud, stones, other algae and plants, or animals, according to "Algae."

Algae are also able to survive on land. Some unexpected places where they grow are tree trunks, animal fur, snow banks, hot springs (according to "Algae") and in soil, including desert crusts.

Mostly, algae live independently in their various growth forms (single cells, colonies, etc.), but they can also form symbiotic relationships with a variety of non-photosynthetic organisms including ciliates, sponges, mollusks and fungi (as lichens). One of the benefits of such relationships is that they enable algae to broaden the horizons of their habitats.

5.1 CHARACTERISTICS OF BLUE GREEN ALGAE

Blue-green algae, also known as Cyanobacteria, are a group of photosynthetic bacteria that many people refer to as "pond scum." Blue-green algae are most often blue-green in color, but can also be blue, green, reddish-purple, or brown. Blue-green algae generally grow in lakes, ponds, and slow-moving streams when the water is warm and enriched with nutrients like phosphorus or nitrogen.

When environmental conditions are just right, blue-green algae can grow very quickly in number. Most species are buoyant and will float to the surface, where they form scum layers or floating mats. When this happens, we call this a "blue-green algae bloom." In Wisconsin, blue-green algae blooms generally occur between mid-June and late September, although in rare instances, blooms have been observed in winter, even under the ice.

Concerns associated with blue-green algae include discolored water, reduced light penetration, taste and odor problems, and dissolved oxygen depletions during die-off, and toxin production. Discolored water is an aesthetic issue, but when blue-green algae reach bloom densities, they can actually reduce light penetration, which can adversely affect other aquatic organisms both directly (e.g., other phytoplankton and aquatic plants) and indirectly (e.g., zooplankton and fish that depend on phytoplankton and plants). Blue-green algae blooms can be quite smelly, and though it is recommended that people never drink raw water, blue-green algae have been known to affect the taste of drinking water that comes from surface waters experiencing a bloom. Here in Wisconsin, most of the state relies on groundwater, rather than surface water, for drinking water. When a blue-green algae bloom dies off, the blue-green algae cells sink and are broken down by microbes. This breakdown process requires oxygen and can create a biological oxygen demand. Increases in biological oxygen demand result in decreases in oxygen concentration in the water, and this can adversely affect fish and other aquatic life, and can even result in fish kills.

Blue-green algal toxins are naturally produced chemical compounds that sometimes are produced inside the cells of certain species of blue-green algae. These chemicals are not produced all of the time and there is no easy way to tell when blue-green algae are producing them and when they are not. When the cells are broken open, the toxins may be released. Sometimes this occurs when the cells die off naturally and they break open as they sink and decay in a lake or pond. Cells may also be broken open when the water is treated with chemicals meant to kill algae, and when cells are swallowed and mixed with digestive acids in the stomachs of people or animals. The only way to be sure if the toxins are present is to have water samples analyzed in a laboratory using sophisticated equipment.

6. EXPERIMENTAL METHODS

6.1 Determination Of pH

The pH was determined by using pH meter. pH is defined as the negative logarithmic of hydrogen ion concentration. **pH= -log[H+]**. The actual pH of industrial effluent is 6.5-8.5.

6.2 Determination of sulphate

Sulphate ions are precipitated with HCl and Barium Chloride. The precipitated Barium Sulphate is filtered and dried, ignited and weighed as $BaSO_4$. The Sulphate content of natural waters is an important consideration in determining their suitability for public and industrial water supplies. Knowledge of Sulphate content of the sludge or waste fed to digestion units provides a means of estimating the H_2S content of the gas produced.

6.3 Determination of chloride

Chloride ion is determined by Mohr's Method. The water sample is titrated with standard Silver Nitrate in which Silver Chloride is precipitated at first. Potassium Chromate is used

an indicator. The end of titration is indicated by formation of red Silver Chromate from excess Silver Nitrate.

8. RESULT AND DISSCUSSION

8.1GENERAL

From the analysis of the sugar mill effluent it is concluded that some of the parameters like chloride, sulfate, pH are treated and the results are obtained.

8.2 CHARACTERISTICS OF WASTE WATER

Table -1: characteristics of sugar mill effluent before the addition of *blue green algae*

PARAMETERS	OBTAINED VALUES	UNITS
pH	7.25	-
TOTAL SOLIDS	4.73	mg/l
CHLORIDE	290	mg/l
SULFATE	625	mg/l
DO	NA	mg/l
BOD	30	mg/l
COD	43	mg/l

Table -2: characteristics of sugar mill effluent after adding *blue green algae* and the results of 5 days analysis.

PARAMETERS OF SUGARMILL EFFLUENT	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
PH	7.28	7.30	7.45	7.49	7.63
SULFATE	622	617	612	609	602
CHLORIDE	290	285	270	260	252

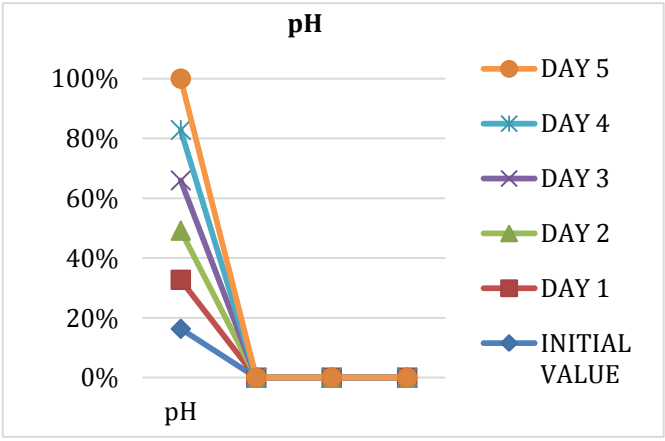


Chart -1: PH rating (with *blue green algae*)

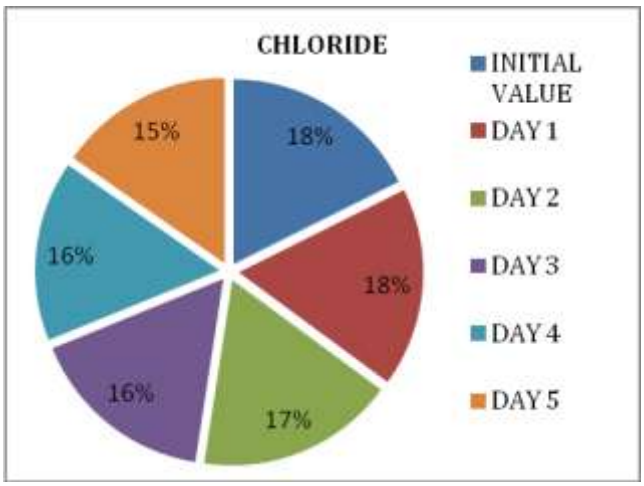


Chart -2: chloride rating (with *blue green algae*)

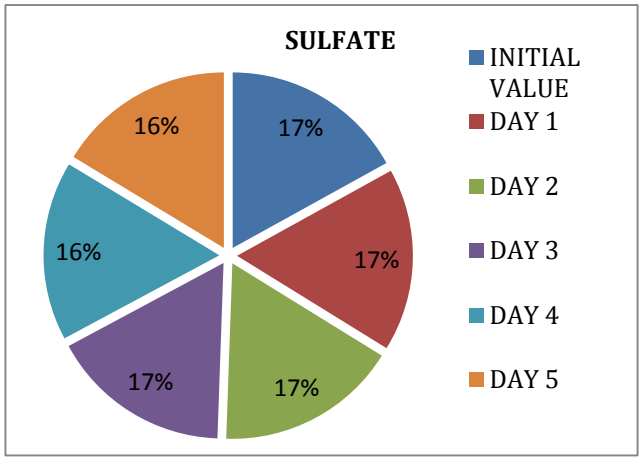


Chart -3: sulfate rating (with *blue green algae*)

9. CONCLUSION

The experimental study of this algae inoculated wastewater treatment proves that this system considerably reduces the amount of pollution when compared to the earlier results in sugar mill effluent. The parameters pH, chloride, sulfate have been selected for study and experiments were conducted in reducing the particular parameters and the results proved the efficiency of this sustainable cost- effective system .

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