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A STUDY ON SALIENT FEATURE AND PROPERTIES OF SUGAR INDUSTRY EFFLUENT QUALITY

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Abstract:

Water is a component that all living things require. In this regard, water contributes greatly to and is crucial to the natural cycle. Only 3% of the world's total water supply is available as fresh water. Pollutants from industrial, residential, and anthropogenic activities have considerably risen in the fresh water sources that are currently available. In this situation, conservation methods are crucial to maintaining both the quantity and quality of freshwater bodies. The industrial process that will take place in the industry will use a significant amount of fresh water. While this is happening, the amount of fresh water used is equal to the amount of wastewater that is discharged as effluent. The current study highlighted the contaminants' concentration in the effluent from the sugar sector in this regard. Once the amount of pollutants in the effluents has been determined, the wastewater treatment system can be adjusted using current technology to remove the greatest amount of pollutants from the wastewater. According to CPCB guidelines, every industry must implement Zero Liquid Discharge (ZLD) in its facilities to prevent the discharge of effluent without treatment. The wastewater released by the sugar industry was examined in the current study, and it was found that the pollutant concentration was relatively high. By using the Biological Treatment Process with Activated Sludge Process (SAP), the treatment efficiency appears to be improved. The analysed parameters of the treated effluent are well within the prescribed by the CPCB for the discharge of effluent to on-land standards and discharged wastewater could be used for the agriculture purposes or any domestic purposes in the industry.

Key words: *Fresh water, Effluent, ZLD, ASP, Sugar industry.*

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INTRODUCTION

Due to increasing industrialization and subsequent urbanization, there has been a recent increase in concern over environmental contamination on a global scale (RA Sail et al., 2006). Regarding the earlier idea of disposing of treated or untreated wastewater from the industry, however, treated or untreated wastewater has been drained into rivers, nearby lakes, or streams and by that river body it may spreading over a huge area until that water reaches its final destination (SK Chatterjee et al., 2010; NK Chaurasia et al., 2011). Therefore, the life of plants and animals that are located close to water sources are affected—not just in industrial areas but also in agricultural fields, rivers, and river beds (K Nath et al., 2005). According to P Malaviya et al. (2007), high levels of nutrients, heavy metals, and toxic compounds in some companies' wastewater may aid microorganisms in the biological treatment of the wastewater. Although effluents comprising different kinds of metallic and non-metallic elements operate as nutrients, at larger concentrations they may have a hazardous character on seed germination and seedling growth, ultimately adversely influencing plant growth and yield in agricultural fields (YM Avasn et al., 2000). In nations like Cuba, Jamaica, and India, sugar is mostly made from sugarcane, however in many other nations, raw beetroot is used in its place. There are two types of sugar production methods: (i) Carbonation methods. Process of sulphitation (ii). However, for the production of white sugar, the majority of sugar companies in India used the double sulphitation technique.

The operations of the sugar industries under examination are as follows:

(i) Milling
(ii) Clarification
(iii) Evaporation
(iv) Crystallization
(v) Centrifugation

Even though the company has a good treatment plant, a large amount of water used in the production of sugarcane is discharged as wastewater to the surrounding area with just partial or no treatment. The wastewater discharged from the industry may leak onto the ground nearby or onto water sources like rivers or streams. Within a few days of the wastewater and water mixing, a foul odor is released, and this is a regular occurrence.

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Sugar industries play a significant role in the economic growth of India. However, the wastewater produced by these enterprises contains a significant amount of pollution. For every ton of crushed sugar cane produced by the sugar industry in India, 1,000 L of wastewater are produced. If released without treatment, sugar industrial wastewater can pollute both aquatic and terrestrial environments. This review has looked at the sources, characteristics, recent developments in the aerobic, anaerobic, and physico-chemical treatment technologies, as well as the areas that require more study. Anaerobic treatment procedures have been used most often in wastewater treatment research for the sugar sector. Oil and grease, however, are difficult for anaerobic processes to break down. Additionally, whereas aerobic processes need more energy, anaerobic processes partially destroy nutrients. Organics can be totally eliminated by anaerobic-aerobic combination systems. Unfortunately, there aren't many studies on anaerobic-aerobic combination systems, and additional research is required.

SOURCES OF EFFLUENTS

The wastewater generated from different process in the industry can be classified as follows:

(1) **Mill House:** The effluent consists of water used from cleaning the mill house which is likely to be converted by spills and pleased sugar juice. Water used for cooling of mills also forms part of the waste water from this source. Basically this water contains organic matter like sucrose, bagacillo, oil and grease from the bearings fitted in to the mills.

(2) **Wastewater from Boiling House:** The waste water from boiling house results from leakages through pumps, pipelines and the washings of various sections such as evaporators, juice heaters, clarification, and pans.

(3) **Wastewater from Boiler Blow-down:** The water used in boiler contains suspended solidsdissolved solids like calcium salts, magnesium salts, sodium salts, fatty salts etc.

(4) **Condensate water:** The excess condensate does not normally contain any pollutant and is used as boiler feed water and the washing operations. Sometimes it gets contaminated with juice due to entertainment of carryover of solids with the vapours being condensed in that case if goes in to the waste water drain.

(5) **Condenser cooling water:** Condenser cooling water is re-circulated again unless it gets contaminated with juice, which is possible due to defective entrainment separators, faulty operation beyond the design rate of evaporation etc. if gets contaminated the water should go into the drain invisibly. This volume of water is also increased by additional condensing of vapour of trained from the boiling juice the pan.

(6) **Soda and Acid Wastes:** The heat exchangers and evaporator are cleaned with caustic soda and hydrochloric acid in order to remove the formation of the deposits of scales on the surface of the tubing. In India, most of the sugar factories let this valuable chemical go into drains. The soda and acid wash contribute considerable amounts of organic and inorganic pollutions and may cause shock loads to waste water treatment.

WASTEWATER TREATMENT TECHNIQUE

Primary treatment: Primary treatment is usually the first stage of wastewater treatment. Many advanced wastewater treatment plants in industrialized countries have started with primary treatment, and have then added other treatment stages as wastewater load has grown, as the need for treatment has increased, and as resources have become available. Its purpose is to eliminate foul, suspended, and floating materials as well as oil and grease from untreated wastewater. It includes screening of solid material and sedimentation by gravity to remove suspended solids. This level is commonly referred to as mechanical treatment, however chemicals are often employed to expedite the sedimentation process. The BOD and total suspended particles of the entering wastewater can both be reduced by 20–30% and 50–60%, respectively, during first treatment.

Secondary treatment: The dissolved organic matter that evades first treatment is removed during this phase. This can be done by utilizing bacteria, who feed on the organic material and use it as fuel to produce carbon dioxide, water, and energy for their own development and reproduction. Additional settling tanks are added after the biological process to remove even more suspended particles. A well-functioning plant with secondary treatment can remove around 85% of the suspended particles and BOD. Technologies for secondary treatment include the fundamental Activated Sludge Process (ASP).

Tertiary treatment: More than 99 percent of all pollutants may be removed from sewage during tertiary treatment, leaving behind an effluent that is nearly drinkable. Before the effluent is discharged, a final step that often involves chlorine disinfection may be taken. However, some environmental authorities have abandoned this method because of concern that chlorine residuals in the wastewater may pose a problem in and of itself. Since chlorine is expensive and ultraviolet radiation is less effective when the water is not adequately clear or

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particle-free, disinfection is commonly included in the design of treatment plants but is not always implemented.

Sludge treatment

Prior to final disposal, the goal of sludge treatment is to eliminate any pathogens present in the sludge and lessen its undesirable qualities. Aerobic and anaerobic biological processes are the most often used therapeutic options. By continually pumping compressed air into a tank containing the waste sludge, aerobic digestion enables the waste's microorganisms to further stabilize or treat the waste. Usually, this is carried out for between 15 and 30 days. In order to allow the leftover sediments to sink to the bottom, the air is then shut off. The sediments are removed from the bottom while the pure water is decanted from the top.

The waste sludge is mixed for 15 to 30 days in a closed tank as part of anaerobic digestion. During this time, anaerobic bacteria in the garbage convert a large portion of the waste ingredients to carbon dioxide and methane gas. After this phase of active digestion, there follows a period of settling during which the solids sink to the bottom of the tank. The water is then removed from the top and the solids from the bottom of the digested sludge.

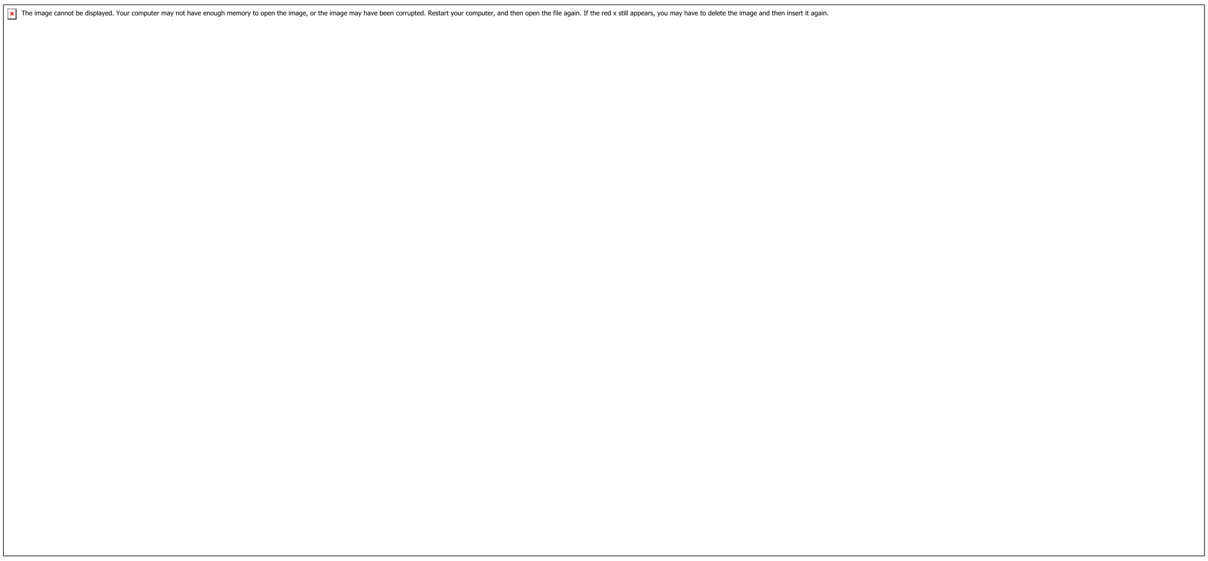

Fig 1: Treatment plant of sugar industry.

Characteristics of Effluents

The characteristics of individual and combined effluents vary from mill to mill and from time to time. All the individual effluents excluding spray pond overflow are acidic and

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coloured posters disagreeable older, high BOD and suspended solid. The oil and grease content is also high. The characteristics of effluents of a typical sugar mill are given in the following table.

TABLE 1: General characteristics of sugar mill effluent

Sl.No	Parameters	Range
1	pH	6.5-8.8
2	Dissloved Oxygen	0-2.0
3	Biochemical Oxygen Demand (BOD)	300-2,200
4	Chemical Oxygen Demand (COD)	1360-2,000
5	Chlorides	18-40
6	Total Solids (TS)	870-1950
7	Total dissolved Solids (TDS)	400-1650
8	Suspended Solids (SS)	220-790
9	Sulphate	40-70
10	Oil and Grease	60-100

All values except pH are expressed in mg/lit.

MATERIALS AND METHODS

Glass bottles were used to collect the effluent from the sugar mill at the treatment plant's entrance and output. Adding alkali azide and MnSO4 of 2 ml each to fix the dissolving oxygen in the field immediately preserved the samples. The effluent and influent were transported into the lab to be determined other physico-chemical parameters.

RESULT AND DISCUSSION

Table No. 02 contains a summary of the outcomes of the analysis. According to R Chandra et al. (2011), temperature is a key element in influencing the effluent quality and its impact on specific biochemical processes that occur in aquatic environments for aquatic species. The average temperature of an aquatic environment is between 200 and 270 degrees Celsius, whereas sugar industry effluent has temperatures of 480 and 300 degrees Celsius in untreated and treated, respectively. The higher temperature may have a negative impact on the agricultural field and crop output by accelerating chemical reactions and chemical

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changes in the aquatic environment (AK Beruch et al., 1993).

The pH of the water is a crucial component of the aquatic ecosystem and serves as an indicator of the viability of aquatic species. The survival of different microorganisms and the rate of biological and chemical reaction can both be impacted by changes in the effluent's pH value. The pH of the effluent can directly relate to the presence or absence of certain ionic specialties. Consequently, the effluent may have an impact on the soil's quality. The pH varies from 4.8 in the raw sewage to 6.9 in the treated effluent in the current experiment. The addition of lime during the equalization tank process is what caused the pH of the effluent to rise.

When the pH varies, so does the electrical conductivity. Due to the high chemical content, the concentration of DO in treated and untreated effluents ranged from 1.1 mg/l to 3.6 mg/l, respectively. The correct aeration procedure used during the treatment of effluents is what causes the increasing concentration of DO. increased DO as a result of the elimination of BOD and COD. As a result, the relationship between DO and COD and BOD load is inverse. The chemical composition of the effluents is directly impacted whenever the concentration of DO increases. The two tanks' fixed aerators provided the aeration method. Microorganisms are essential for the elimination of chemical components from effluents.

Therefore, throughout the wastewater treatment process, some nutrients will be given to these bacteria. After leaving the aeration tank, the effluents travel in the direction of the clarifier. The denser particles in the clarifier flow towards the bottom due to the centrifugal force produced by the scrapper at the bottom of the clarifier. The bed for sludge drying will receive the sludge that has accumulated at the bottom. But because there is still some oil and grease in the treated effluent after it has been treated, several important techniques for removing it are still needed.

Due to the creation of an oil film on the top, failing to remove the oil and grease from the wastewater could result in major water pollution issues in the nearby water bodies. As soon as the formation begins, it degrades the oxygen level, which has a detrimental effect on aquatic life and vegetation. The oxygen cannot enter the internal system of water bodies because of this oil layer. When DO becomes anaerobic, its effects degrade. AAS was used to determine the presence of the heavy metals by adding 2ml aquaregia to the effluent sample.

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Table 2: The Physico-chemical parameters of treated and untreated sugar mill effluent

Sl.No	Parameter	Untreated	Treated	BIS standards
1	Colour	Dark Brown	Light Brown	-
2	Temperature	48^0C	30^0C	-
3	pH	4.8	6.9	6.5-9.0
4	Dissolved Oxygen	1.10	3.6	4-6
5	BOD	98	76	50
6	COD	385	190	250
7	TDS	3120	1489	2100
8	TS	2150	1460	2700
9	TSS	96	68	600
10	Chlorides	178	140	600
11	Sulphate	580	310	1000
12	Oil and Grease	52	15	10

All values except pH and temperature are expressed in mg/lit.

Table 3: The concentration of Heavy Metals in the sugar mill effluents

Sl.No	Heavy Metals	Untreated (ppm)	Treated (ppm)
1	Cu	0.14	0.06
2	Cr	0.18	0.04
3	Cd	0.14	0.10
4	Zn	1.60	1.10
5	Ni	0.11	0.05

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CONCLUSION

Due to growing industrialization and consequent urbanization, there has been a significant increase in concern about environmental contamination on a global scale in many different areas. Regarding the earlier idea of disposing of treated or untreated wastewater from the industry, however, treated or untreated wastewater has been drained into rivers, neighboring lakes, or streams and by that river body it may spreading over a vast area till that water reaches its final destination. As a result, both directly and indirectly, the life of plants and animals that are located close to water sources—not just in industrial areas but also in agricultural fields, rivers, and river beds—are impacted by the pollution of the water.

However, effluents comprising different kinds of metallic and non-metallic elements work as nutrients, but at larger concentrations they may have a harmful effect on seed germination and seedling growth, ultimately harming plant growth and yield in agricultural fields. High amounts of organic compounds are found in the waste water from the sugar industry, which is occasionally released into nearby water sources. This study compared the characteristics of treated and untreated wastewater. According to CPCB guidelines, all industries must implement the Zero Liquid Discharge (ZLD) program within their facilities to prevent the discharge of effluent that has undergone only minimal or no treatment. The wastewater discharged by the sugar industry's influent and effluents were examined in the current study, and it was discovered that the pollutant concentration was relatively high. The treatment efficiency of the wastewater was improved by using the Biological Treatment Process with Activated Sludge Process (ASP). The amount of BOD that was removed was somewhat less than the BIS guidelines. The treated effluents currently suffer from a dissolved oxygen shortage. Even after the initial treatment, there may still be oil and grease present. According to CPCB guidelines, all industries must implement the Zero Liquid Discharge (ZLD) program within their facilities to prevent the discharge of effluent that has undergone only minimal or no treatment. The wastewater discharged by the sugar industry's influent and effluents were examined in the current study, and it was discovered that the pollutant concentration was relatively high. The treatment efficiency of the wastewater was improved by using the Biological Treatment Process with Activated Sludge Process (ASP). The amount of BOD that was removed was somewhat less than the BIS guidelines. The treated effluents currently suffer from a dissolved oxygen shortage. Even after the initial treatment, there may still be oil and grease present.

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