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Discharge of Effluent from Sugar Industry into Water Bodies: A Study

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Abstract

Water contamination is a serious worry for environmentalists due to the fast rise of industrialization and human activities. The sugar industry plays a significant role in the production of water pollution in industrial sectors. The majority of water pollution in the sugar business is caused by operations including mill house, boiler blow down, condensing cooling water, soda and acid wastes, wasted wash, etc. pH, BOD, COD, TDS, TS, chloride, sulphate, and phosphate are common physicochemical characteristics found in wastewater in substantial amounts. Untreated or treated effluent from the sugar mill is discharged into a neighbouring water body or used for irrigation. The quality of the soil, surface water bodies, and ground water is all declining daily as a result of these activities.

Keywords*: - Sulphate, Physicochemical parameters, Water pollution,*

INTRODUCTION

Water is a very important component of life that all species require for survival. Water is needed for sanitation and waste disposal in addition to home use and irrigation. According to data from the DDWS of drinking water supply and the GOI, approximately 90% of the water needed in rural areas comes from groundwater sources. Groundwater is the main source of water supply for drinking purposes in the majority of India. With almost 80% of the rural population and 50% of the urban population using groundwater for residential purposes, India is by far the biggest and fastest rising user

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of groundwater in the world. Groundwater contamination can result from on-site sanitation systems, excessive fertiliser use in agriculture, leaking landfill septic systems, or gas stations. Contamination can happen due to naturally existing pollutants like fluoride or arsenic. Public health issues arise from the use of polluted groundwater due to the spread of illness or toxicity.

Most of the sugar industries in India adopted double sulphitation process for the production of white sugar. Current practices or production processes in sugar industry are (i) Crusing (ii) Clarification (iii) Evaporation (iv) Crystallization (v) Centrifugation.

The main product of the sugar cane industry is white sugar. The other byproducts are produced during the fermentation and distillation of molasses and sugar cane juice. For every tonne of cane sugar produced, alcohol distilleries that service the sugar industry generally create 250 kg of bagasse and 156 litters of stillage. While stillage is often disposed of with field crops and presents a risk of polluting bodies of water, bagasse is a combustible boiler fuel that may be used to generate energy. The possible surface water pollution is mostly caused by the high concentration of organic compounds in the sediment. Stillage, the leftovers from manufacturing alcohol, contains a large amount of potassium, which can accumulate to harmful levels in the soil (Korndörfer & Anderson, 1997). Sugar production requires a lot of water, which generates a lot of effluent that is subsequently thrown into adjacent bodies of water like rivers or streams. It is typical for wastewater to quickly combine with streams, emit a bad smell, and subsequently mix with groundwater, degrading the quality of the latter. The release of wastewater from the sugar industry that has either not been treated at all or has only been partially treated causes pollution problems in both terrestrial and aquatic ecosystems.

Anaerobic treatment has been the foundation of the majority of research on the treatment of wastewater from the sugar sector. Oil and grease cannot be easily broken down by anaerobic processes. Additionally, anaerobic activities partially oxidise nutrients, whereas aerobic processes need more energy. Anaerobic and anaerobic systems used together may entirely eliminate organic materials. Unfortunately, there are not many studies on anaerobic-aerobic combination systems, and additional research is

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required (D. Shiva Kumar & S. Srikantaswamy, 2015).

The key parameters in the sugar mill effluent are TDS, TSS, BOD, COD, and sulfate. This parameter is significant because it may directly affect the neighbourhood and adjacent community. We offer anaerobic and aerobic treatment solutions to address this sugar wastewater issue. Anaerobic treatment requires a lot of time, whereas aerobic treatment consumes a lot of electricity.

Sources of effluent (Sugar with Distillery plant): Moose House (this water contains organic matter like sucrose, oil, and grease from the bearings fitted into the mills), Blower-down water from a boiler, waste (the water used in boilers has suspended solids and dissolved solids like salts of Ca, Mg, Na, Fatty, etc.) , water for condenser cooling (condenser cooling water is recirculated again up until it gets contaminated with juice, which is possible due to defective separators, faulty operation, etc.; if the water gets contaminated, it goes into the drain invisibly), Significant volumes of organic and inorganic pollutants are produced by soda and acid wastes. This increases the pollutant load and adds stress to the waste water treatment process.) , used laundry (in the distillery plant, this spent wash has high BOD and COD with a low pH range and a dark color.) For every litre of alcohol produced, about 8 to 15 litres of spent wash are created.

Wastewater Treatment Technique:

Primary treatment: Although it is typically referred to as a mechanical process, the addition of a coagulant and other chemicals can boost the effectiveness of the sedimentation phenomenon. To remove suspended solids, it uses gravity-based sedimentation together with screening of coarse, floatable solid particles. By using primary treatment, 20–30% of BOD and 50–60% of TSS may be eliminated.

Secondary treatment: In this procedure, the dissolved organic debris left behind following the first therapy is eliminated. Microorganisms will be used to do this. They use the organic matter for their own development and reproduction, and as a result, the organic material is transformed into tiny molecules (water, CO2, and energy). Then, if necessary, another settling tank is added. For BOD and SS criteria, a well-functioning plant may reach removal efficiencies of around 80%. In essence, ASP serves as a supplementary

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treatment facility. Aeration in many stages can occasionally be offered.

Tertiary treatment: In India mostly sugar industry installs ACF (activated carbon filter) or RSF (rapid sand filter) to polishing treated effluent water quality. After this treatment treated effluent will be used for irrigation purpose or discharge in near water body.

Distillery plant effluent treatment (Indian practice): Spent wash and other utilized water is going to the holding tank. This will be go to lagoon system, after that wastewater is spread or sprinkle on the press mud for making fertilizer for The mixing of SW and press mud (50-70% moisture) has to be carried out (for 45 days cycle completion require 2.5:1 proportion and for 60 days cycle 3.5:1 proportion require) in surface windrows with the help of an aero tiller machine (Self-propelling) for, mixing, turning, spraying and aeration of compost material. Composting is requiring addition of cow dung or special blend of cultures for providing of microbes. Bio-methanation is also option for treating the wastewater from the distillery plant.

Table 1: Typical Characteristics of effluent from Sugar industry

S.No	Parameter	Sugar Industry		BIS effluent Discharge standards	BIS Drinking water standards
		Untreated Effluent	Treated Effluent		
1	Colour	Dark Brown	Light Brown	-	-
2	Temperature	40ºC	38ºC	35ºC	-
3	pH	5	6.8	6.5-9.0	6.5-8.5
4	D.O.	1.30 ppm	2.30 ppm	2-6 ppm	-
5	BOD	98 ppm	88 ppm	30 ppm	-
6	COD	35 ppm	255 ppm	250 ppm	-
7	TDS	2980 ppm	1920 ppm	2100 ppm	500 ppm
8	TS	2700 ppm	2010 ppm	2700 ppm	-
9	Chlorides	210 ppm	175 ppm	600 ppm	250 ppm
10	Sulphates	760 ppm	420 ppm	1000 ppm	200 ppm

(Weqar A. Siddiqui and Muhammad Waseem, 2012)

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Impact of Physico-chemical Parameter:

Colour and Temperature: According to study, untreated sewage had a dark brownish colour and treated effluent had a light brownish colour. This difference is crucial for aquatic plants that produce their own food through photosynthesis. Other variables, like DO, BOD, temperature, etc., will be impacted by this. Groundwater has an unpleasant colour and contains mineral salts. impacts of temperature on water-based chemical and biological processes. The upper limit for discharge in any body of water is 35°C. The germination process has been negatively impacted by the high temperature of untreated wastewater, or 40°C.

pH and DO: At cleaning of sugar cane juice PO4 - acid and SO2 Juice from sugar cane is cleaned. Both treated and untreated samples have their pH values reduced by PO4-acid and SO2. It has a direct impact on the growth and yield of the crop. The DO of the effluent should fall between 4 and 6 ppm according to the BIS effluent discharge standard. According to the current study, the DO of untreated effluent is only 1.30 ppm, while the DO of treated effluent is 2.30 ppm, both of which are below the BIS standard levels. There is no need to do any specific checks for the groundwater sample. are used to decrease the pH values of treated and untreated samples. It is directly affect growth and yield production of crop. Based on the BIS effluent discharge standard, the DO of the effluent should be within the range of 4 to 6 ppm. The present study shows the DO of the untreated effluent is only 1.30 ppm and the treated effluent has a DO of 2.30 ppm, which is lower than the values of the BIS standard. For the groundwater sample, it's not required to check.

BOD and COD: The BOD of the untreated effluent, according to the current study, was close to 100 ppm, whereas the BOD after treatment was 88 ppm. But according to BIS guidelines, BOD shouldn't be more than 50 ppm. However, COD is measured for groundwater samples rather than BOD. For identifying hazardous circumstances and the presence of biological materials, COD is important.

TDS and TS: The seasonal change has an impact on the solids in the wastewater. In effluent discharge, TDS content is lower during the wet season. According to some studies, excessive salinity levels in irrigation fields are caused by treated and untreated effluent with high values. It's also possible that these high salinity levels reach the groundwater and cause a problem with high salinity levels there.

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Chlorides and Sulphates: 210 ppm of chlorides in the influent were discovered through study, while 175 ppm were identified after treatment. This result is within the BIS tolerances. High SO4 2- content in both effluents is indicative of heavy sulphur consumption in manufacturing processes. When there is an excessive quantity of organic waste in the water, it produces a lot of odours that deplete the oxygen in the water. SO4 is frequently used to break down organic materials, which produces H2S, which has a strong, unpleasant smell like rotten eggs (Welch 1980).

CONCLUSION

According to some studies, using the ASP procedure to treat sugar wastewater is a more effective treatment option. The sugar industry's treated effluent has a well-balanced chemical content; if it is diluted with fresh water, it may be used for irrigation. Additionally, treated effluents that are discharged by the sugar sector may be recycled in subsequent industrial operations. Recycling waste water is an alternative method that benefits the sugar business financially. If used for drinking, degraded water has a substantial negative influence on people's health. Additionally, if this water is not regularly inspected, it will eventually render the land and water utterly unsuitable for agriculture and human consumption. If we want to achieve sustainable growth in the future, we must regularly assess the quality of the environment and take appropriate action to reduce contamination of the surface and ground waters around the industry.

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