PERFORMANCE AND EVALUATION OF SUGAR INDUSTRY EFFLUENT TREATMENT PLANT

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***Abstract*—At present Sugar Industry is one the most polluting industry in the environment. The sugar industry wastewater is characterized by its brown colour, low pH, high temperature, high BOD, high COD, odor problem, total solids, and high percentage of dissolved organic and inorganic matter.So this untreated wastewater will create problem to the environment. The analyzed parameters are pH, COD, BOD, TS, TSS, TDS, OIL and GREASE. Initial concentrations of COD,BOD,TSS,TS,TDS are 5102mg/l,1988mg/l,772mg/l,4530mg/l,3758mg/l respectively. After treatment of effluent the removal efficiency of COD,BOD,TDS,TSS,TS,OIL and GREASE are 97%,95%,69.21%,87.30%,72.29%,64.28% respectively. The low grade potash powder is generated from molasses distillery spent wash . This potash powder is used as fertilizer. It is also a solution for zero water pollution. The powder contains 14.70% of potash.**

Index Terms—BOD, COD, TSS, efficiency, Sugar ETP

I. INTRODUCTION

Sugar industry is a seasonal industry working for maximum of 5-6 months in one season. The industry uses sugarcane as their raw material along with various chemicals added to increase the face value of the final product. During the process a huge amount of water is also used per day and as a result industry generates waste water (effluent) on daily basis [4].

Waste water from sugar industries, if not treated properly, contains significant amount of TDS and TSS. This water may not be useful for crop land irrigation. There are reports which indicate that infiltration rate decreases with increased loading of BOD and TDS & TSS. The high value of TSS can cause decrease in soil porosity due to salt deposition. High TDS value in waste water may also have adverse effect on crops. A TDS of 500-1000 ppm may have detrimental effect on sensitive crops. In view of the above facts, it is quite evident that the sugar industry is a significant contributor to the environmental pollution and has typical problems. Another important factor in studying the pollution effect is that the sugar industry is seasonal industry and the waste flow is mainly during the crushing season. This causes difficulty in employing biological pollutional abatement systems which should otherwise remain very suitable for treating such wastes. Waste water from sugar industries, if not treated properly, contains significant amount of TDS and TSS. This water may not be useful for crop land irrigation. The high value of TSS can cause decrease in soil porosity due to salt deposition. Due to high

concentration of solids in the effluent, the dissolved oxygen available to germinating seeds of plants gets depleted. This results in reduction of energy supply reaching them through anaerobic respiration. This manifests into decreased growth and development of the seedlings. High TDS value in waste water may also have adverse effect on crops. A TDS of 500-1000 ppm may have detrimental effect on sensitive crops. In view of the above facts, it is quite evident that the sugar industry is a significant contributor to the environmental pollution and has typical problems. Another important factor in studying the pollution effect is that the sugar industry is seasonal industry and the waste flow is mainly during the crushing season. This causes difficulty in employing biological pollutional abatement systems which should otherwise remain very suitable for treating such wastes [1].

SOURCES OF EFFLUENTS—

The waste water generated from different sub-streams can be classified as follows—

(1) Mill House—The effluent consists of water used for cleaning the mill house floor which is liable to be converted by spills and pleased sugar juice (This clearing up operation will prevent growth of bacteria on the juice-covered floor).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) Waste Water from Boiling House—The waste water from boiling house results from leakages through pumps, pipelines and the washings of various section such as evaporators, juice heaters, clarification, pans crystal is action, and centrifugation etc. The cooling water from various pumps also forms part of water.

(3) Waste Water from Boiler Blow-down— The water used in boiler contains suspended solids dissolved solids like calcium salts, magnesium salts, sodium salts, fatty salts etc. These salts get concentrated after generation stream from the original water volume. These solids have to be expelled time to time to save the boiler being covered up by scales.

(4) Excess Condensate— 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 vapors being condensed in that case it goes in to the waste water drain. The treatment requirement in this case is almost negligible and can replace fresh water or let out directly as irrigation water after cooling it to ambient temperature.

(5) Condenser cooling water—Condenser cooling water is

recirculated 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 once in a fortnight or so.

The present study is carried out in M/s. Ugar Sugar Works Ltd. Its capacity is 20,000 TCD and a distillery of 75KLPD.The total quantity of wastewater generated is 1750 cum/d. The samples are collected from Sugar factory Effluent treatment plant.

II. MATERIAL AND METHODOLOGY

A. SAMPLING TECHNIQUE

Water sample will be collected in such a manner that the sample truly represents the water source or the main body of water or wastewater. Sampling is one of the most important and foremost steps in collection of representative wastewater sample from an effluent treatment plant. The reliability of laboratory analysis and tests depends upon the method of sampling. A factor involved in the

proper selection of sampling site depends on the objective of the study. A sample volume between 2 and 3 liters is normally sufficient for a fair complete analysis. The total number of samples will depend upon the objectives of the monitoring program. During the study, the samples were collected in clean polyethylene containers. A total of 3 grab samples were collected at an regular interval of 4 hours in each shift and mixed to give composite sample.

B. Physical and Chemical methods of analysis for sugar industry wastewater

The sugar industry wastewater is characterized by its brown colour, low pH, high temperature, high BOD, high COD, odour problem, total solids, and high percentage of dissolved organic and inorganic matter**.** Some generalized parameters are to be tested to determine the performance and evaluation of sugar industry effluent treatment plant.

I-Analytical Methods adopted for sugar industry wastewater analysis

Sl. No	Parameter	Method Used	Experiment Used
1.	pH	Electrometric	Digital pH meter
2.	BOD_5 @ 20 °C	Dilution Method	Volumetric glassware's, BOD Bottles, Incubator
3.	COD	Open reflux method	COD apparatus, Round Bottom Flask
4.	Total Solids	Gravity metric method	Gooch Crucible and electronic Balance, Burner
5.	Total Dissolved Solids	Gravity metric method	Gooch Crucible, Centrifuge machine, Electronic Balance, Burner
6.	Suspended Solids	Gravity metric method	Gooch crucible, Electronic Balance, Burner, Centrifuge Machine

Performance and Evaluation

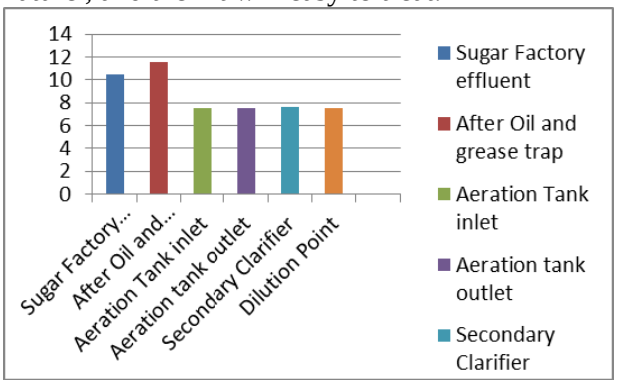
In order to check the efficiency of the sugar industry effluent treatment plant to examine the working of each unit and to determine how much pollution load has been removed and hence performance evaluation has been carried out.

II-Typical composition of Sugar Industry wastewater

Sl. No	Parameter	Average Values	Effluent Standard for discharge on inland Surface Water	Effluent Standard for discharge on land for irrigation
1.	pH	10.69	5.5-9.0	5.5-9
2.	COD	5102(mg/L)	250	-
3.	BOD	1988(mg/L)	30	100
4.	TS	4530(mg/L)	-	-
5.	TDS	3758(mg/L)	-	-
6.	TSS	772(mg/L)	100	200
7.	Oil And Grease	14	10	10

A. pH

Generally sugar industry effluent is acidic in nature. The lime is added to the effluent to increase pH value so effluent become alkaline in nature , and then it will easy to treat.



B. Screen and Oil & grease

Screening is the first unit operation in ETP which removes the solids from the wastewater. Where as Oil & Grease trap removes the floating substances like grease, oil, fats etc. from sugar industry wastewater. And also reduces the COD and BOD values. Removal efficiency of COD and BOD are 37.33% and23.13% respectively.

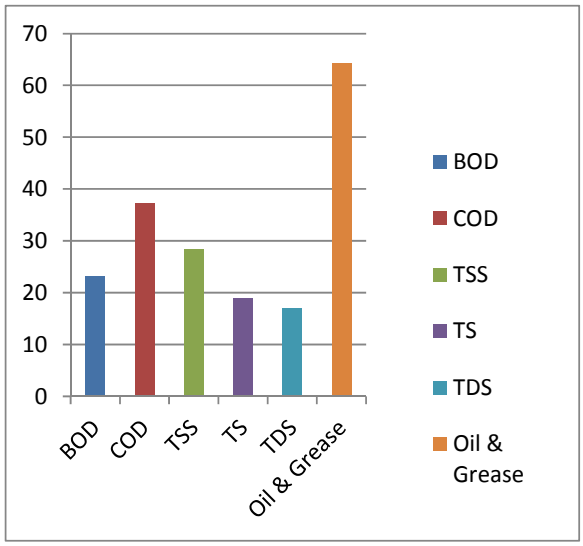


Fig.1.1: Removal Efficiency of Screen And Oil and grease trap

C. Aeration tank

The primary treated effluent would be collected in the aeration Tank for degradation of organic matter with the help of micro-organism, especially grown and maintained in the Aeration Tank in conjugation with oxygen transferred through Diffused Aeration System. Here reduction of BOD is 84.02% and which improves the purification of wastewater.

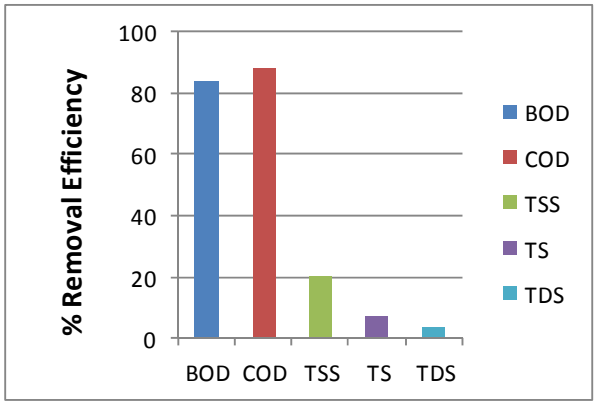


Fig.1.2: Removal Efficiency of Aeration Tank

C.Secondary clarifier

The function of secondary clarifier is to produce clarified effluent. Half of suspended solids will get removed in this clarification process. So removal efficiency of suspended solids is 25.94% and total solids removal efficiency is 27.29 %.

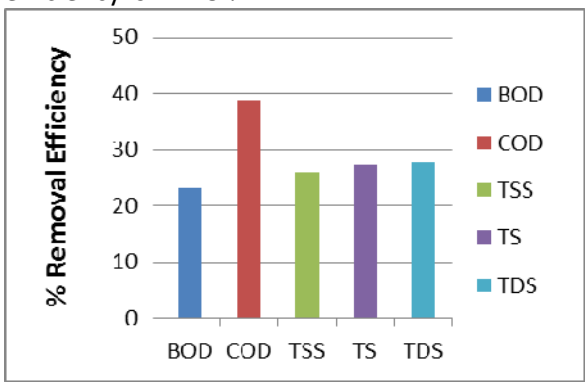


Fig. 1.3 : Removal Efficiency of Secondary Clarifier

C. After Dilution

After secondary clarification the fresh water added to the treated effluent. And then which is used for irrigation purposes. So reduction efficiency of BOD,COD and TSS are 13.76%,19.78% and 66.66% respectively.

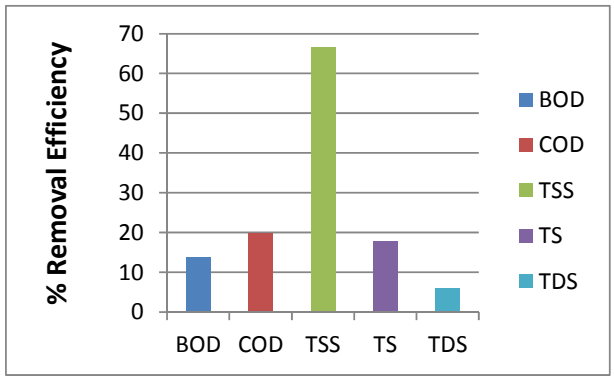


Fig.1.4: Removal Efficiency of dilution point(After Dilution)

D. Overall efficiency

The overall efficiency of treatment plant in BOD_5, COD and TSS,TS are 95.27%,97%,87.30%72.29%.

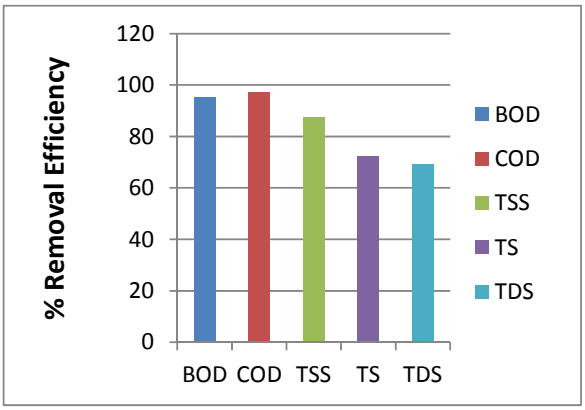


Fig.1.5: Removal Efficiency of treatment plant

The low grade Potash powder is produced from molasses distillery spent wash.

ZERO POLLUTION PLANT GENERAL DESCRIPTION

The Evaporator Plant **:** The plant is designed for 360 m^3/d post biomethanated effluent feed is received in a level controlled balance tank and passed through pre-heaters, calendrias and vapor separators of various effects. The evaporation takes place under vacuum, which is maintained mainly by vacuum system. Steam is supplied as a heating medium to high heater and through thermal vapor recompression (TVR) to the first effect jacket. The concentrated product at the desired concentration is continuously taken out from the plant.

The spray drying plant**:** The concentrate is sprayed through spray nozzle with the help of high-pressure pump into the drying chamber. The droplets of feed are atomized with the help of high-pressure nozzle/hot air. The resultant powder is collected in 50 Kg bags.

III. Conclusions

- The screen and Oil & Grease trap removes oil and grease, BOD, COD, TSS 64.28%, 23.1%, 37.33%, 28.3.
- The removal efficiency of Aeration for BOD, COD, and TSS are 84.02%, 88.46%, 20.28% respectively.
- The removal efficiency of secondary clarifier BOD, TSS, TS are 23.23%, 38.88%, and 25.94% respectively.
- The removal efficiency after dilution for BOD, COD, and TSS are 13.76%, 19.78%, 66.66% respectively.
- Overall efficiency of treatment plant for removal of COD, BOD, and TSS are 97%, 95.27%, 87.30% respectively.

The sugar industry effluent which is untreated exhibits high COD, BOD, TDS, contents and low contents of DO which is toxic to plants, so it is not permissible for irrigation. Treated effluent of sugar industry which is well balanced of chemicals if it is diluted with other fresh water, will be suitable for irrigation purposes. The treated effluents of sugar industry are not highly polluted and they satisfy the CPCB standards. The low grade potash powder is produced from the molasses distillery spent wash. This potash powder is used as fertilizer. It is also a solution for zero water pollution.

III -The contents of the powder are as follows

Parameter		Results
Organic Matter		26.17%
Potassium	As K	14.70%
Phosphorus	As P	0.21%
Nitrogen	As N	1.66%
Gross Calorific Value		2549 cals /gm.
Iron	As Fe	379.7 ppm
Manganese	As MN	40.56 ppm
Zinc	As Zn	7.19 ppm
Copper	As Cu	33.97 ppm
Nickel	As Ni	10.19 ppm
Calcium Carbonate Content		4.73%

Suggestions

- Industrialist should check their instruments / equipment to avoid leakage.
- Each industry should follow environmental policies, regulations and environmental protection acts to conserve the environment.
- Industrialist should use such raw materials which will give maximum good products and less toxic waste in fewer quantities.
- Industries should be installed in low laying areas away from the public locality.
- Each industry should have ETP plant to treat the effluents, which can be further used for the agricultural purpose.

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