Characterization and Comparative study of Cane Sugar Industry Waste Water

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Abstract

Sugar industry is one of the most important agro based industry segment in India. Cane Sugar Industry being an important role in the Indian economy as well as in the foreign exchange earnings and also plays a very vital part in polluting the environment with its waste discharge. With expansion of Sugar plants, pollution due to inadequate and it becomes threat for environment .In this study four Sugar Industries were selected for the analysis of the composition of their effluents, which are the primary source of water pollution. The results of the study showed that the effluents in general exceed the limits specified in CPCB with reference to parameters a such as BOD, COD , Oil and greases , total suspended solids. The effluent level found through the analysis can be reduced if suggested recommended measures are worked upon.

Key Words: Effluents CPCB, BOD, COD, Sugar Waste, Environment;

Introduction

Sugar industry is seasonal in nature and operates only for 120-200 days in the season[1]. The industry usages sugar cane as their raw material along with various chemical added during the process to increase the value of final product. During the process the huge amount of water is also used and a result industry generates waste water on larger amount. The generation of waste water is shown in the table -1. The waste water from mill house is usually contaminated with oil and grease. The spillage of oil and grease[3] on floor of mill house is washed away during floor washing. The waste water generated from process and mill house is highly contaminated with process chemicals ,which are being used at different processing stages. Sugar industry is a larger water consuming industry . Water quantity required can vary due to the application of new technology and quality of raw material used. Sugar cane entering in the industry contains about 70-80 % moisture, as a result, excess water has to be disposed off, even with the water reuse[8,9]. It has been observed that each ton of cane crushed should produce about 0.73 m^3 of water if sugar and water are completely separated[1]. Mostly water is required in the sugar mills as mill floor washing, cooling water for barometric condensers, boiler fed water, lime preparation, for power pumps and evaporators.

According to Indian industry standards, water consumption varies from 1.3 to 4.36 m^3. The water generated is about 20% of the water requirement. The sugar industry with crushing capacity of 5000 Tons per day requires 10000 m^3 /day of water. The mills generate the waste water in the ratio[5] of 1:2.

The sugar industry waste water is characterized by its color, temperature of water, low pH, ash, and dissolved organic and inorganic matter of which 50% may present as reducing sugar[6]. In addition to sugar mill waste water carry the constituents such as Biochemical Oxygen demand, Chemical Oxygen demand, oil and grease in the range which more than the CPCB standards.

Materials and Methods

For the comparative study we were selected four Sugar mills near by the Marathwada region. Waste water samples were collected from two sections of industry. First one from mill house and second one are from process house. One composite sample from the final drain carrying waste water of all the sections and going outside the plant premises. Physical analysis was done on site, while for chemical analysis, the samples had to be preserved by maintain the sample container temperature at 4^0C. Before analyzing the samples in laboratory. The sampling strategy for each parameters and point sources are identified in table-2.The parameters such as BOD, COD, TSS,p H , oil and greases were analysis by standard analytical Methods[2].

Results and Discussion

Physical Analysis

Color of the waste water for all the samples was recorded as dark brownish, giving a sugar cane juice –like smell. This gives the presence of sugar residues in the waste water[6]. The waste water temperature ranged from 43- 46^0C. This is above the standard value of CPCB and MPCB. The solubility of oxygen decreases as the temperature and pressure increases. , warm waste water discharges tend to lower value of the dissolved oxygen, which increases in environmental problems.

Chemical Analysis:

The p H of the effluents is generally shown in the graph . The p H results for process house and final effluent samples showed that unit-2 was more acidic in nature, since it contained the lowest p H value of 5.2 and 4.4 respectively. The values of pH are due to the change in the manufacturing process of each industry with remelt sulphitation process in which acidic compounds of sulphur are formed ,while the unit -1 use remelt carbonation. Several chemicals are used for coagulation of impurities. Calcium

Hydroxide is used to clarify and increase in pH of juices.[4] Unit-2 waste water temperature was 45^0C as compared to 42^0Cfor unit-1 effluent. While the p H of all four sugar industry was found to be in its alkaline range within the specified limits of 6-8. The values obtained for TSS was again found to be much higher than the standard limit value of 150 mg/L for TSS. The analytical results for TSS show that unit-3 had the higher TSS of 321 mg/L from process section as compared to other industry samples. Where as , final effluents of unit-2 contained more TSS of 660 mg/L than the other three mills, indicating high crushing rate of the industry and as a result generating larger amount of fly ash and bottom ash. The bagasse stacking plant is also near, so the coarse bagasse particles are mixing with final effluent. The shredded bagasse particles and the flying ash particles are the major contributor of TSS. The lowest value of TSS i.e. 159 mg/L found in the process house water contained by unit-2 effluent, while the final effluent of unit-3 notated lowest value of TSS i.e.272 mg/L. All the results are described by graphical method in fig.2.

BOD and COD were analyzed for process house and final effluent. We found the all values of BOD and COD are higher than the standard CPCB values of 80 mg/L and 150 mg/L. Unit-3 final effluents had the higher values of BOD and COD of 670 mg/L and 3683 mg/L . While process house BOD value of 355 mg/L for unit -1 was the highest among the four mills. COD of unit-3 effluent was found to be highest value among the all samples i.e. 1985 mg/L. However unit-2 effluent had the lowest BOD and COD values measured both for the process and combined effluents i.e. 95 mg/L and 189 mg/L for BOD and 392 mg/L and 639 mg/L respectively. Increase in BOD and COD values may be endorsed to the spillage of molasses and leaked sugar contents on the floors of the mills, which are swept washed away to be mixed with the effluents causing the high levels of BOD and COD, which are shown by graphically in fig.3 and 4.

Oil and grease were determined for the mill house samples, where oils and greases are particularly used. The analytical results showed these values are higher than set standard values (10 mg/L)as per CPCB norms. Unit -2 and unit -4 recorded the lowest value for oil and grease i.e.22 and 23 mg/L. While sample of unit-1 showed the higher value for OG .i.e.48 mg/L. The sample of unit -2 having lowest value of O&G for final effluent sample i.e.27 mg/L. While the unit -1 had the highest value of 134 mg/l for final effluent. The final effluent contains higher values of O&G , effluent carries from the lubricating house and the gland leakage is one of the major problems. where the unit-4 has are getting less values due to use of Mechanical seals instead of gland packing's. The graphical representations are shown in fig-5.

Conclusions

The analytical results of final effluent BOD and COD showed that unit-3 sugar mills effluent had a higher values i.e. 673 mg/L ,3683 mg/L as compared to unit-1 and unit -3 and unit -4. Increase in BOD and COD values attributed to the spillage of molasses and leaked sugar contents on the floor mills. TSS contents are higher than standard value, mostly because of flying particles of bagasse and fly ash from boiler house.

Oil and grease values are found to be more than standard values due to improper maintance of equipments and leakages of power pumps.Segrgation of oils from the effluents will for recovery and reuse of lubricating oils. Screening before discharging the effluent reduces the particles of bagasse and cane pieces reduce the load of total suspended solids. Reuse of water and less consumption of water reduces discharge and generation of waste water,

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Table 1: Waste water generation from each unit in a sugar industry.

Input	Unit House	Waste water generated
Sugar Cane	Mil housing	Waste water from bearing house of mills, contains suspended solids and oil contents, washing of floors.
Sugar Juice	Process house(Juice heaters/ Evaporators/ Condensers/ Crystallizers/Rotary filters)	Washing of different components such as juice heaters /crystallizers evaporators and water circulation through condenser
Bagasse and Furnace oil	Boiler house	Waste water of wet scrubbers/blow down of boiler /flay ash particles

Table-2: Waste water sampling and analytical parameters.

SN	Sample Point Source	Prescribed Parameters	Total no of Samples from four Sugar Industry
1	Mill House	Oil and Grease,p H ,TSS	8
2	Process House	BOD,COD, p H,TSS	8
3	Combined effluent (Final)	Oil and Grease, pH BOD, COD,TSS	8

Table -3: Cumulative Waste water analysis for four Industries.

Parameter (mg/l)	Unit-1			Unit-2			Unit-3			Unit-4		
	Mill	Process	Final	Mill	Process	Final	Mill	Process	Final	Mill	Process	Final
p H	7.8	7.5	7.39	8.2	5.2	4.4	8.6	7.6	6.3	8.2	7.7	6.8
TSS	--	228	390	---	159	660	--	321	272	--	342	280
BOD_5	---	355	478	--	95	189	--	343	670	--	342	681
COD	--	1190	2272	--	392	639	--	1985	3683	--	2120	3549
O &G	48	----	134	22	--	27	32	--	47	23	---	32

Fig.1 Graphical Presentation of p H

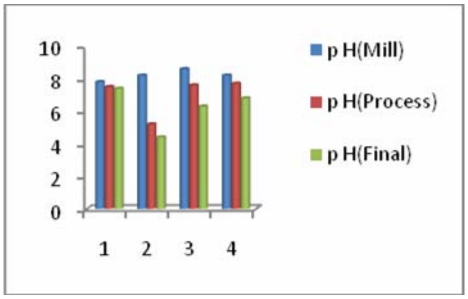

Fig.2 Graphical Presentation of TSS

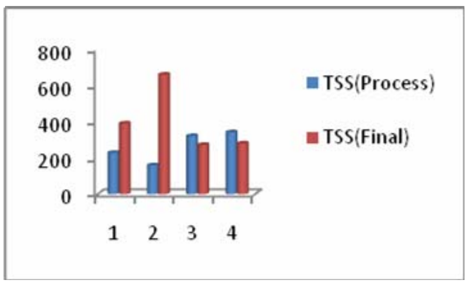

Fig.3 Graphical Presentation of BOD_5

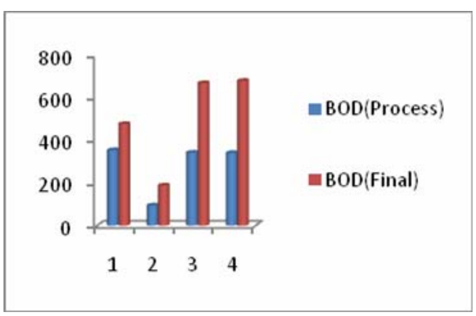

Fig.4.Graphical Presentation of COD

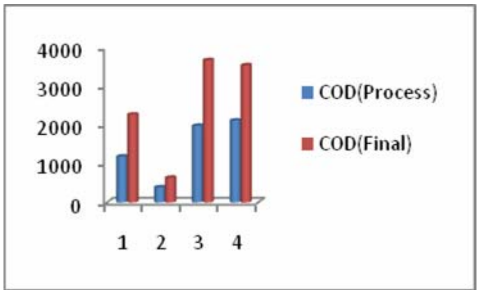

Fig.5. Graphical Presentation of O&G