© 2018 IJSRST | Volume 4 | Issue 5 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

A Study on the Characteristics of Sugar Mill Effluent

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ABSTRACT

This paper presents the physico-chemical characteristics of sugar mill effluent. The parameters studied are colour, odour, pH (6.1), temperature (39°C), total dissolved solids (2653.1 mg/l), total suspended solids (401.3 mg/l), total solids (3054.4 mg/l), D.O (2.83 mg/l), BOD (86 mg/l), COD (325 mg/l), chloride (262.31 mg/l), and sulphate (641.52 mg/l). According to the limits suggested by Bureau of Indian Standards, almost all the parameters have been found to be very high and well above the permissible limits. This study revealed that the untreated wastewater discharged from the sugar industry is highly polluted and exceeds the prescribed limits for irrigation and public use.

Keywords: sugar mill effluent, physico-chemical characteristics, D.O, BOD, COD, BIS limits, Permissible limits

I. INTRODUCTION

Nowadays, Water resource management has taken place an important role all over the world. Due to the disposal of untreated effluent into the surface water bodies leads to severe problems and the health aspects of peoples were affected [1,2]. Particularly in the urban areas, domestic wastewater that discharged nearby the surface water bodies creates serious problems for the public's [3-5].

Sugar industry is a seasonal Industry operating industry, which is run for maximum of 4-5 month in one season. India is the largest producer of sugarcane in the world. Sugar industry requires huge amount of water for the production of sugar and they released almost equal quantity of effluent which contains toxic materials. The sugar manufacturing process is known to produce considerable amount of solid waste, waste water and noise pollution. In particular, the highly polluted wastewater from sugar industry poses an extensive danger to human health and environment [6]. During the manufacturing of sugar, several chemicals are added mainly for the coagulation of impurities and of end products. Large volume of wastewater is generated from the sugar industry which contains a high amount of pollution load, predominantly in terms of suspended solids, organic matter, bagasse, press mud and air pollutants [7-9]. Wastewater from sugar industry with high pH level, which rapidly depletes the available oxygen level in the discharged water bodies which affects the fish and other aquatic life. High TDS level in the discharged wastewater would have undesirable impacts on the aquatic life, cause the receiving water unfit for drinking, reduction in crop yields if used for irrigation purpose and make worse corrosion in the water systems and pipes [10,11]. The main objective of this study is to assess the characteristics of effluent from the sugar industry and compared with standard BIS limits and permissible levels.

II. METHODS AND MATERIAL

For this study, the sample was collected from M.R.K sugar industry, Sethiyathope, Cuddalore, India. The

effluent was collected in 10 liter can and preserved in the laboratory for analysis. The physico- chemical parameters were analysed by standard procedures given by APHA (1995).

A. Colour

In this study waste water from the sugar industry was dark brownish in colour. Colour is a qualitative measurement, which is used to evaluate the general characteristic of effluent. Color is the most important factor for the aquatic life. Because, the aquatic life produces its food from the sunlight by photosynthesis process. Due to the dark colouration, there is a reduction in photosynthesis activity and the parameters like DO, BOD, Temperature also affected.

B. Odour

It is observed that, the untreated wastewater from the sugar industry have fishery odour. Generally, the unpleasant odours in the wastewater of food processing industry are caused by the gases produced by anaerobic decomposition of organic matter in the wastewater.

C. Temperature

The temperature of the effluent plays an important role for the certain chemical and biological process and will affects the organism and aquatic life. Generally, the effluent released from the sugar industry is high in temperature and the land was harmfully affected. According to BIS limit, the temperature of the effluent should not exceed 35°C. In this study the untreated effluent from sugar industries was recorded as 39°C, which is higher than limits.

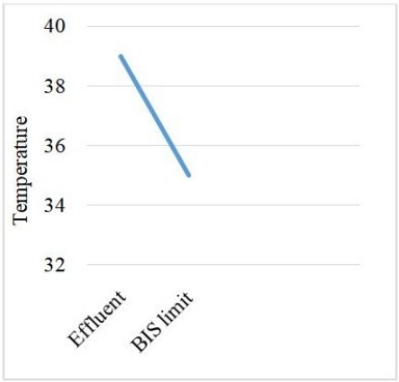

Figure 1. Comparison of temperature between Effluent and standard limits

D. pH

pH is defined as the negative logarithm of hydrogen ion concentration. pH value ranges from 0 to 14. A pH value of 7 indicates that, it was neutral in concentration, pH valve less than 7 indicates that acidic and pH value above 7 indicates basic or alkaline. The broad classification in the pH of effluent can affect the reaction rate of biological process and survival of several micro organisms. The soil becomes acidic in nature and poor crop yields due to the long time usage of untreated effluent from sugar industries. According to BIS standards, the pH range for sugar mill effluent is 6.5 to 8.0 and the permissible limits ranges from 6.5 to 8.5. In the present investigation, the pH value is recorded as 6.1, which is lower than limits. The digital pH meter is used to find the pH of the effluent.

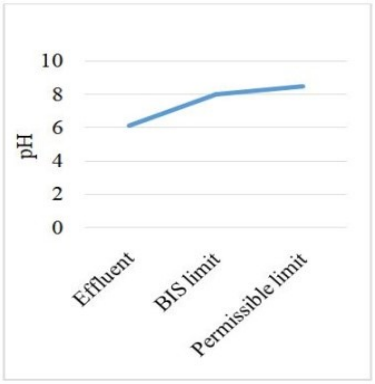

Figure 2. Comparison of pH between Effluent and standard limits

E. Total Solids

The term solids refers to the substance which is either filterable or in filterable that remain as a residue after drying at a particular temperature. Based on method of application, there are different forms of solids such as TS, TDS and TSS. Generally, these forms of solids are composed of carbonate, bicarbonate, calcium, magnesium, chlorides, etc. The BIS limit for total solids is 2700 mg/l and the permissible level is 1200 mg/l. In this present study the total solids for effluent was recorded as 3054.4 mg/l, which is higher than limits. Gravity metric method is used determined the total solids in the effluent.

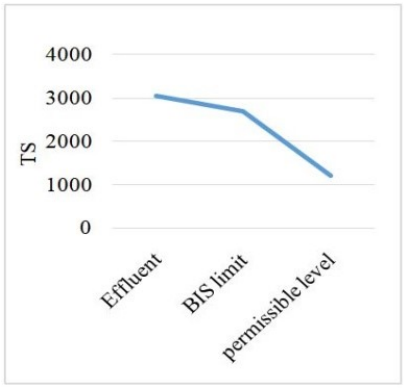

Figure 3. Comparison of Total Solids between Effluent and standard limits

F. Total Dissolved Solids

The total dissolved solid is a measure of combined content of all the organic and inorganic matters present in a liquid in molecular, ionized or suspended form. TDS is differentiated from TSS in that the latter cannot pass through the sieve of 2μ and indefinitely suspended in solution. BIS limit for total dissolved solid is founds as 2100 mg/l and permissible limit for TDS is 1000 mg/l. In this study the total dissolved solid was recorded as 2653.1 mg/l, which is higher than limits.

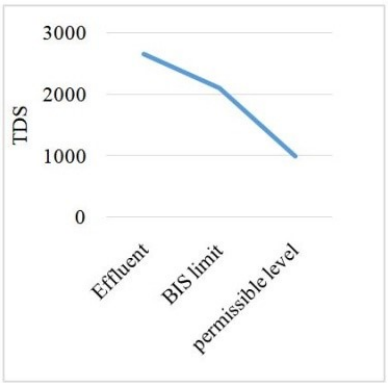

Figure 4. Comparison of Total Dissolved Solid between Effluent and standard limits

G. Total Suspended Solids

Total suspended solids are the dry weight of the particles that are entrapped by the filter. The existing of suspended solids will affect the intensity of light in the water. Suspended solids are main reason for the presence of turbidity in the water. The BIS limit for Total suspended solids is 600mg/l and permissible limit was 200mg/lit. In this study the total suspended solids was recorded as 401.3 mg/l.

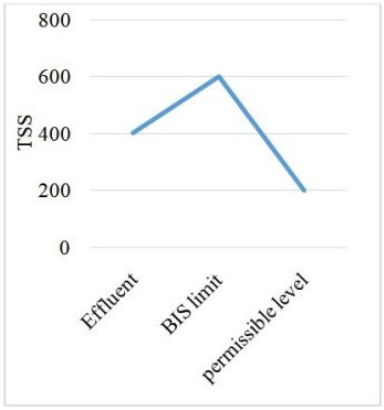

Figure 5. Comparison of TSS between Effluent and standard limits

H. Dissolved Oxygen

Dissolved oxygen is one of the most significant water quality parameter. The determination of dissolved oxygen plays an important role in waste water pollution control. Dissolved oxygen is the measurement of amount of gaseous oxygen (O2) dissolved in the water. The dissolved oxygen level in water can be affects the temperature of water. If the dissolved oxygen level dropped below to 5.0mg/l, it cause stress to aquatic life. According to BIS standard, the dissolved oxygen for waste water should be with the range of 4-6mg/l and permissible limit is greater than 6 mg/l. The present study, the dissolved oxygen for the sugar mill effluent was recorded as 3.81 mg/l, which is lower than limits.

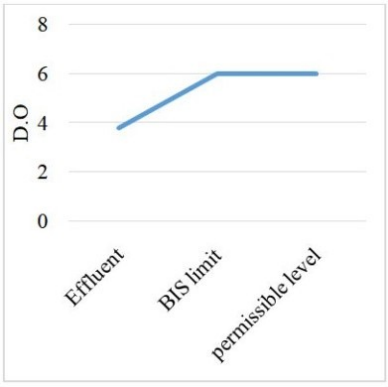

Figure 6. Comparison of D.O between Effluent and standard limits

I. Biochemical Oxygen Demand

Biochemical Oxygen Demand is defined as the amount of oxygen required to biologically degrade the organic matter present in the water under the aerobic conditions by the microorganisms present in the given

water sample at certain temperature over a specific time period. The BOD value is mostly expressed in terms of milligram of oxygen consumed per liter of sample during the incubation for 5days at 20°C. According to BIS standard, BOD value should not exceed 30mg/l and the permissible limit is 100mg/l. The BOD value for waste water is determined by dilution method. In this study, the BOD from sugar industry was recorded as 86 mg/l.

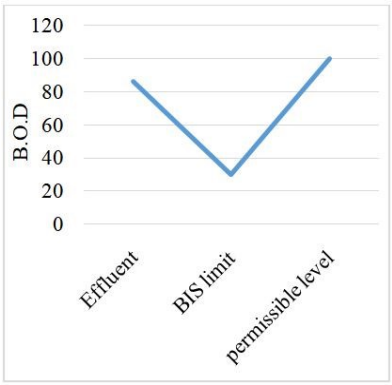

Figure 7. Comparison of B.O.D between Effluent and standard limits

J. Chemical Oxygen Demand

The COD is the test which determines the amount of oxygen required for the chemical oxidation of organic matter present in the given water sample with the help of strong chemical oxidants. This test is used to determine the pollution level of domestic and industrial waste. It is a most significant water quality parameter, because it is similar to BOD, it provides an index to assess the effects of discharged waste water in the receiving environment. According to BIS limit, the COD level should be 250mg/l and the permissible limit is 250 mg/l. In the present study, the COD for the sugar mill effluent was recorded as 325 mg/l. The COD level is determined by open reflux method.

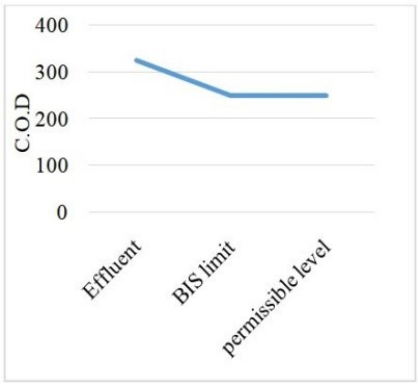

Figure 8. Comparison of C.O.D between Effluent and standard limits

K. Chloride

Generally, the presence of chlorides in natural water is common. Although, the concentration of chlorides are significantly low in water. Conversely, the wastewater produced industries, domestic and agricultural practices may contain large amount of chlorides, which can cause noteworthy distraction in the ecological balance. According to BIS limit, the chlorides level should be 600mg/l and permissible limit is 600mg/lit. In this study, the chlorides level in the effluent was recorded as 262.31mg/l, which is below the limits of BIS and permissible level.

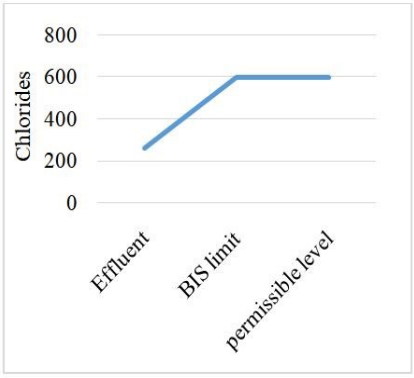

Figure 9. Comparison of Chloride between Effluent and standard limits

L. Sulphate

Sulphate is a naturally occurring anion in water. The main source of sulphate is from the discharge of municipal or industrial wastewater. Runoff from fertilized agricultural lands also contributes to water bodies. At normal concentration, sulphates are not considered as toxic to animals or plants. In human, the sulphate level between 500-750 mg/l cause a temporary laxative effect. Sulphate level in the water can be determined by colorimetric method or ion chromatography. In this study, the sulphate level is recorded as 641.52 mg/l. According to BIS limits, the sulphate level should not exceed the 100 mg/l and the permissible is 400 mg/l.

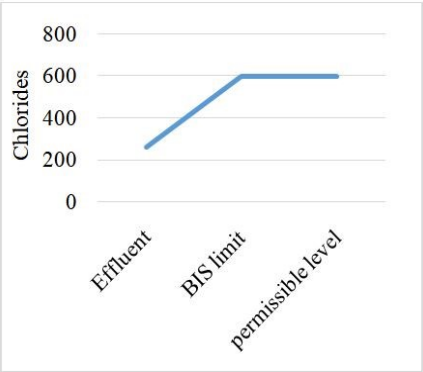

Figure 10. Comparison of Sulphate between Effluent and standard limits

III. CONCLUSION

The present study is to assess the physico-chemical characteristic of sugar mill wastewater. From the study, the untreated effluent from the sugar industry contains high amount of TSS, TDS, TS, BOD, COD and low amount of DO and pH which is toxic to plants. From this study, the physicochemical characteristics of sugar mill effluent are almost above the standard limit. If the wastewater is discharged directly without any treatment, it will affect the ecology system and affects the nearby agricultural land, which results in reduction of crop yields and soil condition. Generally, Physico-chemical and biological methods are used to treat the sugar industries wastewater. Effluents which are released after necessary treatment may be utilized for industrial processing over again and used for irrigation purpose.

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