PHYSICO–CHEMICAL ANALYSIS OF SUGAR MILL EFFLUENTS

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Sugar industry is one of the most important agro based industries in India and is highly responsible for creating significant impact on rural economy in particular and countries economy in general. Sugar industries rank second amongst mavar agro based industries in India. Sugar industry is seasonal in nature and operates only for 120 to 200 days in a year (early November to April). A significant large amount of waste is generated during the manufacture of sugar and contains a high amount of production load particularly in items of suspended solids, organic matters, press-mud, and bagasses and air pollution. (Bevan, 1971, Hendrickson et.al.1971).

All the industries consume huge quantity of water and throw back almost and equal quantity of effluent which contains highly toxic materials in dissolved or suspended form. If this water is properly used or it is purified to recycled, a part of water shortage will surely be solved. The sugar industry require nearly about 1200 to 1400 m^3 M.T. of water is released as waste water of cane crushed.

MATERIAL AND METHODS :-

For the present study the effluent was collected from sugar industry in 5 filter can at the source & It was preserved for long period by adding chemicals to analyse in the laboratory, physico-chemical parameters were analysed by standard procedures given by Trivedi et.al.1984

RESULT & DISCUSSION

1. Colour—In the present investigation the colour of the untreated effluent was dark brownish to brown and treated effluent appeared whitish. Colour is very important factor for the aquatic life for making food from sun-rays. This photosynthesis activity reduced due to dark colouration is affecting other parameters like temperature D.O. and B.O.D. etc.

2.Temperature —Temperature is basically important for its effect on certain chemical and biological radiations taking place in water for organism and inhabiting aquatic media. It depends upon season, time sampling etc.The water temperature plays an important role in influencing abundance of phytoplankton.The water discharged from industries, which has generally higher temperature, affects the land adversely. Discharging not effluents also cause loss of heat energy. Which may affect economy of the product produced by the industry. In the present study temperature of the untreated effluent was recorded in November 40^0C and in December 41^0C respectively, and temperature of the treated effluent was recorded as 32^0C and

Physico-chemical parameter of sugar mill effluent

Sr. No.	Parameter	Untreated Effluent November	Untreated Effluent December	Treated Effluent November	Treated Effluent December	ISI Standards
1	Colour	Dark Brownish Brown	Dark Brownish Brown	Whitish Yellow	Whitish Yellow	
2	Temperature	43^0C	41^0C	32^0C	31^0C	
3	pH	6.5	7.0	7.5	7.5	5.5 to 9.0
4	D.O.	1.29mg/lit	1.5 mg/lit	2.52 mg/lit	2.95 mg/lit	6.0 mg/lit
5	B.O.D.	97 mg/lit	92 mg/lit	85 mg/lit	80 mg/lit	30 mg/lit
6	C.O.D.	350 mg/lit	345 mg/lit	240 mg/lit	200 mg/lit	250 mg/lit
7	T.D.S.	2990 mg/lit	2970 mg/lit	1930 mg/lit	1920 mg/lit	2100 mg/lit
8	T.S.	3000 mg/lit	3075 mg/lit	2030 mg/lit	2015 mg/lit	2700 mg/lit
9	T.S.S.	110 mg/lit	105 mg/lit	100 mg/lit	95 mg/lit	600 mg/lit
10	Chloride	205 mg/lit	205 mg/lit	170 mg/lit	180 mg/lit	600 mg/lit
11	Sulphate	660 mg/lit	650 mg/lit	320 mg/lit	305 mg/lit	1000 mg/lit
12	Oil and Grase	16 mg/lit	10 mg/lit	9 mg/lit	8 mg/lit	10 mg/lit

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31^0C in November and December respectively. The temperature of the discharge should not exceed 35^0C since high temperature many produce softening of bituminous joints and may be deteropans to the pipe material itself. The rise in temperature accelerated the chemical reaction in oxygen. Beruch et.al., (1993), recorded the temperature 18% degree of the Gelabil in Assam. Kannan and Rajasekaran, (1991), recorded the value of temperature of printing effluent 28.80^C.

3. pH—pH is one of the important biotic factor that serves as an index for pollution. The factors like photosynthetic exposure to air, disposal of industrial water and domestic sewage affect pH. pH is the value expressed as the negative logarithm of the hydrogen ion concentration. Its range is give between 0 to 14.7 being neutral less than 7 being acidic and above 7 being basic or alkaline. The wide narration in the pH value of effluent can affect the rate of biological reaction and survival of various microorganisms. The presence or absence of various ionic special can have direct relation with pH of the effluent. Subsequently such effluent can influence the quality of soil. The reaction between effluent flowing from open drainage system with the soil has direct relevance to the pH effluent. It is therefore necessary to evaluate effluent with respect to the pH value. In the present investigation the pH value of the untreated effluents was 6.5 and 7.0 in November and December respectively and treated effluent was 7.5 and 7.5 in November and December respectively. Senthil et.al.(2001), observed the pH of sugar mill effluent is in between 6.0 to 7.6, Avasn (2001), observed the pH of the sugar mill effluent discharges from Tummapala sugar factory, Anakapalli (Andhra Pradesh) was 6.5 to 8.8 range. Matkar.S. (2002), observed the pH of sugar mill effluent is 4.5. Thorat t.al.,(1999), observed the pH of the sludge sample was 8.4 Khan et.al.,(1999), recorded the pH pharmaceutical industry untreated effluent in January 6.68 and treated effluent recorded in January 7.38. Rao et.al., (1993), observed the pH of textile industry effluent varied from 11.0 to 8.0.

4. Dissolved oxygen—It is one of the most important parameter in water quality assessment. D.O. is an index of physical and biological process going in water. The D.O. levels in natural as well as water waters depends on physical, chemical and biological activities of the water body. The analysis of D.O. is very important in water pollution control as well as waste water control. Aquatic ecosystem is totally depends on dissolved oxygen various biochemical changes and its effects on metabolic activities of microorganism were very well documented. All the literature collectively indicated the importance of the dissolved oxygen concentration. The solubility of atmospheric oxygen in freshwater ranges from 14.6 mg/lit at 0 degree to about 7.0 mg/lit at 35 degrees. Under one atmospheric pressure since if is poorly suitable gas its solubility directly varies with the atmospheric pressure at any given temperature. Its presence was essential to maintain variety of forming of biological life in water and the effect of water discharge in water body are largely determined by oxygen balance of the system, non-polluted surface water remaining normally saturated with dissolved oxygen. It can be rapidly removed from the water by discharge of oxygen demanding waste. Inorganic reducing agents such as hydrogen sulphates, ammonia nitrites and ferrous ions and certain available oxidizable substance also tend to decrease the oxygen in water. Mitra (1982), reported the recommended value of dissolved oxygen in normal drinking water was 8 mg/lit while suffornated value. DO was 14 mg/lit. Any subnormal value of DO concentration of pollutant can be semi quantitatively related with the difference in concentration of dissolved oxygen from its normal value. High dissolved oxygen was found its normal value. Devi (1980), also reported high DO during monsoon and low during summer in Asmaansagar. Mahan (1980), recorded dissolved oxygen range as 4.61 mg/lit to 6.68 mg/lit in the winter season. In the present investigation the Do of the untreated effluent is 1.29 mg/lit and 1.50 mg/lit in November and December respectively and the treated effluent was 2.52 mg/lit and 2.95 mg/lit in November and December respectively. Kannan and Rajasekaran (1998), observed the value of DO in printing effluent 1380 mg/lit. Throat et.al., (1999), observed the DO in untreated tamasi effluent 0.5 mg/lit and treated effluent 0.8 mg/lit. Avasan et.al., (2001), observed the DO of sugar mill is ranging between 0-2.0. He observed that if DO is low then it cause anoxic conditions. This causes respiratory distress of fish and fish shows erratic movements.

5. Total solids (T.S.)—The term solid refers to the matter either filterable or in filterable that remain as residue upon venerating and subsequent

drying at a defined temperature employed for drying and ignition. Different forms of solids are defined on the basis of method applied for their determination. High concentration of total solids during summer was probably due to low level of water, the direct relationship between rainfall and total solids was attributed to an increased load of soluble salts from the catchment area as a results of surface runoff. In effluent total solids total dissolved solids total suspended solids are composed mainly of carbonates bicarbonates, chlorides, sulphates, nitrates, Ca, Mg, Na, K, Mn and organic matter silts and other particles polluting water increase the concentration f total solids. In the present investigation the range of total solids in untreated effluent was 3000 mg/lit and 2015 mg/lit in November and December respectively. Senthil (2001), observed that the effluent discharged from sugar mill is ranging between 4485.0 to 1520 mg/lit with increasing distance (0 to 5 km). Avasan (2001), observed the total solids from the Tummanals sugar factory effluent it ranged between 870 to 1950 mg/lit. Ammoathusalam. A. (2002), observed the total solids from the sugar industry effluent it ranging between 1979 to 1820 mg/lit.

6. Total suspended solids (T.S.S.)—The T.S.S. affect the light intensity of water, suspended solids are the cause of suspended particles in side the water body influencing turbidity and transparency. Devi (1980), recorded total plankton, which showed a sterling parallelism with suspended solid. Effluent from different industries many have different amount of solid particulate matter either as suspended solids or total dissolved solids. In the present study, suspended solids of untreated effluent were 110 mg/lit and 104 mg/lit in November and December respectively and treated effluent 100 mg/lit and 95 mg/lit in November and December respectively. Avasan et.al., (2001), observed the T.S.S. of sugar mill effluent is 220 to 790 mg/lit.

7. Total Dissolved Solids—The maximum concentration of total solids was in summer, which increased, in rainy season while the minimum value was found in winter probably because of stagnation. In summer most of the vegetating was decaying as a rise in amount of dissolved solids was neutral, as the products of the decaying matter were settled in water. The total solids concentrations in waste effluent represent the colloidal form and dissolved specters. The probable reason for the fluctuation or values of total solids and subsequent the value of dissolved solid due to convent collision of the colliding particles. The rate of collision of aggregated process is also influenced by pH of these effluents. In the rainy season less concentration of total dissolved solids are obtained due to dilution of waste effluent with rain water. Hosetti et.al.,(1994), created or replaces have reported total dissolved solids in range 488 mg/lit in waste water for Jayanthinala. Most industries located near the area of responsible for higher values. In the present study the dissolved solids of untreated effluents was 2990 mg/lit and 2970 mg/lit in November and December respectively and treated samples are 1930 mg/lit and 1920 mg/lit in November December respectively. Avasan (2001), observed the sugar mill effluent and the observed that the total dissolved solids ranging between 400 to 1650 mg/lit. Thorat et.al., (1999), studied tannery waste and observed total dissolved solids in effluent 2850 mg/lit. Rao et.al., (1993), studied textile industrial effluent and recorded total dissolved solid value which ranges from 8500 mg/lit to 10000 mg/lit.

8. Chlorides—Chlorides are generally present in natural water. The presence of chloride in natural water attributed to dissolution of salt deposits discharge of effluents from chemical industries oil well operations, sewage discharges initiation drainage, contamination from refuse leachates, and sea water intrusion in coastal area. The chloride content in the river water has been investigated by Singh (1999) & Hanock (1973), and also working on Jionis river painted the significance of chlorides and stated that its principle source was animal matter, sewage and drainage from refuse and animal matter. Ragagopalan (1980), reported sharp increase in the chloride concentration at the sewage pollution station of the rivers. In the present study chlorides of untreated effluents was 205 mg/lit and 205 mg/lit in November and December respectively and treated effluent showed 170 mg/lit and 180 mg/lit in November and December respectively. Matkar (2002), observed that the effluent from sugar industry is having 450 mg/lit and 455 mg/lit untreated effluent chloricle and the treated effluent was 156 mg/lit and 162 mg/lit in November and December respectively.

9. Biochemical Oxygen Demand (B.O.D.)—

B.O.D. is defined as amount of oxygen required by microorganism while stabilizing biological decomposable organic matter in a waster aerobic conditions. The biological oxidation is very slow process during oxidating organic pollutants are oxidized by certain microorganism into carbon dioxide and water using dissolve oxygen. Hence lowering in dissolved oxygen value is the measure of BOD relation. The chemical kinetic factor like temperature pressure palette can favourably affect the BOD reaction. Beruch et.al.,(1993), suggested that oxidation of the organic waste by natural microorganisms create high level of BOD (1920 mg/lit of 2100 mg/lit) with a man of 8000. Biological oxygen demand is an important parameter that indicates the magnitude of water pollution, by the oxidizable organic matter and the oxygen used to oxidize inorganic material such sulphides and ferrous ions. In natural source the oxidizable matter on oxidation enters into biogeochemical cycle BOD does not work independently hence it performs well depend on so many called factors, low value of BOD in comparatively wider months may be due to lesser quantity of total solids, dissolved solids, suspended solids in water as well as to the quantitative number microbial pollution. (Avasan & Rao, 2001). In present study the untreated effluents BOD was 97 mg/lit and 92 mg/lit in November and December respectively and treated effluent BOD showed 85 mg/lit and 80 mg/lit in November and December respectively. Senthil et.al., (2001), observed the BOD of sugar mill effluent in 635 mg/lit to 950 mg/lit range. He observed in summer season. He observed the value of BOD for the sugar mill effluent and it varied from 950 to 635 mg/lit with flowing distance. Trivedi et.al., (1986), observed the effluent of a textile industry from different unit BOD value of mixed effluent ranged between 320 mg/lit to 720 mg/lit and final effluent 80 mg/lit to 640 mg/lit.

10. Chemical Oxygen Demand (C.O.D.)— The COD test determines the oxygen required for chemical oxidation of organic matter with the help of strong chemical oxidant. The COD is a test, which is used to measure pollution of domestic and industrial waste. The waste is measured in terms of quality of oxygen required fro oxidation of organic matter to produce carbon dioxide and water. It is a fact all organic compounds with few exceptions can be oxidized by the action of strong oxidizing agents under acidic conditions COD is a useful in pinpointing toxic condition and presence of biological resistance substances. The conjugation of BOD test, with COD test is helpful in indication of toxic conditions and the presence of biological resistance. In the present study the COD of untreated effluents was 350 mg/lit and 345 mg/lit in November and December respectively and treated effluent COD is 240 mg/lit 200 mg/lit in November and December respectively. Devi et.al., (2001), observed COD 500 mg/lit to 550 mg/lit on galvanised industries. Importance of organic matter in the ecology of bloom firming eyanobacteria has been reported by many workers. Trivedi et.al., (1986), observed COD value range from 300 mg/lit to 2400 mg/lit of textile industry effluent.

11. Sulphate—It is one of the major active occurring in natural water. Sulphate may enter natural water through weathering of deposits. It may be leached from sedimentary rocks. Particularly from sulphate deposits such as gypsum and anhydrate. Effluent from certain industries also may be major sources of sulphate to be receiving water. Another significant source of water system in airne industrial pollutant containing oxides of sulpher which is converted to sulphuric acid in precipitation (acid rain). Sulphate can also be produced by factorial or a oxidizing action as in the oxidation action or in the oxidation of oregano sulphur compounds. Suphur itself has never been limiting factor in aquatic system, the normal levels of sulphates are more that adequate to meet plants needs, odours conditions are easily greater when water is over loaded with organic waste to the point that oxygen is removed, that SO_4 as electron acceptor is often used for the breakdown of organic matter and produced H_2S and rotten egg smell. (Welch 1980). In the present study sulphate of untreated effluents was 660 mg/lit and 650 mg/lit in November and December respectively and treated effluent should 320 mg/lit and 305 mg/lit in November and December respectively. Manal (2002), observed sulphate in sugar industry effluent that was 550 mg/lit and 555 mg/lit in November and December respectively which in untreated and treated effluent showed 256 mg/lit and 262 mg/lit in November and December respectively. Senthil et.al.,(2001), observed sulphate range between 200 mg/lit to 93 mg/lit according to flowing distance from effluent discharging unit to 5 km long. Which indicates while

the distance in increased from the outlet the value of sulphate decreases.

12. Oil and Grease—It is present in the water can be extracted in petroleum either, which is immiscible in water and can be separated by a separatory funneal. Oil, grease, fats and waxes are dissolved in suitable solvent and separated from the aqueous phase. The solvent layer is then evaporated and the residue is weighed as oil and grease. In the present study oil and grease present in untreated effluents was 16 mg/lit and 10 mg/lit in November and December respectively and the treated effluent showed 9 mg/lit and 8 mg/lit in November and December respectively. Manal (2002), reported oil and great in sugar industry effluent range in between 14 mg/lit to 11 mg/lit (untreated). Thorat et.al., (1999), reported oil and great was 12 mg/lit and 7 mg/lit respectively. Trivedi et.al., (1986), reported oil and grease in textile industry effluent from 230 mg/lit to 1798 mg/lit.

CONCLUSION

* The sugar industry effluent which is untreated highly contains COD, BOD, TSS, TDS, TS and low contents of DO which is toxic, to plants. So it is not permissible for irrigation.
* The treated effluent of sugar industry which is well balanced of chemicals if it is diluted with other fresh water, which will be suitable for irrigation purpose.
* Effluent which are released from sugar industry treated and then may be utilized for industrial processing again. Recycle rise of waste water is possible in sugar industry and it is economically profitable for sugar industry.
* Untreated effluent of sugar industry shows higher values of COD and low value of DO.
* The treated effluents of industry are not highly polluted and they satisfy the ISI standard values and therefore can be used for irrigation purpose.

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