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Physico-Chemical Analysis of SriChamSugar's Mill Effluent Water of Bharathi Nagara (Karnataka)

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Abstract
Sugar industries have an essential place in Indian economic development. However, the wastewater generated from these industries poses a significant threat to the environment as well as irrigated land. If untreated effluents are used in irrigation, they might contaminate food crops and, if they are released into water bodies, they might also be dangerous to the survival of the aquatic ecosystem. The Physico-chemical characteristics of the content in the effluents from Sri Cham Sugars Private Limited, Bharathi nagara Sugar mill have been explored. Physico-chemical characteristics included color, odor, temperature, pH, BOD, COD, TDS, TS, DO, Chloride, Sulphate, Nitrate, Calcium, Magnesium, Sodium, Potassium, oil and grease, Electrical conductivity of the effluent collected from the different sites at discharge point in different months have been determined.
Keywords: Effluent, SriChamundeshwari Sugars Ltd, Mandya, Physico-chemical parameters, Bharathi College, BIS

Introduction

Water is one of the several important of all-natural resources known on earth. It is important to all living organisms, human health, most ecological systems, human health, food production, and economic development. The safety of drinking water is important for health. The safety of drinking water is affected by various contaminants, which included chemical and microbiological. Such contaminants cause serious health problems. The recent studies have indicated that water bodies becoming increasingly contaminated due to domestic and industrial wastes.

The sugar industry is a seasonal Industry run for a maximum of Five months in one season. India is the greatest producer of sugarcane in the world. Sugar production processing requires a large amount of water for a different process of manufacture of sugar and released almost equal quantity of effluent, which contains toxic material. Their recent studies have indicated that the effluent discharge from sugar consists of several organic as well as toxic metal ions dissolved or suspended form that can bring about changes in the physical, chemical & physiological features of freshwater. The effluents of industries have ultimate disposal in agriculture field. The sugar mill effluents are having high amounts of suspended solids.

Material and Methods

Sri Chamundeshwari sugar factory is situated in Bharathinagara, which is at 58 km distance from Mysore and 90 km from Bangalore.

The effluent water samples were collected in pre-cleaned, airtight plastic containers of one-liter capacity, at the point of disposal from a sugar factory. The collected effluent was stored properly to maintain its original characteristics.

Method of Analysis

The Water Samples were collected from two different places in the Morning hours between 6 to 10.30 am, in thoroughly cleaned Polythene bottles. The Water samples were rapidly brought into to Laboratory for the Estimation of various Physico-chemical parameters such as Temperature; p^H was recorded using digital pH Meter (SYSTRONICS). TDS values were measured by using TDS meter, Electrical conductivity by Digital conductivity meter (Chemline) While other Parameters Such as Sodium and Potassium by Flame photometry, Chloride, Calcium, and Magnesium by Titrimetric method. Sulphate and Nitrate were determined by the Spectrophotometric method. The present study involves the Analysis of Water quality by using APHA procedure.

Result and Discussion

Some of the Physico-chemical parameters of the effluent were found to exceed those permissible by the Bureau of Indian Standards (BIS), Overall the parameters were found on the higher side of the pollution levels, and hence proper treatment methods are advised before the industrial effluents are released to the sewage. The data of industrial effluent of different physicochemical parameters are presented in table 1.

Colour: In the present study, the color of the unprocessed effluent was dark brownish due to the presence of undesirable molasses content. Photosynthesis activity gets reduced due to dark coloration and affects on temperature, the oxygen level in effluent water and BOD, etc.

Odour: The Unpleasant or offensive smell of the untreated effluent was due to the presence of some indole derivatives and sulphur compounds. The bad odor may induce some allergic effects such as nasal irritation, breathing problems, asthma on individuals, especially on children.

Temperature: The effluent which had been released from the industry generally has a high temperature. In the present study, the temperature of untreated effluent was recorded at 44°C in November and 430 c in December. Temperature affects the chemical, biological reactions in water.

P^H: In the present study, the pH of the untreated effluents was 4.3 and 4.6 in November and December, respectively, and treated effluent was 7.7 and 7.8 in November and December, respectively. This is by BIS. Senthil et al., Showed that the pH of Sugar plant emanating is in the middle of 6.0 to 7.6

The extreme pH of waste water is generally not acceptable, as lower p^H cause problems to its usage in drinking and irrigation purpose.

Biochemical Oxygen Demand (BOD): Biochemical oxygen demand represents the amount of oxygen consumed by bacteria and other microorganisms while they decompose organic matter under aerobic conditions at a specified temperature. Beruch et.al. recommended that oxidation of the natural waste by common microorganisms make the abnormal state of BOD (1920 mg/lit of 2100 mg/lit).

In the present study, the untreated effluent BOD was 1440.0 mg/lit and 1455.0 mg/lit in November and December individually and in treated effluent BOD demonstrated 12 mg/lit. and 13 mg/lit. In November and December separately. According to the BIS standard, the BOD should not exceed 100 mg/lit.

Chemical Oxygen Demand (COD): The chemical Oxygen demand test describes the amount of oxygen required for chemical oxidation of organic matter with the help of an oxidant. COD is useful to determine the exact toxic condition and appearance of biological matters. In the present study, the COD of the untreated effluents was 310 mg/lit. In November and 360 mg/lit. In December, respectively. In treated effluent, it was 16 mg/lit. In November,15 mg/lit. In December, month, respectively, indicates that COD is appreciably high in the sample compared to BIS (250 mg/lit.).

Total Dissolved Solids (TDS): The total dissolved solids concentration in the effluent

represents the colloidal form and dissolved salts. In the present study, the total dissolved solids in untreated effluent were 2550 mg/lit. In November and 2510 mg/lit in December. The TDS of treated effluent in November and December was found to be 70 mg/lit. And 72 mg/lit, respectively. The samples in TDS values are much higher compared to BIS(2100 mg/lit.). The effluents with high TDS value may cause salinity problem if discharged to irrigation water and also in freshwater streams when added.

Total Solids (TS)

In total, effluent solids are composed mainly of carbonates bicarbonates, chlorides, sulfates, nitrates, Ca, Mg, Na, K Mn, and organic matter silts and other particles polluting water increase the concentration of total solids.

In the present investigation, the range of total solids in untreated effluent was 3500 mg/lit and 3570 mg/lit in November and December season, respectively. The TS of treated effluent for the corresponding period was 436 mg/lit. And 430 mg/lit. Respectively. The values are higher compared to the BIS standard (2700 mg/lit.).The higher amounts of TS may be probably due to the use of mineral water containing dissolved salts. Senthil observed that the effluent discharged from the sugar Industry is ranging between 4485.0 mg/lit to 1520 mg/lit with increasing distance from 0 to 5 km.

Chloride (Cl^-)

In the present study, the chloride amount in untreated effluent was 145 mg/lit. In November and 153 mg/lit in December. The chloride content in treated effluent in November and December was 49 mg/lit. And 50 mg/lit, respectively. Chloride is generally present in natural water. The presence of chloride in natural water attributed to the dissolution of salt deposits discharge of effluents from sewage discharges.

Sulphate (SO_4^{2-})

Sulphate is one of the most active species in natural water. It may come into natural water through the weathering of deposits. Sulphate might enter fresh water through sulphitation of sugar juice. It is an electron acceptor that is frequently used for the disintegration of organic matter, and H2S is produced to possess rotten egg smell. In the present study, sulphate in untreated effluent was 493 mg/lt. and 540mg/lt. In November and December, respectively. In treated effluent, it was 34 mg/lt. And 35mg/lt. In the same months. The amount of sulphate recorded was found to be below the BIS standard.

Nitrate (NO_3-): Nitrate in untreated effluent was 135 mg/lt. In November, 140 mg/lt in December, respectively. In treated effluent, it was 25 mg/lt. and 30mg/lt. in the same months.

Sodium (Na): Sodium-ion in effluent water varies between 110-120 mg/lt. In treated effluent, it was recorded below the standard level.

Potassium (K): The amount of potassium in the effluent was found to be 118mg/lt. In untreated water. But in treated water, it was found to be safe. The occurrence of potassium mainly came from the washings of sugar juice during the manufacturing process.

Calcium & Magnesium: In the present study Calcium values ranges between 123-180 mg/lt. and Magnesium value were between 190-195mg/lit. in untreated effluent, but in treated water Ca2+ and Mg 2+ were 30-34 mg/lt. & 25 mg/lt respectively.

Oil and Grease: In the present study, oil and grease present in untreated effluents were ranges between 18-21 mg/lit, and the treated effluent showed between 4-5 mg/lit. Trivedi et.al. reported oil and oil in the material industry emanating from 230 mg/lit to 1798 mg/lit.

Dissolved Oxygen (DO): It is one of the essential parameters in water quality analysis. Dissolved Oxygen is an indicator of the physical and biological process that occurs in water. The aquatic environment entirely depends on dissolved oxygen, various biochemical changes, and its effects on metabolic activities of microorganisms were very well recognized. According to the BIS standard, the Dissolved Oxygen of the wastewater should be within the range 4 to 6 mg/lit. In the present study, the Dissolved Oxygen of the untreated effluent was recorded in the range of 7.0 -7.4 mg/lit, and treated effluent was recorded as 4-4.1 mg/lit, respectively, which is sufficiently lower than the BIS limit.

Electrical Conductivity (EC)

Electrical conductivity is an indicator of ions of dissolved salts, which is a measure of salinity that affects the taste of potable water. In the present investigation, the value of electrical conductivity was 1553 µS/cm and 1492 µS/cm in November and December, respectively, and the treated effluent was 756 and 762µS/cm in November and December, respectively. EC value is found to be well below the tolerance limit of 2250 µS/cm suggested by BIS.

Sl. No	Parameter	Untreated Effluent		Treated Effluent November	Treated Effluent December	BIS Standard
		November	December			
1	Colour	Dark Brownish	Dark Brownish	Whitish yellow	Whitish yellow	Whitish yellow
2	Odour	Strong unpleasent	Strong unpleasent	Normal	Normal	odourless
3	Temperature (^{0}c)	44	43	29	28	30
4	PH	4.3	4.6	7.7	7.8	5.5.9.0
5	BOD (mg/lt.)	1440	1455	12	13	100
6	COD (mg/lt.)	310	360	16	15	250
7	TDS (mg/lt.)	2550	2510	70	72	2100
8	Total Solids(TS) (mg/lt.)	3500	3570	436	430	2700
9	Chloride (mg/lt.)	145	153	49	50	600
10	Sulphate (mg/lt.)	493	540	34	35	1000
11	Nitrate (mg/lt)	135	140	25	30	30
12	Sodium	120	110	44.47	40	60
13	Potassium	118	118	24	20	100
14	Ca^{2+} (mg/lt)	180	123	34	30	200
15	Mg^{2+} (mg/lt.)	190	195	25	25	100
16	Oil and Grease (mg/lt.)	18	21	5	4	10
17	D.O.(mg/lt.)	7.0	7.4	4.0	4.1	6.0
18	Electrical conductivity Ms/cm	1553	1492	756	762	2250

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Conclusion

From this study, The sugar industry effluent, which is untreated, highly contains COD, BOD, TSS, TDS, TS, and low contents of DO, which is environmentally unfriendly, So it is not permissible for irrigation. The treated effluent of the sugar industry, which is well balanced of chemicals, will be suitable for irrigation. In this analysis, it affects several phenomena such as soil, water & environment, etc.

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