

ENVIRONMENTAL POLLUTION EFFECTS OF A SUGAR FACTORY

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Sewage, industrial wastes, and agricultural chemicals such as fertilizer pesticides are the main causes of water pollution. In developing nations, more than 95 percent of urban sewage is discharged untreated into rivers and bays, creating a major human health hazard.

Air Pollution

The dry air comprises about 78% nitrogen, 21% Oxygen, 0.93% argon and 0.032% carbon dioxide by volume, besides, it also contains neon, helium, Krypton, ozone, carbon, monoxide, oxides of nitrogen and sulphur dioxide. Air is one of the most important constituent of environment. Clean and pure air is very essential for health and survival of man. The occurrence of foreign particles or gases in the atmosphere which are harmful to human beings, vegetation, animals and buildings is called air pollution.

Air Pollutants: The burning of baggage produces particulates like unburnt fibres, carbon particles, fly ash and gaseous pollutants like oxides of N_2 , water vapour, and other organic compounds of the particulate waste, the heavier particles slowly settle down in the surrounding area. Such dust fall leads to the problems of cleaning, reduction in property value, effect on vegetation, etc. The main gaseous pollutant is CO, which is altogether not measured by any unit and CO_2 is reported to be 12 – 14%.

Sugar Factory – Pollutants: Sugar factory operates for about 4 – 8 months after harvesting of sugar cane. A large volume of waste of organic nature is produced during the period of

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production and they are discharged onto land for irrigation. Water consumption in sugar factories is very high. The impurities from sugar cane remaining after the extraction of sugar which flow down the drain are mainly carbohydrate and hence easily biodegradable. The wastes from sugar industry being highly putrescible tend to deplete dissolved oxygen from receiving water bodies. One important factor in studying the pollution effect is that the industry is seasonal one and waste flow is mainly during crushing season. This causes difficulty in employing biological pollution abatement systems which should otherwise remain suitable for treating such wastes.

The following are the effluents released by the sugar factory located at Gajulamandam in Chittoor District.

1. **Cane Wash water:** This arises from washing of cane. The suspended solid content of cane wash water is high. It may also contain considerable amounts of sugar.
2. **Mill house effluent:** This includes water that is used for cooling the bearings of milling machines that pickup lubricants and also spill over and floor washes.
3. **Effluent from evaporation:** Cooling and condenser waters are the wastes from this section which contain sugar particulars that gain access during concentration of juice at multiple effect evaporators.
4. **Boiling house effluent:** Mostly generated by leakage from centrifuges and periodical floor washings. This waste has an extremely high BOD though small in volume and is discharged intermittently.
5. **Spray pond overflow:** The cooling waters are recycled from the pond. However, excess water is let out as waste which posses low BOD and suspended solids.
6. **Molasses effluents:** Leakage and overflow from molasses storage tanks contribute to high BOD of sugar factory effluents.
7. **Boiler house effluents:** Like other industries, boiler blow down also contribute to effluents, but the volume is much less.
8. **During Off – Season,** juice heaters and the heating surfaces are cleaned to remove accumulation of scales with hot caustic soda solution, then with dilute HCl acid followed by rinsing with water. These operations produce a large volume of effluent. BOD value of this effluent is very high.

Characteristics of Sugar Mill Effluents: All the individual effluents excluding spray pond overflow are acidic and colored, possess disagreeable odour, high BOD and suspended solids. The oil and grease content is also high. The characteristics of effluents of S.V. Co-operative Sugar Factory is given in Table – I.

Effects of Effluents on recipient system

The immediate oxygen demand of sugar factory effluents causes rapid depletion of the dissolved oxygen of receiving streams resulting in anaerobic conditions. This results in the release of foul odour and in the production of Hydrogen Sulphide which precipitates iron as black sulphide. All these effects makes water totally unfit for fish and other aquatic life. The dissolved and suspended solids deteriorate slowly resulting in obnoxious odours. Further, suspended impurities block the drainage and ditches, oil and grease content prevents aeration.

Measures taken by the factory to minimize pollution. S.V. Co-operative sugar factory on its part has taken the following measures to minimize pollution:

Since industrial wastes have to be treated before they are dumped, emission charges on waste taken the form of waste treatment charges. Waste related emission charges tend to vary as a function of the cost of waste treatment. The factory installed and commissioned an Effluent Treatment Plant supplied by M/s. Aqua Chemical and Systems Pvt. Ltd., Chennai in the month of April 1994. This new industrial Water Treatment Plant works on the principle of Dissolved air floatation and extended aeration process". The capital cost of ETP was Rs.9.5 lakhs (Civil-6 lakhs, Machinery – Rs.2 Lakhs and Electrical – 1.5 lakhs).

Treatment Method

Conventional biological treatments are not so effective due to high concentration of carbohydrates and are not economical as the industry is seasonal. Wastewater is treated by chemical coagulation using lime and alum following by clarification with 'Dissolved air flotation' technique. The output of the effluent from dissolved air flotation unit is further subjected to aerobic biological treatment using extended type of activated sludge process, the organic matter (expressed as BOD) is removed by micro-organisms (heterotrophic bacteria). Sludge is generated in the form of cellular material in the extended type of activated Sludge process. Necessary oxygen required for the respiration of bacteria is supplemented by aeration

system. The aeration system consists of two (15 HP) floating type of aerators. Sludge is separated in the settling tank attached to the aeration unit. A part of the sludge is recycled back into the aeration unit and the remaining to Sludge Drying Beds (SDB). The output water is further subjected to stabilization. A part of stabilized water is used for on land irrigation process and the rest is sent into the nearby nalla. Sudden discharge of effluent into treatment plant causes shock loading to the plant. To avoid this holding tanks are provided. A 'V' notch for measuring the flow entering the treatment plant is provided. In order to remove the inorganic settleable solids, oil and grease matter, a catch pit, oil and grease trap respectively are provided.

The factory conducts periodical tests through private environmental agencies on the basis of lowest bidder in tender. The cost of these tests amounts to Rs.5,000 per visit. The factory submits environmental statement for the financial year ending 31st March to APPCB. The cost of Preparing Environmental statement accounts Rs.10,000. In addition to these, Andhra Pradesh Pollution Control Board (APPCB) conducts periodical tests. The cost incurred in getting samples analyzed is paid by the factory. Analysis of samples collected for the past two seasons and the fee charged for conducting the tests is presented along with the Tolerance limits in Table – II.

In order to assess and analyze the environmental pollution and health hazards arising from Sri Venkateswara Co-operative Sugar Factory (Gajulamandyam Sugar Factory) field study was conducted in January 2005. Information is collected from 100 respondents (50 respondents working in the factory and 50 respondents living around the factory) through a well designed questionnaire. The data has been analyzed and presented in table – III.

Table – IV presents the general background of the Respondents living Around the Factory Age of the Respondents. Out of 50 respondents living around the sugar factory, 70 percent (35) were male and 30 percent (15) were female. The age level of the respondents living around the sugar factory is presented in Table – IV. The data reveals that out of 50 respondents, 34 percent (17) belonged to the age group of 21-30 years, 26 (13) percent were above 31 and below 40 years, 20 (10) percent belonged to 41-50 years and the remaining 20(10) percent were 50 years and above. The distance between the Sugar Factory and the residence of respondents is presented in Table – V.

Out of total respondents, 80(40) percent were residing over a distance of 0.5Km from the factory. 7 percent of them were residing between 0.6 to 1.0Km distance and the remaining 3

percent were living 1.1 to 2.0Kms away from the factory. It is clear from the table that 94 percent of the respondents were living nearer to the factory. Effects of Environmental Pollution of the Sugar Factory on the Respondents Living Around the factory. The intensity of different types of population on the respondents living around the factory is presented in Table – VI.

The respondents living around the Sugar Factory are facing health problems like Headache, Cough, Common Cold, Diarrhoea, Dysentery, joint Pains, Allergy etc., repeatedly due to the pollution generated by the Sugar Factory. As Table – VI reveals 30 (15) percent of respondents are affected by air pollution and the remaining 70 (35) percent are affected by water pollution.

Suggestions

To reduce pollution load arising from the factory the following suggestions may be considered. To save the chemical cost on neutralization of water, restricted use of water should be practiced. Recycle water as far as practicable.

Solid wastes must not be mixed with water.

Using right proportion of detergents for cleaning and their proper handling could eliminate a lot of suspended solids load in the effluent. Follow all the canons of good house-keeping. Environmental loss should be implemented stringently. In case, pollution from the factory is beyond their tolerance, workers and households in and around the factory should raise their voice and flight with the management to reduce the pollution level by the use of sophisticated antipollution equipments in the factory.

References

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Table – I : Characteristics of Sugar Mill Effluents

S.No.	Parameters	Standards
1	2	3
2	PH	5.6 – 6.8
3.	Suspended Solids (mg/l)	35 – 60
4.	Bio-Chemical Oxygen Demand (BOD) (mg/l)	800 – 1200
5.	Chemical Oxygen Demand (COD) (mg/l)	1500 – 2000
6.	Oils and grease (mg/l)	25 – 40

Source : Records of S.V. Co-op. Sugar Factory, Gajulamandyam.

Table – II : Tolerance Limits

S.No.	Parameters	Standards
1	Colour and Odour	All efforts should be made to remove colour and unpleasant colour as far as practicable
2.	PH	5.5 – 9.0
3.	Total Dissolved Solids (mg/l)	2100
4.	Total Suspended Solids (mg/l)	200
5.	Biochemical oxygen Demand (BOD) (mg/l)	100 – 1000
6.	Chemical Oxygen Demand (COD) (mg/l)	250
7.	Chlorides (as Cl) (mg/l)	1000
8.	Sulphates (as SO ₄) (mg/l)	1000

The following tables gives analysis of samples collected in the Sri Venkateswara Co-operative Sugar Factory for the last two seasons.

Table – III : Analysis of samples collected as on 10.03.2005 during 2004-05 season

S.No.	Population Parameters	Before treatment	After Treatment
1.	2	3	4
2.	PH	7.5	6.7
3.	Total Suspended Solids (mg/l)	182.00	140.00
4.	Total Dissolved Solids (mg/l)	2108.00	1924.00
5.	Chlorides (as Cl) (mg/l)	328.00	290.00
6.	Chemical Oxygen Demand (COD) (mg/l)	432.00	330.00
7.	Biochemical Oxygen Demand (BOD) (mg/l)	246.00	190.00

Source : A.P. Pollution Control Board, Regional Office, Tirupati.

Table – IV : Age group of the Respondents Living Around the Factory

S.No.	Age group of the Respondents (Years)	Number of respondents
1.	Upto 20	---
2.	21 – 30	17 (34.00)
3.	31 – 40	13 (26.00)
4.	41 – 50	10 (20.00)
5.	51 and above	10 (20.00)
	Total	50 (100.00)

Source : Field Survey Data

Note : Figures in parentheses indicate percentage to total.

Table – V : Distance from the Factory to respondents' residence

S.No.	Distance (Kms)	Number of respondents
1.	Upto 0.5	40 (80.00)
2.	0.6 – 1.0	07 (14.00)
3.	1.1 – 2.0	03 (6.00)
	Total	50 (100.00)

Source : Field Survey Data

Note : Figures in parentheses indicate percentage to total.

Table – VI : Effect of various types of pollution on respondents living around the factory

S.No.	Type of Pollution	Number of respondents affected
1.	Air Pollution	15 (30.00)
2.	Water Pollution	35 (70.00)
	Total	50 (100.00)

Source : Field Survey Data

Note : Figures in parentheses indicate percentage to total.

