

“Physicochemical and heavy metal analysis of sugar factory effluent of Yelegaon”

Sambhaji N. Kabad

HOD, Department of Chemistry A. C. S. College, Shankarnagar. Tq. Biloli Dist. Nanded. (MS) India

Abstract

Physico-Chemical parameters and toxic metal contents in the effluents discharged from sugar factory have been studied. The study reveals most of the physico-chemical parameters such as Colour, Odour, Total Solids, COD, BOD, & alkalinity have exceeded the Indian Standard Institution prescribed values while PH, Phosphate, Sulphate are found within the permissible limits. The concentration of toxic metals like Cd, Cu, Fe, Hg, Mn, Mg, Pb, Zn & Ni was determined by Inductively Coupled Plasma Atomic Emission Spectroscopy. The Fe, Hg, Mg, Pb & Mn contents exceed the permissible limits. Zn, Cu & Cd are within the permissible limits while Ni is found in trace amount.

KEYWORDS: sugar factory effluents, physico-chemical parameters, toxic metals, water pollution.

INTRODUCTION:

Water plays an essential role in human life. Although statistics, the WHO reports that approximately 36% of urban and 65% of rural Indian were without access to safe drinking water. Fresh water is one of the most important resources crucial for the survival of all the living beings. It is even more important for the human being as they depend upon it for food production, industrial and waste disposal, as well as cultural requirement. Human and ecological use of ground water depends upon ambient water quality. Human alteration of the landscape has an extensive influence on watershed hydrology. Ground water plays a vital role in human life. The consequences of urbanization and industrialization lead to spoil the water for agricultural purposes ground water is explored in rural especially in those areas where other sources of water like dam and river or a canal is not considerable. During last decade, this is observed that ground water gets polluted drastically because of increased human activities. Consequently number of cases of water borne diseases has been seen which is a cause of health hazards. An understanding of water chemistry is the basis of the knowledge of the multidimensional aspect of aquatic environmental chemistry which involves the source, composition, reactions and transportation of water. The quality of water is of vital concern for the mankind since it is directly linked with human welfare. It is a matter of history that facial pollution of drinking water caused water-borne diseases.

In rural area and agriculture is the main occupation. According to an estimate the agriculture production and yield is increasing due to irrigation throughout India. Country to the belief, agricultural sector is a major source of water consumption for production of Banana, sugarcane etc. In Marathwada region Vishnupuri and Yeldari dam are the major sources of water for agriculture. Due to this farmer cultivate

sugarcane as a major cash crop. Sugar factory are considerably increasing in Marathwada region particularly in Nanded districts.

The sugar factory is playing an important role in the economic development of region, state and country. Increase in sugar industrialization along with high rate of urbanization and subsequent increase in population has led to unprecedented increase in the environmental degradation of the resources. The damage to both aquatic and terrestrial ecosystems caused by the enormous quantity of waste released in the form of effluent produces is certainly alarming. These pollutants not only alter the physico chemical characteristics of the recipient aquatic bodies but also affect the aquatic flora and fauna. Similarly, the rural and semi-urban population, drinking water from streams or rivers and using it for agricultural and domestic purposes has undergone serious health hazards on account of the sugar mill effluents, being discharged into the environment. Farmers have been using these effluents unscientifically for irrigation and found that the growth, yield and soil health is reduced. Contaminants such as Cl^- , SO_4^{2-} , PO_4^{3-} , Mg^{+2} and NO_3^- are discharged with the effluent which creates a nuisance due to physical appearance, odor and taste.

Sugar industries effluents are characterized by high Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Dissolve Solids. Generally, Wastewater from sugar industry contains carbohydrates, nutrients, oil and grease, chlorides, sulfates, and heavy metals. Wastewater from sugar industry, if discharged without treatment, poses pollution problem in both aquatic and terrestrial ecosystems. Also, sugar industry wastewater when not treated completely produces unpleasant smell when released into the environment.

The effluent discharged from sugar factory constitute number of organic & inorganic pollutants, such as carbonate, bicarbonate, phosphate, sulphate, and toxic metals in addition to the Total Solids, Total Suspended solids, Total dissolve solids, and some toxicants. This effluents are discharged in the environment they disturbed the ecosystem of living & non living organisms. The present study was undertaken to study the physico-chemical characteristics and toxic metals of sugar factory effluent discharged from the Bhaurao Chavan Sahakari Sakhar Karkhana Ltd. Yelegaon Nanded district. This study was conducted during the sugar factory is in full crushing capacity (March 2000)

MATERIALS AND METHOD

Four different water samples were collected from different locations at Bhaurao Chavan Sahakari Sakhar Karkhana Ltd. Yelegaon randomly and kept in glass bottles without any air bubbles. The bottles were rinsed before sampling and tightly sealed after collection and labeled in the field. Analysis of water samples was done as per standard process. All the chemicals used of AR grade. Double distilled water was used for the preparation of reagent and solutions. The water samples were immediately brought in to Laboratory for the estimation of Physico-chemicals parameters, like water temperature were recorded at the time of sample collection by using Thermometer.

While other parameters such as pH, Electrical conductivity, Total Suspended Solids, Total Dissolved Solids, Total Solids, Oil & Grease, Hardness, Sulphate, Dissolve Oxygen COD, BOD contents. Temperature, pH and TDS measured as per the by silver nitrate titration method using potassium chromate as indicator. For metal analysis 500 ml of effluent sample was collected & transferred in one liter beaker. After adding 5ml (5:1) Con. HNO_3 and HClO_4 mixture, kept on hot plate, a light colored residue indicates the completion of digestion. This residue was diluted with double distilled water. This filtrate used for analysis of toxic metals using ICP-AES.

Table 1: Physic-chemical parameters in Sugar Factory Effluents collected at various distances.

Parameters	Site Notation			
	S1	S2	S3	S4
Colour	Dark brownish brown	Dark brownish brown	Dark brownish brown	Dark brownish brown
Odour	Decaying molasses smell	Decaying molasses smell	Decaying molasses smell	Decaying molasses smell
Temp.	30.2	30.0	29.7	29.5
PH	6.9	7.2	7.3	7.7
Electrical conductivity	6270	5460	5190	4890
TSS	100	95	90	83
TDS	1895	1870	1855	1835
TS	1995	1965	1950	1940
Oil & Grease	9.0	8.8	8.6	8.4
Hardness	370	265	250	215
Chloride	315	310	295	280
Sulphate	435	430	415	345
DO	2.2	2.2	2.3	2.4
COD	248	220	215	200
BOD	155	140	120	110

Result and discussion:

All the effluent samples were collected in the month of March 2000. The results of the physicochemical analysis of the Bhaurao Chavan Sahakari Sakhar Karkhana Ltd. Yelegaon water effluent samples S1 to S4 are compared with standard values prescribed by WHO and are presented in Table 1.

1] Colour:

The sugar factory effluent is dark brownish black in colour. This is observed visually.

2] Odour:

The odour of the sugar factory effluents is disagreeable and almost equivalent to decaying molasses smell.

3] Temperature:

The range of temperature of the effluent samples was within 30.2 to 29.5 °C in their sampling sites studied during the operational seasons. Temperature of S1 site was higher as compare to other site. The sampling of S1 site is very close to the point effluent discharged by sugar factory. As increasing distance the temperature decreases due to loss of heat of effluent in the environment.

4] PH:

The range of P^H of the effluent samples was within 6.9 to 7.7 in their sampling sites studied during the operational seasons. Change in P^H was recorded in S1 site with higher values from other sites. The S1 site is very close to the point of effluent discharge by sugar factory. The decrease in P^H may be attributed to the loss of heat of effluents in the environment with more in the P^H the concentration of other parameter are affected.

5] *Electrical Conductivity:*

The electrical conductivity of the effluent was recorded in the range 6270 to 4890 $\mu\text{mhos/cm}$ in sampling site of sugar factory during the operational seasons. The electrical conductivity value of S1 sampling sites was higher than that of other sampling sites. The recorded values found to decrease with increase in distance, due to dilution of effluent with water.

6] *Total Suspended Solids:*

The Total Suspended Solids of the effluents was recorded in the range 100.0 to 83.0 mg/l. in sampling site studied during the operational seasons. The Total suspended Solids were high value in sampling site S1 from other sampling sites. The suspended solids recorded on these sites decreased with increase in distances, due to biodegradation and dilution or dispersion of the wastes.

7] *Total Dissolve Solids:*

The range of TDS of the effluent was recorded 1895 to 1835 mg/l in sampling sites studied during the operational seasons. The TDS recorded in the sampling sites S1 was high as compared with the other sampling sites. The TDS recorded on these sites were decrease with increase in distance due to dilution of the effluents.

8] *Total Solids:*

The range of Total solids of the effluent was recorded 1995 to 1940 mg/l in sampling sites studied during the operational seasons. The Total solid was recorded high value at S1 sampling sites than the other sites. The S1 site value of TS was high due to site is close to the point of effluent discharged by sugar factory. The discharge effluent comes from number of processing units which use of solid matters. The other sampling sites TS value are decreases with increase in distances.

9] *Oils & Grease:*

The range of oil & grease of the effluent was recorded 9.0 to 8.4 mg/l in sampling sites studied in operational seasons. The S1 sampling site with higher values of oil & grease than other sites, due to it is very close to the point of effluent discharged by sugar factory. The discharged effluent comes from number processing units which required oil & grease for smooth working process. The other sites value is decreases with increase in distances due to dilution of effluent.

10] *Dissolve Oxygen:*

The range of Dissolve Oxygen of the effluent was recorded 2.2 to 2.4 mg/l in sampling sites studied in operational seasons. The S1 sampling site with lower values of dissolve Oxygen than other sites, due to it is very close to the point of effluent discharged by sugar factory. The comparing S1 sampling site with other sampling sites, the dissolve oxygen recorded on these sites were increased with increase in distances.

11] *Hardness:*

The range hardness of the effluents was recorded 370 to 215 mg/l. The hardness was recorded in S1 site with higher value from other sites. The S1 site is very close to the point of effluents discharged by sugar factory. The hardness was decreases with increasing distances & dilution of effluents.

12] *Chloride:*

The range Chloride of the effluents was recorded 315 to 280 mg/l. The chloride was recorded in S1 site with higher value from other sites. The S1 site is very close to the point of effluents discharged by sugar factory. The decrease in chloride may be due to biodegradation and dispersion or dilution of effluents.

13] Sulphate:

The range sulphate of the effluents was recorded 435 to 345 mg/l. The sulphate was recorded in S1 site with higher value from other sites. The S1 site is very close to the point of effluents discharged by sugar factory. The decrease in sulphate may be due to biodegradation and dispersion or dilution of effluents.

14] Chemical Oxygen Demand:

The range of Chemical Oxygen Demand of the recorded effluents was 248 to 200. Sampling site S1 with higher values from other sites. The S1 site is very close to the point of effluent discharged by sugar factory. The COD recorded on S2, S3 & S4 sites are decreases with increasing distance due to biodegradation and dilution of the effluent with water.

15] Bio-Chemical Oxygen Demand:

The range of Bio-Chemical Oxygen Demand of the recorded effluents was 155 to 110. Sampling S1 site has higher values than other sites. The S1 site is very close to the point of effluent discharged by sugar factory. The COD recorded on S2, S3 & S4 sites are decreases with increasing distance due to biodegradation and dilution of the effluent with water.

Table 2: Concentration (ppm) of toxic metals in effluent samples collected at various site.

Heavy Metal	Site Notation			
	S1	S2	S3	S4
Fe	6.80	6.45	6.28	5.84
Mg	40	36	32	30
Pb	0.40	0.34	0.28	0.17
Zn	0.38	0.20	0.10	0.05
Mn	1.48	1.00	0.50	0.40
Ni	0.02	0.02	0.018	0.017
Cu	0.34	0.25	0.18	0.10
Cd	0.022	0.020	0.018	0.014
Hg	1.5	1.1	0.8	0.7

The quantitative analysis of toxic metals has generally indicated that there was a gradual decrease in their quantity due to the dilution or dispersion & distance is increases from discharge point.

Iron:-

The contents of iron (Fe) in sugar factory effluent show variation of 6.80 to 5.84 ppm with distance which is higher than the ISI limits.

Magnesium:

It has been observed that the concentration of Magnesium (Mg) various from 40.00 to 30.00 ppm. Which is higher the ISI limits.

Lead:

Concentration of Lead (Pb) with values varying from 0.40 to 0.17 ppm. The concentration of Pb is higher than the limit prescribed by ISI limits.

Zinc:

It has been observed that the concentration of Zinc (Zn) various from 0.38 to 0.05 ppm. Which is higher the ISI limits.

Manganese:

It has been observed that the concentration of Manganese (Mn) various from 1.48 to 0.40 ppm. Which is higher the ISI limits.

Nickel:

It has been observed that the concentration of Nickel (Ni) varies from 0.020 to 0.017 ppm. Which is lower than the ISI limits.

Copper:

The present study indicates that, the concentration of copper (Cu) was in between 0.34 to 0.10 ppm. Which is higher than the ISI limits.

Cadmium:

It has been observed that the concentration of cadmium (Cd) varies from 0.022 to 0.014 ppm. Which is higher than the ISI limits.

Mercury:

It has been observed that the concentration of Magnesium (Mg) varies from 1.5 to 0.7 ppm. Which is higher than the ISI limits.

Conclusion:

The analytical results of sugar water effluents of Yelegaon town, Nanded District shows that the PH, total alkalinity, Chloride, calcium, COD are well within the permissible limit given by WHO. The effluent is dispersed or diluted by water all parameters are permissible limit. Hence all the samples are fit for agriculture and other purpose.

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