# Studies on Physico-Chemical Characteristics and Toxic Metals of Shankarnagar Sugar Factory Effluent

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## Abstract

Water is an essential part of all living organisms. In this connection water plays a most valuable and important role in the natural cycle. Among the whole water availability, only 3% fresh water is available on the earth. In the available fresh water sources, entries of pollutants have been significantly increased from industries and domestic/anthropogenic activities. Huge quantity of fresh water will be consumed for the production process which will be held in the industry. In the mean while the amount of consumption of fresh water is equal to the amount of discharge of wastewater as effluent. In this aspect the present study pointed out the pollutants concentration in the sugar industry effluent. Once determine the concentration of pollutants in the effluents, the wastewater treatment system can also be modified as per the modern technology to remove the maximum concentration of pollutants in the wastewater. In the present study the influent and effluents was analyzed of a sugar industry and revealed that the pollutant concentration was comparatively high and by adopting the Biological treatment process with Activated Sludge Process (SAP) the treatment efficiency looks better treatment for the wastewater released by sugar industry. The analyzed parameters of the treated effluent are well within the prescribed by the CPCB for the discharge of effluent to on-land standards and discharged wastewater could be used for the agriculture purposes or any domestic purposes in the industry. Physico-Chemical parameters and toxic metal contents in the effluents discharged from sugar factory have been studies. The study reveals most of the physic-chemical parameters such as Colour, Odour, Total Solids, COD, BOD, Fluoride & alkalinity have exceed the Indian Slandered 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 traces amount.
**KEYWORDS:** sugar factory effluents, physico-chemical parameters, toxic metals, water pollution.

## INTRODUCTION:

Recently great concern has been universally raised regarding environmental pollution as a side effect of rapid industrialization and subsequent urbanization. Today, the main concern with environmental pollution is with it's impact on the health of the present generation and the coming ones. Our culture is completely river oriented and most of our important towns and urban areas are located on the bank of Major River. Unfortunately, untreated industrial wastes have been drained into the rivers and by river it is spreading over a large area. Therefore, it directly affects lives of flora and fauna not only in the

industrial area but also in agricultural fields, river and river beds, thereby creating secondary source of pollution. Various industries have been continuously adding lot of waste water containing high level of nutrients, heavy metals and hazardous substances to the cultivable land. However, effluents containing various metallic and nonmetallic elements act as nutrients but at the higher concentration they show toxic effects on seed germination and seedling growth, ultimately adversely affecting plant growth and yield in cultivated land. Moreover, deaths of domicile animals of such polluted water have been reported increasingly.

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. The consequences of urbanization and industrialization leads 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 get polluted drastically because of increased human activities. Consequently number of cases of water borne diseases has been seen which a cause of health hazards. An understanding of water chemistry is the bases 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 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. 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 physic-chemical characteristics and toxic metals of sugar factory effluent discharged from the Godavari Manar Sahakari Sakhar Karkhana Ltd. Shankarnagar 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 Godavari Manar Sahakari Sakhar Karkhana Ltd. Shankarnagar Nanded district, 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 regent 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. | 30.5 | 29.3 | 28.5 | 28.0 |
| PH | 6.9 | 7.2 | 7.3 | 7.7 |
| Electrical conductivity | 6020 | 3970 | 3580 | 3080 |
| TSS | 90.0 | 84.5 | 80.0 | 75.0 |
| TDS | 1870 | 1650 | 1425 | 1390 |
| TS | 1960 | 1735 | 1510 | 1465 |
| Oil & Grease | 7.8 | 7.1 | 6.8 | 6.3 |
| Hardness | 390 | 285 | 250 | 235 |
| Chloride | 410 | 375 | 348 | 310 |
| Sulphate | 540 | 420 | 370 | 295 |
| DO | 3.1 | 3.2 | 3.4 | 3.5 |
| COD | 260 | 230 | 212 | 150 |
| BOD | 82.5 | 71.0 | 63.5 | 58.0 |

**Result and discussion:**

All the effluent samples were collected in the month of March 2000. The results of the physicochemical analysis of the Godavari Manar Sahakari Sakhar Karkhana Ltd. Shankarnagar 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 30.5 to 28.0 $O^oC$ 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 6020 to 3080 $\mu$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 decreases 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 90.0 to 75.0 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 1870 to 1390 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 1960 to 1465 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 7.8 to 6.3 mg/l in sampling sites studied in operational seasons. The S1 sampling site with higher values of oil & grease then 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 3.1 to 3.5 mg/l in sampling sites studied in operational seasons. The S1 sampling site with lower values of dissolve Oxygen then 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] Harness:

The range hardness of the effluents was recorded 390 to 235 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 410 to 310 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 540 to 295 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 260 to 150. 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 82.5 to 58.0. Sampling site S1 has 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.

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

| Heavy Metal | Site Notation | | | |
|---|---|---|---|---|
| | S1 | S2 | S3 | S4 |
| Fe | 6.90 | 6.68 | 6.48 | 6.00 |
| Mg | 42.00 | 39.70 | 35.00 | 31.10 |
| Pb | 0.39 | 0.33 | 0.27 | 0.16 |
| Zn | 0.38 | 0.29 | 0.18 | 0.02 |
| Mn | 1.45 | 1.05 | 0.51 | 0.35 |
| Ni | 0.02 | 0.02 | 0.02 | 0.02 |
| Cu | 0.32 | 0.26 | 0.11 | 0.07 |
| Cd | 0.021 | 0.020 | 0.017 | 0.013 |
| Hg | 1.45 | 1.10 | 0.70 | 0.67 |

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 6.90 to 6.00 ppm with distance which is higher than the ISI limits.

**Magnesium:**

It has been observed that the concentration of Magnesium (Mg) various from 42.00 to 31.10 ppm. Which is higher the ISI limits.

**Lead:**

Concentration of Lead (Pb) with values varying from 0.39 to 0.16 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 0.02 ppm. Which is higher the ISI limits.

**Manganese:**

It has been observed that the concentration of Manganese (Mn) various from 1.45 to 0.35 ppm. Which is higher the ISI limits.

**Nickel:**

The present study indicates that, the concentration of Nickel (Ni) was less than 0.02 ppm. Which is lower the ISI limits.

**Copper:**

The present study indicate that, the concentration of copper (Cu) was in between 0.32 to 0.07 ppm. This is higher than the ISI limits.

**Cadmium:**

It has been observed that the concentration of cadmium (Cd) various from 0.021 to 0.013 ppm. Which is higher the ISI limits.

**Mercury:**

It has been observed that the concentration of Magnesium (Mg) various from 1.45 to 0.67 ppm. Which is higher the ISI limits.

**Conclusion:**

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

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recorded values found to decreases 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 210 to 162 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 effluents.

7] Total Dissolve Solids:

The range of TDS of the effluent was recorded 3460 to 3360 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 2060 to 1935 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 10.7 to 10.0 mg/l in sampling sites studied in operational seasons. The S1 sampling site with higher values of oil & grease then 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] Harness:

The range hardness of the effluents was recorded 320 to 197 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.

11] Chloride:

The range Chloride of the effluents was recorded 448 to 398 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.

12] Sulphate:

The range sulphate of the effluents was recorded 207 to 148 mg/l. The sulphate was recorded in S1 site with higher value from other sites. The S1 site is very close to the