

## Physico-Chemical Analysis of Sugar Mill Effluent and their Impact on Soil of Kabirdham (C.G.)

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### Abstract

Industrial waste encompasses the full range of unwanted substances and losses generated by industrial activities, including emissions to air or surface water and the substances sent to sewage treatment plants, deposited in landfills released or applied to the land, treated, injected underground control through storage, recycled or burned for energy recovery. It renders impact over all biological kingdoms. Sugar industry is being an important player in foreign exchange earnings and also plays its part in polluting the environment with its discharge. Use of industrial effluent in the land of irrigation has become common practice in India as a result of which these toxic metals get accumulated in soil. The present study was aimed to investigate the physicochemical analysis of Boramdev co-operative sugar factory Kabirdham effluent and impact sugar industry on soil quantity of area around the sugar industry. The various parameters studied were colour, odour, temperature, pH, total hardness, turbidity, iron, chloride, sulphate, fluoride ions, total dissolved solids, BOD, COD, calcium, magnesium. Results indicate at sugar mill effluent affected soil parameter such as pH, EC, sulphur and phosphorus. Addition of nutrients by effluent improves the soil properties but the addition too much nutrient like sulphur content in soil become toxic, decline the soil property.

**Keywords:** Sugar Mill Effluent, Physicochemical Characteristic, Soil Analysis and Impact on it

### Introduction

Sugar industry is a seasonal Industry operating for maximum of 4-5 month in one season. India is the largest producer of sugarcane in the world. Sugar production processing requires huge water for a number of steps and released almost equal quantity of effluent which contains toxic material. There recent studies have indicated that the effluent discharge from sugar consist of a number of organic and heavy metal pollutant in dissolved or suspended form that can

bring about changes in the physical, chemical & physiological sphere of the biota. The effluents of industries has ultimate disposal in agriculture field [Sharma RK, et al (2007)]. This can alter the soil properties and crop yielding. The sugar mill effluents are having high amounts of suspended solids [Loska K, Wiechula D & Korus I (2004)]. The continues use of these industrial effluents sewage sludge on agricultural land has become a common practice in India as a result of which these

toxic metals can be transferred and get accumulated into plant tissues from soil and may become a health problem to the rural and semi-urban populations that use stream. Toxic elements present in effluent accumulate in the soil and induce a potential contamination of food chain and endanger the ecosystem safety and human health. Waste water from sugar mills with its high BOD, COD and TDS rapidly depletes available oxygen when discharged into water bodies and have adverse impact on aquatic life [Sharma R.K, et al (2007)]. In general, sugar mill effluents contain acidic and alkaline compounds, a significant concentration of suspended solids and a high BOD, COD, and sugar concentration. The objective of the study is to determine the physico-chemical characteristics of the effluents of the sugar mill and the impact of sugar mill effluent on soil.

## **Materials and methods**

### **Sampling site**

The Borhamdev sugar factory is situated in Ramhepur which is at the 12 km distance from Kawardha.

### **Collection of sample**

The effluent samples were collected in pre-cleaned, air tight plastic containers of one liter capacity. From the point of disposal from a Ramhepur sugar mill. The collected effluent was stored at 4°C to maintain its original characteristics. Soil samples were collected from the site in clean and dry polythene bags.

### **Analysis method**

#### **Physico-chemical analysis of effluent and their method**

The pH, electrical conductivity (EC) and temperature were measured by the method of pH meter, electrical conductivity meter and thermometer respectively. The analysis was carried out in the laboratory by using the procedures given by APHA. Using

titrimetric methods, the analysis of chloride (Cl<sup>-</sup>), Magnesium, Calcium and total hardness as CaCO<sub>3</sub> (TH) was performed. While nitrate, iron and sulphate were analyzed by spectrophotometric method. The biological oxygen demand (BOD), which is the amount of oxygen required by microorganisms to stabilize biologically decomposable organic matter under aerobic condition, indicates the amount of biologically degradable organic matter in the wastewater. The BOD of the wastewater samples were measured by titration method. The chemical oxygen demand (COD) measures the amount of oxygen required for oxidation of organic compounds present in wastewater by means of chemical reactions involving oxidizing substances such as potassium dichromate and potassium permanganate. And many more parameters such as colour, odour, and turbidity were determined in this paper.

### **Soil analysis and method**

The EC and pH of the soils were determined by measuring them in the saturation extract of the soils by a combine EC/pH meter at 25°C. Phosphorus and sulphur were analyzed by the method of spectrophotometer.

## **Results and discussion**

The present study was carried out to find the suitability of industrial effluents for soil and to study the physico-chemical characteristics. Some of physico-chemical parameters of the effluent and soil analysis were found to exceed those permissible by the Bureau of Indian Standards (BIS), and Indian council of agricultural research (ICAR). 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 physico-chemical parameters and soil analysis parameters are presented in table -1 and table -2.

**Table 1: Physico-chemical parameters of effluent.**

Parameter	Unit table	Accepted limit BIS for drinking	Permeable limit in the absence of alternate source BIS (for drinking water)	Remark
Colour	-	-	-	Brown
Odour	-	Unobjectable	Unobjectable	Unpleasant
Temperature	<sup>0</sup> C	-	-	29
pH	μ/cm	6.5-8.5	-	6.3
Total hardness	mg/l	300	600	200
Turbidity	NTU	1	0.5	76.1
COD	mg/l	200	300	405
BOD	mg/l	300	400	275
TDS	mg/l	500	2000	565
Cl <sup>-</sup>	mg/l	250	1000	63.9
F <sup>-</sup>	mg/l	1.0	1.5	0.0
NO <sub>3</sub> <sup>-</sup>	mg/l	45	100	132
SO <sub>4</sub> <sup>2-</sup>	mg/l	200	400	70
Fe	mg/l	0.3	1.0	5.00
Ca <sup>2+</sup>	mg/l	75	200	65
Mg <sup>2+</sup>	mg/l	30	100	29

**Table 2: Soil Parameters.**

Analyte	Remark
pH	6.9
Electrical conductivity	0.43
Phosphorus	5.86
Sulphur	31.46

**Colour**

In the present investigation the colour of the effluent was dark brownish to brown. Colour is very important factor for the aquatic life for making food from sun-rays. Photosynthesis activity gets reduced due to dark colouration and affects other parameters like temperature DO and BOD etc.

**Odour**

Odour affects human beings in a number of ways. Strong, unpleasant or offensive smells can interfere with a person's enjoyment of life especially if they are frequent and

persistent. Major factors relevant to perceived odour nuisance are:

In the present study the smell of effluent is decaying molasses smell.

**Temperature**

Temperature affects chemical, biological reactions in water. In the present study, it varies from 28 to 29.5<sup>0</sup>C.

**pH**

The pH values are in the range 6.5-8. This is in accordance with the Bureau of Indian Standards (BIS) The extreme pH of wastewater are generally not acceptable, as

lower pH cause problems to survival of aquatic life.

#### **Total Hardness**

The more cations broke up in the water the "harder" the water. in present study the hardness of sample within limits prescribed by BIS .

#### **Total Dissolved Solids**

Total dissolved solid is the measure of total inorganic salts and other substances that are dissolved in water. In the present study the effluents with high TDS value may cause salinity problem if discharged to irrigation water but under BIS.

#### **Chemical Oxygen Demand (C.O.D.)**

The COD test decides the oxygen required for concoction oxidation of natural matter with the assistance of solid synthetic oxidant. The COD is a test, which is utilized to quantify contamination of local and modern waste. The waste is measured as far as nature of oxygen required for oxidation of natural matter to create carbon dioxide and water in the present study COD value is high within limit.

#### **Biochemical Oxygen Demand (B.O.D.)**

B.O.D. is characterized as measure of oxygen required by microorganism while settling natural decomposable natural matter in a water vigorous condition. The natural oxidation is moderate procedure .During oxidation the natural toxins are oxidized by certain microorganism into carbon dioxide and water utilizing broke down oxygen. Hence, forth bringing down in broke up oxygen worth is the measure of BOD connection in the present study BOD value.

#### **Chloride (Cl)**

Chloride is 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, and sea water intrusion in coastal area. The concentration values of chloride in the effluent samples 63.9 mg/L.

#### **Sulphate (SO<sub>4</sub><sup>2-</sup>)**

It is one of the significant dynamic happening in common water. Sulphate might enter characteristic water through weathering of stores. The concentration values of sulphate in the effluent sample 70 mg/L.

#### **Calcium (Ca<sup>2+</sup>) & Magnesium (Mg<sup>2+</sup>)**

Calcium value is 65 mg/L. & Magnesium value is 29 mg/l with in the BIS limit.

#### **Iron (Fe) & nitrate (NO<sub>3</sub><sup>2-</sup>)**

Iron & nitrate value is higher concentration levels within limit they are unfit for irrigation and soil without proper treatment.

#### **pH**

pH of soil sample determined for sampling locations and it was in the range of 6.9, which satisfied the range of soil productivity. Thus, the pH of wastewater-affected soils was optimum for sustainable soil fertility and crop productivity. The pH level in the soil is a measure of its relative acidity or alkalinity. This is important when considering soil fertility because pH can affect the availability of soil nutrients.

#### **Electrical conductivity (EC)**

In present investigation EC content of soil samples were in the 0.43 mhos.

#### **Phosphorus**

In present investigation the content of phosphorus present in soil samples are range from 5.86 kg/acre. The concentration of phosphate is not enough for the better crop production. For good fertility the concentration of phosphate must be in range from 10-20 kg/acre.

## Sulphur

In present investigation the sulphur content in the soil samples found in range from 31.46 kg/acre which is very much high for soil productivity.

## Conclusion

Bhoramdev co-operative sugar factory Kabirdham is a first sugar mill of Chhattisgarh state. The present investigation has been to assess the physicochemical characteristic of effluent of sugar mill. The result of present study indicates that sugar mill effluent which is discharged to nearby land and used by the farmer for irrigation purposes, may affects the soil properties. Disposal of sugar mill effluent also improves the EC of soil. Sugar mill effluent has high concentration of sulphur because sulphur is used for refining the juice during sugar manufacturing process which also increases the S content in soil. There is considerable concern about P being lost from soils and transported to nearby streams. So by the perusal of result we conclude that at one side it improve the soil quality by increasing the Electrical conductivity. But on other side sugar mill effluent affected soil have high concentration of potassium and sulphur which may be harmful for soil. It is to be concluded that it maintains standard for iron, nitrate, TDS, turbidity, COD while discharging its effluent.

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