© 2019 IJSRST | Volume 6 | Issue 3 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology
DOI : https://doi.org/10.32628/IJSRST196618

Waste- Water of Sugar Industries- A Serious Threat to the Natural Environment

- *A Contemporary Challenge with Effective Solution*

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ABSTRACT

Over recent years, great concern has been given throughout the globe regarding the environmental pollution in many ways due to the rapid industrialization and subsequent urbanization. Industrialization is a critical means for the improvement of any country. With the fast development of business market (sugar, tannery material, sago, color, commercial enterprises) in the nation and worldwide, contamination in fresh water and soil by mechanical waste water has expanded vastly. The developed countries worldwide have always been exploiting each bit of natural resources or raw material to convert them into goods for their own comforts and the exportation of them to the down and out developing countries. In executing this, industrialized countries dump lot of waste materials in their environment which becomes polluted. Even though rapid urbanization and industrialization in the developing countries like India are facing acute problems in collection, treatment and disposal of industrial effluents. Unmanaged organic waste fractions from industries, municipalities and agricultural sector decompose in environment resulting in large scale contamination to the land, water and air.

Several chemical elements are used in sugar industries mainly for coagulation of impurities/contamination and refining of end products. Ca(OH)2 is usually used to clarify and to increase pH of juice. A small quantity of H_3PO_4 is added prior to liming to improve clarification. CO_2 gas is bubbled through the defecated juice to lower pH, which results in improvement of precipitation of impurities. Polyelectrolyte, which are polymer based chemical are also used for the coagulation of impurities during defecation and carbonation process. SO_2 is bubbled through the defecated raw sugar to remove color. Dilute solutions of NaOH or Na_2CO_3 are used for the periodic descaling of heaters followed by neutralizing it with dilute HCl. Lead acetate is used for the analysis of sugar content. All the chemicals, one way or another, are contributing towards increasing the organic strength, dissolved solids and suspended matter.

The sugar mill's waste-water is characterized by its brown color, low pH, high temperature, turbidity, electrical conductivity, chloride, total alkalinity, high BOD, high COD, odour problem, total hardness, sulphate, phosphate, total acidity, calcium, magnesium, total solids and high percentage of dissolved organic and inorganic matter. So, this untreated water creates the problem to the environment up to a large extent.

Keywords : Temperature, Turbidity, Electrical Conductivity, Chloride, Alkalinity, BOD, COD, Inorganic Matter

I. INTRODUCTION

India has emerged as one of the largest productions of sugarcane and sugar too in the world with highest number of sugar industries. In India, especially Uttar Pradesh (a state of India) is the highest sugar producing state in the country; and in Uttar Pradesh, western UP in particular is a potential sugarcane belt area. Sugarcane mills/factories are considered as a noteworthy part in discharging the waste-water so as to contaminate the water bodies and land a lot. Any physical, chemical and biological change in water quality that adversely affects living organism or make water unsuitable for desired use, can be considered as the water pollution. The sugar effluent is the most complex and cumbersome waste having high measure of suspended solids, broken up solids, chlorides, sulphates, very high BOD, COD, TSS and TDS contents. This may create many public health problems and environmental degradation too. At large, surface water quality is deteriorated because of mixing of chemical elements of the effluents with water.

The quality of waste water discharging from sugar industry decides the line of treatment. Waste water from sugar industry, if not treated properly and intelligently, contains significant amount of TDS and TSS. Such water may not be useful for crop land irrigation. There are many reports and findings which indicate the infiltration rate decreases with increased loading of BOD, TDS and TSS. The high value of TSS can cause decrease in soil porosity due to salt deposition. High TDS value in waste water may also affect adversely on crops. A TDS of 500—1000 ppm may have detrimental effect on sensitive crops. In view of facts the above facts, it is quite evident that sugar industry is a significant contributor to environmental pollution and has always been a typical problem. Unfortunately, due to lack of knowledge, financial support and sometimes unwillingness to spend on treatment of waste-water properly and adequately, most of sugar industries in developing countries discharge their waste-water without adequate treatment. This not only creates the serious problem but also wastes the water resources in the process of sugar production. In fact, all the concerned bodies both sugar industries and pollution control agencies are much aware of these burning problems and have been trying to find an economical means to the nuisance or contamination created by the sugar industry effluents.

Review of Related Studies

The purpose of review of related literature is not only compilation of previous studies but also an analytical review of various sources. In every field of research, the research worker needs to acquire comprehensive information about what has been done in particular area from which he/she intends to take up the problem for research.

Various Industrial Effluents

In recent years, considerable attention has been paid to industrial wastes which are usually discharged on land or into sources of water. It is anticipated that the industrial activities will accelerate with the pace of development. Soil polluted with cement industries had low water holding capacity and higher electrical conductivity (Shanthi, 1993 and SivaKumar and John De Brito, A. 1995). Zende, G.K. (1996) reported that discharged of cane sugar residues from sugarcane industry reduced soil pH. Similarly, soil discharged with effluents from cotton ginning mills (Narasimha et al. 1999) and paper mills (Medhi et al. 2005)

increased the water holding capacity and electrical conductivity.

Effluents of Sugar Industries

Ozoh and Oladimeji (1984) reported that sugar factory effluent produces obnoxious odour and unpleasant colour when released into the environment without proper treatment. Farmers have been using these effluents for irrigation, found that the growth, yield and soil health were reduced. Murty and Kumar (2004) reported that the sugar industry is one of the most water polluting industries with the recently studied pollution concentrations for some factories in India with as high as 1154mg/l of BOD, 5915 mg/l of COD and 5759 mg/l for SS. The industry has to incur a significant cost to reduce these very influent concentrations of pollutants to the Minimum National Standards (MINAS) of 35 mg/l of BOD, 250mg /l of COD and 100mg/l for SS in India. Awasare, et al(2015) reported that sugar industry waste water has a high degree of pollution parameters as pH , BOD,COD etc. Agale, et al (2013) reported that the sugar mills generate effluent which makes environment problems related to water and land pollution. The waste water generated from sugar mill infiltrate into subsoil and leaches into groundwater forming contaminated pool which disturb the groundwater quality by changing its chemical composition property.

Sugar Industry and Water -Diseases

Onsdorff (1996) reported that the major human activities have been used for polluting fresh water bodies. About 1.5 billion people have no safe drinking water globally and 5 million deaths per year are attributed due to waterborne diseases. Moses et al (2010) found that factories are consumers of huge volume freshwater; wastewater contains high level of contaminants such as, suspended solids, organic and inorganic matter and chemicals. Most chemicals used in sugar professing are toxic; if not well treated might ultimately find their course into the streams which make poor quality of fresh water bodies. Junejo, S.A. (2012) reported that those districts where these sugar industries are disposing their effluents having more deteriorated quality of groundwater, the ground water in the term of percentage having higher TDS values.

The Nation Karachi (November 21, 2012) reported that rashes on the body of newborn baby, a terrible aspect of the skin disease caused by chemical transforming through her mother. Qureshi et al (2015) reported that the chemical and poisonous industrial waste discharged by sugar mills in Badin district is becoming serious health hazard who are suffering from various skin and other disease such as asthma, eye infection etc. Qureshi, et al (2015) found that livestock including buffalos, cows and goats suffered due to various diseases. Even some of them were died due to consumption of sugar mills effluents discharged into drains, which in the vicinity of villages. They further reported that the fish catching birds and aquatic fauna are dependent on the drain system. Allwetlands attract local and migratory wildlife, particularly in winter. The contaminated water always threat for wildlife. It was found that the dead birds in the drains due to local sugar industry effluents.

Effects of Water Pollutants

Pollutants	Effects
1. Organic wastes	Promote decomposition, causing deoxygenation and death of animals, anaerobic (oxygen hating) bacteria produce foul smelling gases, scum and sludge form and render water unfit
2. Pathogens	Disease of human and domestic animals
3. Phosphates and nitrates in fertilizers and detergents	Promote algal growth, causing deoxygenation and death of animals, decay of dead algae produces foul gases, silt and decaying matter may fill up the water body.
4. Toxic chemical (Hg, As, Pb, Cyanide)	Reach human and animals bodies through poisoning, disease and death as they accumulate in bodies
5. Oil	Kills animals by catching fire and by reducing oxygen and plant life
6. Radioactive wastes	Reach human and animals bodies via food chain and cause death
7. Solid particles	Cause turbidity that reduces light for photosynthesis and this causes loss of water life
8. Heat	Warm water holds less O_2 insufficient to support life
9. Non-degradable pesticides	Reach human body via food chain, affect nervous system
10. Broad spectrum pesticides	Causes large scale destruction of aquatic life
11. Fluorides	Fluorosis
12. Dyes: Fe and Cr compounds	Change colour of water
13. Fe, Cl, Mn, HC, Phenol	Make water distasteful
14. Cl, H_2S, NH_3	Impart unpleasant ordour to water
15. Detergent, Soaps	Cause from formation
16. Corrosive materials	Spoil waste water treatment plants
17. Organic sulphur	Hampers nitrification

Source-Foundation of Environmental Studies, *Galgotia Publication PVT Ltd, New Delhi*

Pathological Effects of Heavy Metal Water Pollution on Man

Metal	Pathological Effects
1. Mercury	Foetal disorder
2. Lead	Neurological disorders, kidney damage, gastrointestinal, pulmonary disorders, genetic damage, brain, liver and kidney damage, anemia, vomiting and loss of appetite
3. Arsenic	Disturbed peripheral circulation, mental disorders, liver, cirrhosis, lung cancer, ulcers in gastrointestinal track, kidney damage
4. Cadmium	Bone deformation, Kidney damage, injury to central nervous system, liver, growth retardation
5. Copper	Sporadic fever, Hypertension
6. Barium	Excessive salivation, vomiting, diarrhea, paralysis, colin pain
7. Zinc	Renel damage, cramps
8. Chromium	Nephritis, gastrointestinal ulceration, cancer, disease of central nervous system
9. Cobalt	Diarrhea, low B.P., lung irritation, bone deformities, paralysis

Source- Environmental Studies**,** *S.K. Kataria and Sons, Publishers and Distributors, Delhi*

Close Monitoring over Sugar Industries' Effluents

Mehta and Sharma (1997) found that a good environmental management policy requires that there should be constant efforts to analyze and monitor various industrial working system and processes, to generate and transmit this information for the inspecting authority. He further also stated that the gap existing between activities generating pollutants and maintenance to a sustainable level need to be narrowed down under present circumstances. Chaudhary (2002) reported that environmental audit investigates all possibilities of material, energy savings, improvement in occupational health and safety of industrial workers. It also helps in communicating the results of this process to the concerned management and suggests corrective steps to be followed at the early stage.

Rao et al (2011) reported that careful and watchful environmental audit as an effective management tool offer prospects for improvement, perfection and achievement of environmental goal and further reported that the targeted sugarcane factory was taking care to avoid pollution, some of the points like good drainage facility, location of ETP neat housing colony and general cleanliness of the area looked after. The factory has planted around 2000 trees sapling in the premises indicates its concerns towards the environment. Meikandaan and Thansekaran (2006) found that it aims at minimizing the negative and maximizing the positive impacts on the environmentally sound system of company activities. Regulatory agencies considered such auditing as an important management technique because it ensures compliance with the environmental requirements and related corporate policies.

Physico - Chemical Analysis of Sugar Mill Effluent and Ground Water

The effluent from sugar mill is collected in polythene bottles/ glass bottles. Physico-chemical parameters like colour, temperature and pH are to be determined immediately at the site of collection. The other water quality parameters are determined as per standard protocol.

Parameters Taken for Sugar Mill Effluents and the Surrounding Ground Water

S.NO	PARAMETERS
1	Colour
2	Temperature
3	pH
4	Dissolved oxygen
5	Biochemical Oxygen Demand(BOD)
6	Chemical Oxygen Demand(COD)
7	Chlorides
8	Total Solids (TS)
9	Total Dissolved Solids (TDS)
10	Total Suspended Solids(TSS)
11	Sulphate
12	Oil and Grease
13	Fluorides
14	Heavy Metals (Pb, Cd, As, Hg and CH_3Hg)

II. METHODS FOR MEASURING DIFFERENT PARAMETERS

The following common parameters are tested by the following methods to analyze the physico-chemical characteristics of sugar mill effluent and the surrounding ground water:

PARAMETERS	METHODS
Colour	Platinum Cobalt (Visual Comparison) Method
Temperature	Electrometric Method
pH Value	Electrometric Method
Dissolved oxygen	Winkler's method
Biochemical Oxygen Demand(BOD) 5 –day dilution	BOD test method
Chemical Oxygen Demand(COD)	Close reflux Titrimetric Method
Chloride	Mohr's Method
Total Solids (TS)	Filtration Thermal Evaporation Method
Total Dissolved Solid (TDS)	" " " "
Total Suspended Solid (TSS)	" " " "
Sulphate	Gravimetric/Thorin/Turbidity Method
Oil and Grease	Partition Gravimetric/ Partition Infra-red/ Soxhlet Extraction Method
Fluorides	Spadn's Method/ Zirconium Alizarin Method
Heavy Metals (Pb, Cd, As, Hg and CH_3Hg)	Atomic Absorption Spectrophotometric

Other parameters are to be determined in laboratory as per Standard Protocol.

Treatment of Effluents

Lakherwal, D.(2014) reported that adsorption process has great potential for the elimination of heavy metals from industrial wastewater using low cost adsorbents. He further advocated for low cst adsorbent to minimize cost and maximize heavy

metal removal. Malik et al. (2014) revealed that there was a reduction of the pH using low cost adsorbent prepared from dry Neem branches. From the experimental finding it has been observed that the adsorbent material can be used successfully for the reduction of the pH. Other studies have been made by Basu et al, 2006; Srivastava et al, 2006 to investigate the adsorption of toxic waste from industrial wastewater using agricultural waste and industrial by-products. In this line, Deeepthi et al(2015) found that tamarindus indica seeds are used for the removal of metals from waste water. Its powered form acts as a good absorbent with 90% efficiency.

Treatment of Sugar Mill Effluents, Using Natural Adsorbents

The key objective of this endeavor is to use the natural adsorbents for the treatment of sugar mill's effluent, because it is economically feasible and eco-friendly technology. The evaluation of appropriate natural adsorbents' performance will be carried out using the following way:

(Effluent before Treatment)
Vs
(Effluents after treatment, using Natural Adsorbent)

The present endeavor unearths the hidden effects of the sugarmills' effluents after chemical analysis upon qualities water and health. A glance in the recent past of sugarmills' effluent and pollution level; researches show that there is a need of proper monitoring and surveillance of sugarmills' effluent and its impact upon the quality of water especially along with removal of the existing heavy metals using the low cost potent natural adsorbents.

III. CONCLUSION

To keep up the feasibility and to keep up data contamination from information degradation in data stockpiling fortification framework are question endeavors. Securing data pieces on different servers lessens the chances of information mishap however these data part stockpiling on various server for information support develops storage room. This data squares might be debased store on cloud server. To recover the demolished data blocks, our proposed structure completes recovering coding technique at delegate, if any pieces is adversity or decline. Furthermore to decrease the figuring cost, system uses cloud servers for securing the information, since cloud server has a couple of favorable circumstances, for instance, security, negligible exertion, high openness, et cetera. System uses dispersed KDC, to restrict the pile at single KDC. In this, if any one KDC is possessed, customer requesting key to another KDC. To figure the execution of our system, diverse balls finished on dataset including number of records. The record measure shifts from 1 kb to 100 mb. The test results shows that, our system is perform best than existing one, to the extent, storage room, cost, availability of data, constrain over-trouble at KDC and recovery of reports.

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Cite this article as :

Sujata Malik, "Waste - Water of Sugar Industries - A Serious Threat to the Natural Environment", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 6 Issue 3, pp. 345-353, May-June 2019. Available at doi : https://doi.org/10.32628/IJSRST196618
Journal URL : http://ijsrst.com/IJSRST196618