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Impact of Sugar Industry Effluent on Nearby Water Body: A Review

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ABSTRACT

Due to rapid growth of industrialization and anthropogenic activities create water pollution, which is major concern for environmentalist. In industrial sectors the sugar industry contributes a major role in generation of water pollution. In sugar industry processes like mill house, boiler blow down, condensing cooling water, soda and acid wastes, spent wash, etc create majority of water pollution. Typical physicochemical parameters present in wastewater are pH, BOD, COD, TDS, TS, chloride, sulphate and phosphate found in significant quantity. Treated/Untreated effluent of sugar industry is directly used as irrigation purpose or discharge in nearby water body. Due to this practices quality of soil, surface water body and ground water is degrading day by day.

Keywords: *Water pollution, Sulphate, Physicochemical parameters*

Introduction:

Water is incredibly vital life supporting material and needed for all organisms for the life processes. Water is required not just for domestic usage and irrigation however additionally for sanitation and waste disposal. Based on data from the DDWS (department of drinking water supply) and GOI, groundwater is sourced for nearly 90% of the rural water requirement. In most parts of India the major source of water supply for drinking purposes is groundwater. India is by far, the largest and fastest growing consumer of groundwater in the world, with around 80% of the rural population and 50% of the urban population use groundwater for domestic purposes. Groundwater pollution can occur from on-site sanitation systems, over application of fertilizers in agriculture, landfills, leaking sewers or petrol filling stations. Naturally occurring contaminants such as arsenic or fluoride can occur ontamination. Use of contaminated groundwater causes problems to public health through the spread of disease or poisoning.

Most of the sugar industries in India adopted double sulphitation process for the production of white sugar. Current practices or production processes in sugar industry are (i) Crusing (ii) Clarification (iii) Evaporation (iv) Crystallization (v) Centrifugation.

The main product is white sugar for sugar cane industry.The other by products is obtained from the distillation and fermentation of sugar cane juice and molasses. Sugar cane industry is facilated with alcohol distilleries plant generally release an average of 156 litter of stillage and 250 kg of bagasse per 1 ton of cane sugar. Bagasse can be used as combustible boiler fuel for energy production, while stillage is mainly disposed to field crops, incorporating a risk for aquatic pollution. Surface water pollution potential is mainly due to the high content of organic matter in stillage. Stillage (The residue from the manufacture of alcohol) contains significant amount of potassium, which can accumulate at toxic levels in the soil (Korndörfer & Anderson, 1997). During sugar production huge amount of water will be used and generate high amount of wastewater, it will be discharged as wastewater to the surrounding water

bodies such as river or streams. Once the wastewater mixed with water course within in few days it liberates the bad odour and this is common phenomenon, also mixing with groundwater and degrades the quality of groundwater. Wastewater discharged without treatment or partially treated from sugar industry, creates pollution problems in both terrestrial and aquatic ecosystems.

Most of the research work on treatment of sugar industry wastewater treatment has been based on anaerobic treatment. Anaerobic processes cannot easily degraded oil and grease. Also, an anaerobic process partly degrades nutrients and aerobic processes consume higher energy. Combined systems of anaerobic-aerobic can remove organics completely. Unfortunately, very few studies are available for anaerobic-aerobic combined systems, and more work is needed in this field (D. Shiva Kumar & S. Srikantaswamy, 2015).

The main parameter is the sugar mill effluent TDS, TSS, BOD, COD, and sulphate which is an important parameter in the sugar mill effluent, as it can have a direct impact on the community and nearby area. To overcome of this problem of sugar effluent we have an anaerobic and aerobic treatment options. Among of these options aerobic treatment take much electricity and anaerobic treatment take much time.

Sources of effluent (Sugar with Distillery plant):
Mill House (this water contains organic matter like sucrose, oil and grease from the bearings fitted in to the mills), Wastewater from Boiler blow-down(the water used in boiler have suspended solids, dissolved solids like salts of Ca, Mg, Na, Fatty, etc.), Condenser cooling water(Condenser cooling water is re-circulated again up to it gets contaminated with juice, which is possible due to defective separators, faulty operation etc. if the water gets contaminated than go into the drain invisibly), Soda and Acid Wastes(considerable amounts of organic and inorganic pollutions comes from the soda and acid wash. This contributes more pollution load and cause shock loads to waste water treatment.), spent wash (In Distillery plant: This spent wash has high BOD and COD with low pH range and dark in colour)Spent wash generation: about 8 to 15 litres per litre for alcohol produced.

Wastewater Treatment Technique:

Primary treatment: Normally it is known as mechanical treatment, but some chemicals are used to increase efficiency of sedimentation phenomenon by adding coagulant. It includes screening of floatable and course solid particles by screening and sedimentation by gravity method to remove suspended solids. 20-30% of BOD and 50-60% of TSS can be removed by primary treatment.

Secondary treatment: The dissolved organic matter that remains from primary treatment is removed in this process. This will be achieved by using of microorganism.They are consume the organic matter for its own growth reproduction by this action organic matters are converting into small molecules (water, CO_2, and energy). Then followed by additional settling tank if require. By a good running plant can be achieved removal efficiency about 80% for BOD and SS parameters. ASP is basically used as a secondary treatment unit. Sometimes multiple stage aeration can be provided.

Tertiary treatment: In India mostly sugar industry install ACF (activated carbon filter) or RSF (rapid sand filter) to polishing treated effluent water quality. After this treatment treated effluent will be used for irrigation purpose or discharge in near water body.

Distillery plant effluent treatment (Indian practice): Spent wash and other utilized water is going to the holding tank. This will be go to lagoon system, after that wastewater is spread or sprinkle on the press mud for making fertilizer for The mixing of SW and press mud (50-70% moisture) has to be carried out (for 45 days cycle completion require 2.5:1 proportion and for 60 days cycle 3.5:1 proportion require) in surface windrows with the help of an aero tiller machine (Self-propelling) for, mixing, turning, spraying and aeration of compost material. Composting is requiring addition of cow dung or special blend of cultures for providing of microbes. Bio-methanation is also option for treating the wastewater from the distillery plant.

Table 1: Typical Characteristicsof effluent from Sugar industry

S.No	Parameter	Sugar Industry		BIS effluent discharge standards	BIS Drinking water standards
		Untreated Effluent	Treated Effluent		
1	Colour	Dark Brown	Light Brown	-	-
2	Temperature	40ºC	38ºC	35ºC	-
3	pH	5	6.8	6.5-9.0	6.5-8.5
4	D.O.	1.30 ppm	2.30 ppm	2-6 ppm	-
5	BOD	98 ppm	88 ppm	30 ppm	-
6	COD	35 ppm	255 ppm	250 ppm	-
7	TDS	2980 ppm	1920 ppm	2100 ppm	500 ppm
8	TS	2700 ppm	2010 ppm	2700 ppm	-
9	Chlorides	210 ppm	175 ppm	600 ppm	250 ppm
10	Sulphates	760 ppm	420 ppm	1000 ppm	200 ppm

(Weqar A. Siddiqui and Muhammad Waseem,2012)

Impact of Physico-chemical Parameter:

Colour and Temperature: On the basis of research untreated effluent appeareddark brownish colour and treated effluents appeared light brownish, it is very important factor making food from photosynthesis for aquatic plants. This will be affecting other parameters like DO, BOD and temperature, etc.Colour found in groundwater is objectionable and contain mineral salts. Temperature effects on chemical and biological reactions in water.35°C is the maximum limit for discharging in any water body. The high tempof untreated effluent i.e. 40°C has adversely affected the germination process.

pH and DO: Atcleaning of sugar cane juice PO_4^- acid and $SO_2$are usewhich decrease pH values of treated and untreated samples. It is directly affect growth and yield production of crop.

Based on the BIS effluent discharge standard DO of the effluent should be within the range 4 to 6 ppm. Present study shows the DO of the untreated effluent is only 1.30 ppm and treated effluent have 2.30 ppm which is low than the values of BIS standard. Specific for the groundwater sample it's not required to check.

BOD and COD: Present study found the BOD of the untreated effluent nearer to 100 ppm while after giving the treatment recorded 88 ppm. ButBOD should not exceed the 50 ppm as BIS standards. But for the groundwater sample COD is check instead of that BOD. COD is significant for point out toxic condition and presence of biological matters.

TDS and TS: Solids in wastewater are affecting by the seasonal variation. TDS less concentration found in rainy season in effluent discharge. On the basis of some researches high value found in treated and untreated effluent its increase salinity on irrigational field and also possibility happens penetrate to the groundwater and create problem of high salty water.

Chlorides and Sulphates: On the basis of research chlorides of influent was found 210 ppm and after the treatment was recorded 175 ppm. This results shows within the limits of BIS. High SO_4^{2-} amount in both the effluents is shows the high use of sulphur in manufacturing process. If the water is over loaded with organic wastes than its generate high amount of odour which reduce the oxygen amount,$SO_4^-$is often use for the breakdown of organic matters and this will generates H_2S which had high bad odour like rotten egg (Welch 1980).

Conclusion:

Some research revealed that adopting the ASP process for treating of sugar effluent is better treatment option with high efficiency. The treated effluent of sugar industries is well balanced concentration of chemicals if this treated effluent is diluted with fresh water than it can be used as irrigation purpose. Also treated Effluents which is released from sugar industry may be recycling in own industrial processing again. Alternative way is recycling of waste water and it is economically beneficial for sugar industry. Degrade water cause a significant impact to the health of the people if used for drinking purpose. Also if this water goes unchecked in time to time than it will convert the water and the soil in completely unfit for consumption and cultivation.

If we like to achieve sustainable development in the future than must be checked time to time quality and take probable measures to evaluating of the surface water and ground water pollution surround the industry.

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