Comparative Study of 'BOD' and PH of Distillery Wastewater

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Abstract

Industrial processes create a variety of wastewater pollutants which are difficult and costly to treat. Production of ethyl alcohol in distilleries based on cane sugar molasses constitutes a major industry in Asia and South America. The world's total production of alcohol from cane molasses is more than13 million m3/annum. The aqueous distillery effluent stream known as spent wash is a dark brown highly organic effluent and is approximately 12-15 times by volume of the product alcohol. It is one of the most complex, and strongest organic industrial effluents, having extremely high BOD values. of organic load. The paper reviews the status of BOD values before and after treatment of the distillery wastewater.

1. INTRODUCTION

Water is one of the most important compounds required for every existing of life. Adequate supply of fresh and clean drinking water is a basic need for all human beings on the earth, yet it has been observed that millions of people worldwide are deprieved of this. Without clean water neither human nor the environment, which sustain them, can survive. Chemically it is a compound of two hydrogen atoms and one atom of oxygen. About 97% of world's water occurs as salt water, of the remaining 3%, two third occurs as snow and ice in the polar and alpine region so only about 1% of global water occurs as liquid fresh water. Groundwater is the underground water that occurs in the saturated zone of variable thickness and depth, below the earth's surface. More than 98% of fresh water present on the earth surface is in the form of ground water while streams, lake and rivers hold only 2% of the total available water therefore ground water is the most valuable natural resource.

Resent study have shown that groundwater is highly susceptible to pollution from natural as well as anthropogenic activities such as municipality sewage, industrial effluent, and agricultural field run off and leaching, land-fills refuse dumps, septic tanks and improper collection of solid wastes.

Quality of ground water is for important like its quantity. When we talk of the quality of ground water, it means some peculiar characteristics of water in relation to a particular use. In safe water and inadequate sanitation is the world's leading cause of human illness. Disease and death are directly attributable to the lack of these essentials. Safe drinking water is vital human needs for health and efficiency. Determination of physical chemical bacteriological and heavy metals characteristics of water is essential for assessing the suitability of water for drinking, irrigation and industrial uses. Various standards has been laid down by various agencies such as the World Health Organization (WHO), the U.S Environmental Protection Agency (USEPA), the Bureau of Indian standards (BIS) & the Indian Council of Medical Research (ICMR) etc for determining the quality of water for various uses. Any physical chemical and biological change in water quality that adversely affects living organism or make water unsuitable for desired use can be considered pollution.

According to the Natural Environmental Engineering and Research Institution (NEERI) Nagpur about 70% of all available water in India is polluted. Two third of all ailment in India such as Typhoid, Jaundice, Cholera, Diarrhea and Dysentery system is caused by contaminated water. These water borne diseases claims 1.5 millions lives in India every year, which means three people die every 10 minutes due to contaminated water.

Excessive use of pesticide and chemical fertilizers in farms aggravates the problem. India produces 11 million tones of fertilizer every year and much of it ultimately percolates down to the ground water sources and contaminates it.

Also Distilleries industries are one of the most polluting industries. In India there are about 579 sugar mills and 295 distilleries with a total installed capacity of 3198 million litres per annum and a yearly production of 1587 million litres alcohol. Alcohol is produced from molasses by two type of fermentation processes, Praj type and Alfa Laval distillation. In Praj type one litres alcohol produced about 12-15 litres of spent wash whereas in the Alfa Laval continuous fermentation and distillation process only 7-8 litres of waste water per litres of alcohol is produced. The effluent coming from distillery industry is highly polluted which when seeps into the ground ultimately contaminated the ground water.

The pH value of water is measure of its alkalinity or acidity. More accuracy sated the pH is a measure of the hydrogen ion concentration in water. Mathematically this is the logarithm to the base 10 of reciprocal of the hydrogen ion concentration of pure water. Thus a pH value of 7 indicates neutral solution, neither alkaline nor acidic. A pH less than 7 indicates an acidic solution indicates the presence of carbonate of calcium and magnesium and a pH value of 8.5 or above usually indicates appreciable exchargeable solution. The discharge of electroplating waste, battery waste, the industrial waste involving the washing and finishing of metal sheets and the waste produced in obtaining metals from their ores etc. into the river is responsible for contamination of river water with heavy metals. Measurement of metals in water is usually made by atomic absorption spectrophotometry. Heavy metal concentration is expressed in mg/L.

The limit of 250 ppm for chlorides in drinking water established (WHO 1904). To some persons this amount is noticeable as imparting a salty or blackish taste to water. On the other hand, some waters with as much as 700 ppm chloride have no noticeable salty taste. There is some indication that these variations depends upon the combination of chlorides with other salts and that chlorides and hardness together may impart a taste when combined content is approximately 400 ppm. Since physiological reaction due to chloride do not occur until much higher concentration, approaching those of sea water, are reached it is obvious that the restriction have been imposed for reasons of portability rather than health.

2. CHARACTERISTICS OF DISTILLERY WASTE WATER

Table-1 : Typical characteristics of distillery spent wash

Parameter	Range
pH	3.8–4.4
Total solids (mg/L)	60000–90000
Total suspended solids (mg/L)	2000–14000
Total dissolved solids (mg/L)	58000–76000
Total volatile solids (mg/L)	45000–65000
Chemical oxygen demand (mg/L)	70000–98000
Biological oxygen demand (for 5 days at 20 ?C) (mg/L)	45000–60000
Total nitrogen as N (mg/L)	1000–1200
Potash as K2O (mg/L)	5000–12000
Phosphate as PO4 (mg/L)	500–1500
Sodium as Na (mg/L)	150–200
Chlorides as Cl (mg/L)	5000–8000
Acidity as CaCO3 (mg/L)	8000–16000

3. SCHEMATIC OF ALCOHOL MANUFACTURING PROCESS

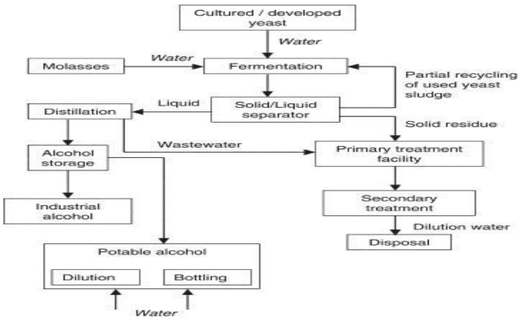

Fig.1: Schematic of Alcohol Manufacturing Process

4. BIOLOGICAL OXYGEN DEMAND

The extent of oxygen consumed by the organic matter present in water sample is known as Biochemical Oxygen demand (BOD). The BOD of raw water will indicate the extent of organic matter present in the water. If sufficient oxygen is present in water, the useful aerobic bacteria production will flourish and cause the biological decomposition of waste and organic matter, thereby reducing the carbonaceous material from the water. The amount of oxygen required in the process until oxidation gets completed is known as BOD. Polluted waters will continue to absorb oxygen for many months, till the oxidation gets completed and it is not practically possible to determine this ultimate oxygen demand. Hence the BOD of water during the first five days at 20^0C. The dissolved oxygen is measured after the period of incubation. The difference between the original oxygen content and the residual oxygen content will indicate the oxygen consumed by the water sample in five days. If BOD of water is zero it means that no oxygen is required and thus no organic matter is present. The extent of pollution of sewage and other industrial wastewater is also measured by determining the values of their BOD as following steps.

i) Take 5 liter tap water in a bucket and add 5 ml Nutrients viz Ferric Chloride, Calcium Chloride, Phosphate Buffer, Magnesium sulphate and aerated it for about 1 hour.

ii) Take 100 ml sample and add 200 ml diluted water.

iii) Now add 2 ml mangnous sulphate to the solution.

iv) Add 2 ml Alkali Azide in the solution and shake it until the yellow color appears.

v) When the solution is half settle then add 2 ml H_2SO_4 and shake it until the clear yellow color appears.

vi) Now take 203 ml sample from the solution and add 2-3 drops starch indicator.

vii) Finally titrate the sample with Sodium Thiosulphate up to the colorless.

5. REAGENTS USED

5.1 Ferrous Ammonia Sulphate (FAS)

It was prepared according to the standard method by adding to about 9.80 gram FAS and 5 ml H_2SO_4 in 250 ml distilled water.

5.2 Sulphuric Acid

It was prepared by adding 2.75 gram of and 272 ml of H_2SO_4 in 500 ml distilled water Then it was allowed to stand for one day to dissolve $AgSO_{4.}$

5.3 Potassium Dichromate ($K_2Cr_2O_7$)

It was prepared by dissolving 16.65 gram of $HgSO_4$, 83.5 ml H_2SO_4 and 2.45 gram $K_2Cr_2O_7$ in 500 ml distilled water.

5.4 Phosphate Buffer

It was prepared by adding 8.5 gram pot. hydrogen phosphate, 21.75 gram Di Pot. hydrogen phosphate, 33.4 gram di sodium hydrogen phosphate and 1.7 gram ammonium chlorides dissolved in 500 ml distilled water and then dilute with 1 litre distilled water.

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5.5 Magnesium Sulphate

It was prepared by adding 22.5 gram magnesium sulfate in 1 liter distilled water.

5.6 Ferric Chloride (FeCl)

It was prepared by adding 2 gram FeCl 1 liter distilled water.

5.7 Calcium Chloride

It was prepared by adding 27.5 gram calcium chloride in 1 liter distilled water.

5.8 Magnous Sulphate (MnSO4)

It was prepared by adding 364 gram $MnSO_4$ in 1 liter distilled water.

5.9 Alkali Azide

It was prepared by adding 125 gram NaOH sodium hydrogen pallets, 37.5 gram potassium Iodide and 2.5 gram sodium azaid (NAH_3) in 250 ml distilled water.

5.10 Sodium Thio sulphate of 0.025 Normality

It was prepared by adding 6.205 gram in 1 liter distilled water.

5.11 Starch Indicator

It was prepared by adding 2 gram starch powder and 0.2 gram salicylic acid in 100 ml distilled water.

5.12 Potassium Chromate

It was prepared by adding 12.5 gram potassium chromate in 100 ml distilled water and then after 12 hours filter the solution and add 250 ml distilled water.

Table-2: Observation

S.N.	BOD values before treatment	BOD values after treatment
1	35000 mg/L	1800 mg/L
2	38000 mg/L	2200L

5.13 *Preparation of bagasse activated carbon (BAC)*

Bagasse are collected from sugar industry and dried in oven at 110oC followed by sieving with mesh of pore size 425 . The sieved particles were washed several times with water and dried at 110oC for 6 hours in hot air oven to remove all the moisture content. The dried bagasse was then treated in combination with concentrated H2SO4and H3PO4in ratio of1:1 by volume, as activating agent to produce activated carbon. The sample was then washed with distilled water and soaked in 1% sodium carbonate solution for about 8 hours. The washing of sample with distilled water was continued until the pH of wash water turned to neutral. The samples were dried in hot air oven at 110oC for 24 hours. The final adsorbent are stored in airtight containers before using for adsorption studies. High moisture content is not desirable as it dilutes the adsorption capacity of the activated carbon and thus, larger dosages would be required. High ash content is not desirable as ash is the residue that remains when the carbonaceous material is burned off, the ash content indicates the inorganic constituents (mainly minerals such as silica, aluminum, iron, magnesium and calcium), associated with the carbon sample. These metals might leach from the activated carbon during adsorption and affect their performance adversely by competitive adsorption with the adsorbate. Hence, the prepared BAC was analyzed for pH, moisture content, conductivity, volatile matter content and ash content.

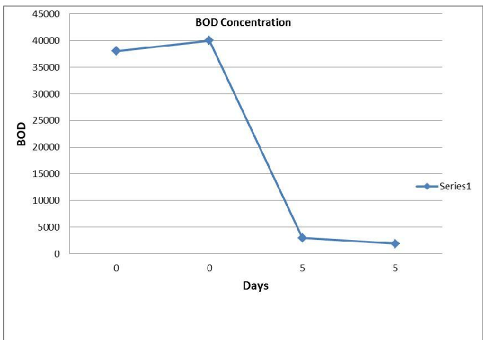

Fig.2: BOD concentration before treatment and after treatment

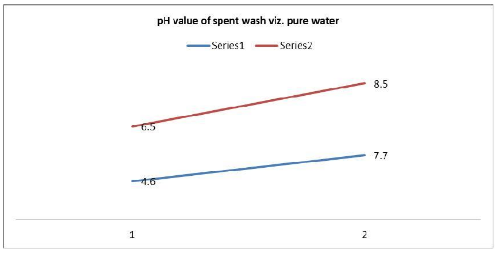

Fig.3: ph values

Series 1 is pH value of spent wash before treatment and after treatment.

Series 2 is pH value of pure water.

6. CONCLUSION

One of the most important environmental problems faced by the world is management of wastes. Now-a-days emphasis is laid on waste minimization. Pollution prevention focuses on preventing the generation of wastes, while waste minimization refers to reducing the volume or toxicity of hazardous wastes by water recycling and reuse.

Here we conclude that the treatment are very important part of distillery spent wash, the major treatment as BOD concentration. We see that the BOD concentration is very high before treatment and it is reduces after treatment. If BOD values is high then the aquatic resion my not properly works

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