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Treatment of Textile Effluent by Activated Carbon as Adsorbent

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ABSTRACT

The Studies were performed using activated carbon as adsorbent and treatment of textile waste water which contains dissolved organic matter. Textile waste water contains a variety of textile dyes particles and chemicals which has a devastating effect on aquatic life in the environment and human health as well as it leads to loss of bio-diversity[1]. The aim of the research project was to check out the DO, BOD, COD, TSS, TDS, pH of a given sample of textile waste water and treat with activated carbon as adsorbent for removal of dissolved organic matter.

Keywords: Activated Carbon, Adsorption, textile waste water, COD, TDS, TSS, BOD, DO, pH.

1. INTRODUCTION

The textile dyeing industry consumes large quantities of water and produces large volumes of wastewater from different steps in the dyeing and finishing processes[2]. Wastewater from printing and dyeing units is often rich in color, containing residues of dyes and chemicals, such as complex components, many aerosols, high COD and BOD concentration as well as much more hard-degradation materials[3]. Treatment of such heavily polluted water is very essential before discharging it into the receiving water body. If such water is discharged in the receiving body, it will affect the flora and fauna of the water body and lead to its pollution.

The textile wastewater treatment technologies aim at achieving color removal and reduction of Total Dissolved Solids (TDS), Total Suspended Solid(TSS), Total solid (TS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pH correction and increase of dissolve oxygen(DO). Coal is a burnable carbonaceous rock that contains large amounts of carbon[4]. Coal is also a fossil fuel—a substance that contains the remains of plants and animals and that can be burned to release energy. Coal contains elements such as hydrogen, oxygen, and nitrogen; has various amounts of minerals; and is itself considered to be a mineral of organic origin. Adsorption is an effective method of lowering the concentration of dissolved dyes in the effluent resulting in color removal. Other means of dye removal such as chemical oxidation, coagulation and reverse osmosis are generally not feasible due to economic considerations (Tsai *et al*., 2001).so The adsorption process is one of the most efficient methods to remove dyes from effluent economically.

Charcoal is carbon. Activated charcoal is charcoal that has been treated with oxygen to open up millions of tiny pores between the carbon atoms. The use of special manufacturing techniques results in highly porous charcoals that have surface areas of 300-2,000 square meters per gram[5]. These so-called active, or activated, charcoals are widely used to adsorb odorous or colored substances from gases or liquids

Potential specific pollutants from textile dyeing and Printing[5]

Process	Compounds
Desizing	Sizes, enzymes, starch, waxes, ammonia.
Scouring	Disinfectants and insecticides residues, NaOH, surfactants, soaps, fats, waxes, pectin, oils, anti-static agents, spent solvents, enzymes
Bleaching	H_2O_2, AOX, sodium silicate or organic stabilizer, high pH.
Mercerizing	High pH, NaOH
Dyeing	Color, metals, salts, surfactants, organic processing assistants, sulphide, acidity/alkalinity, formaldehyde.
Printing	Urea, solvents, color, metals.
Finishing	Resins, waxes, chlorinated compounds, acetate, stearate, spent solvents, softeners.

Adsorbent preparation

The bio-adsorbent used for this study was the activated carbon which was prepared from the coal of Boropokuria coal mine, Dinajpur, Bangladesh.

It was prepared by gas activation method.

↓

The charcoal then carbonized at (400 – 500) ^{o}C

↓

to eliminate the bulk of the volatile matter

↓

The oxidation is preceded usually by a primary

↓

Carbonization of raw material.

The pyrolysis of wood (cellulose) starts at temperature about 225 C.

EXPERIMENTAL

Waste Water Collection

The sample waste water was collected from Jamuna Group (Wet Processing Unit) Nishat Nagar, Tongi , Gazipur, Bangladesh.

Instruments

Glassware and apparatus, UV-Vis Spectrophotometer, Portable multi-parameter meter, Electronic balance, Vacuum Oven, Magnetic/Hotplate stirrer, Incubator, Refrigerator, Standard flasks, Magnetic Stirrer, Funnel. Beaker, Wash Bottle.

Dissolved Oxygen (DO)

DO is one of the most important factors controlling the presence or absence of estuarine species. It is crucial for most animals and plants except for a small minority that can survive under conditions with little or no oxygen. Animals and plants require oxygen for respiration—a process critical for basic metabolic processes. In addition to its use in respiration, oxygen is needed to aid in decomposition. An integral part of an estuary's ecological cycle is the breakdown of organic matter. Like animal and plant respiration, this process consumes oxygen[6]. Decomposition of large quantities of organic matter by bacteria can severely deplete the water of oxygen and make it uninhabitable for many species. An overload of nutrients from wastewater treatment plants or runoff from various land uses also adds to the problem. Nutrients fuel the overgrowth of phytoplankton, known as a bloom. The phytoplankton ultimately die, fall to the bottom, decompose, and use up oxygen in the deep waters of the estuary.

Oxygen present in sample rapidly oxidizes the dispersed $Mn^{2+}$to Mn^{4+}, which precipitates as a brown hydrated oxide after addition of NaOH and KI. Upon acidification, manganese reverts to divalent state and liberates iodine from KI equivalent to the original DO content. The liberated iodine is titrated against N/40 $Na_2S_2O_3$ solution using freshly prepared starch solution as indicator.

Total Dissolved Solids (TDS)

Total dissolved solids (TDS) combine the sum of all ion particles that are smaller than 2 microns (0.0002 cm). This includes all of the disassociated electrolytes that make up salinity concentrations, as well as other compounds such as dissolved organic matter. In "clean" water, Total dissolved solids are reported in mg/L. TDS can be measured by gravimetric (with an evaporation dish) or calculated by multiplying a conductivity value by an empirical factor.

Biological Oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) refers to the amount of oxygen that would be consumed if all the organics in one liter of water were oxidized by bacteria and protozoa. The first step in measuring BOD is to obtain equal volumes of water from the area to be tested and dilute each specimen with a known volume of distilled water which has been thoroughly shaken to ensure oxygen saturation[7]. Microorganisms such as bacteria are responsible for decomposing organic waste. When organic matter such as dead plants, leaves, grass clippings, manure, sewage, or even food waste is present in a water supply, the bacteria will begin the process.

The determination of DO of a sample before and after five days incubation at 20°C is the basic of BOD determination.

The chemical oxygen demand (COD) test is commonly used to indirectly measure the amount of organic compounds in water. It is expressed in milligrams per liter (mg/L), which indicates the mass of oxygen consumed per liter of solution[7]. The basis for the COD test is that nearly all organic compounds can be fully oxidized to carbon dioxide with a strong oxidizing agent under acidic condition. A blank sample is created by adding all reagents (e.g. acid and oxidizing agent) to a volume of distilled water. COD is measured for both the water and blank samples and the two are compared. The oxygen demand in the blank sample is subtracted from the COD for the original sample to ensure a true measurement of organic matter

$$\text{COD, mg /L} = \frac{(A-B)\times M \times 8000}{Volume\ of\ Sample\ ,ml}$$

Where:

A = mL of titrant used for sample
B = mL of titrant used for blank
M = normality of ferrous ammonium sulfate

Total Suspended Solid

Total suspended solids (TSS) are particles that are larger than 2 microns found in the water column. A well-mixed sample is filtered through a weighed standard glass-fiber filter and the residue retained on the filter is dried to a constant weight at 103 to 105°C.

A well-mixed sample is filtered through a standard glass-fiber filter, and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180°C. The increase in dish weight represents the total dissolved solids. By using following formula Total suspended solid can be calculated

$$\text{TSS, mg /L} = \frac{(A-B)\ X\ 1000}{Volume\ of Sample\ ,ml}$$

Where:
A = weight of filter + dried residue, mg, and
B = weight of filter, mg.

pH

pH is a measure of how acidic or basic (alka-line) a solution is. It measures the hydrogen ion (H+) activity in a solution, and is expressed as a negative logarithm. It carried out by digital pH meter.

Parameter of Water	Temp. of Sample (° C)	Before The Test (Mg/L)	After The Test (Mg/L)	Standard value of inland surface water(9)	Removal Efficiency (%)	Test Method (APHA)
BOD	27	120	56	50mg/L	53.33%	4500.O
COD	27	245	176	200mg/L	28.16%	5220.B
DO	27	0.09	2.76	4.5-8mg/L	296.67%	-----
TSS	27	55766	95	150mg/L	99.83%	2540.D
TDS	27	4287	1759	2100mg/L	58.97%	2540.C
pH	27	9.8	7.5	6-9	23.47%	4500-H+ B

RESULT And DISCUSSION

The test showed that Activated carbon filter was the most efficient in reducing COD, TDS and TSS from the effluent sample and also improve the DO remarkably.

Result also shows that, after treated with activated carbon, the value of BOD, COD, TDS, TSS are remarkably reduce and it is very close to the standard value of intended surface water however the test result may vary with the time.

In Bangladesh aspect, we know that, Bangladesh is a growing economic developing country and passing a crucial time for developing the infrastructures and treatment plants for textile toxic waste and other industrial hazardous pollutants, where industrial toxic waste can be treated with suitable bio adsorbent to get the harmless water for us and as well as aquatic life. Our research findings will help to find out the suitable adsorbent which can be used as large scale commercial effluent treatment plant.

Graphical Representation of analytical data

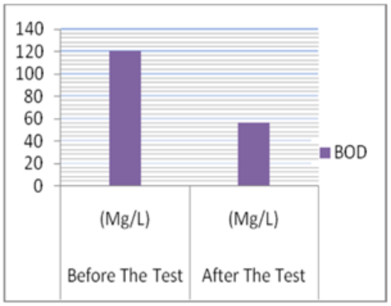


Fig (a)-Comparative graph of BOD analysis (Before and after treatment by the activated carbon)

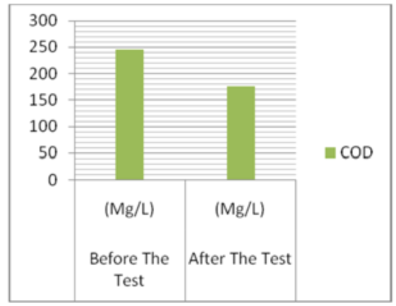
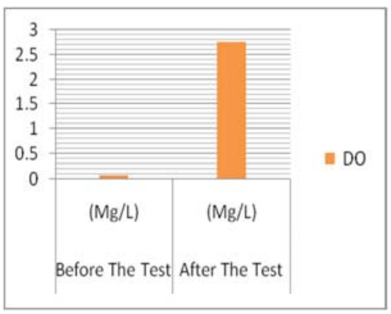


Fig (b)-Comparative graph of COD analysis (Before and after treatment by the activated carbon)



Fig(c)-Comparative graph of DO analysis (Before and after treatment by the activated carbon)

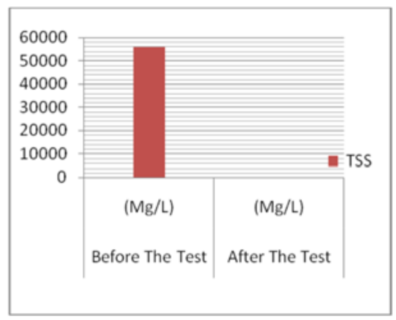


Fig (d)-Comparative graph of TSS analysis (Before and after treatment by the activated carbon)

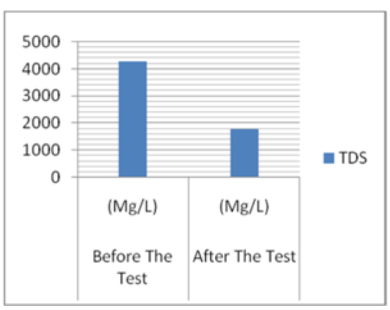
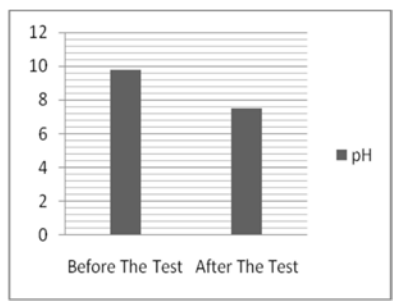


Fig (e)-Comparative graph of TDS analysis (Before and after treatment by the activated carbon)



Fig(f)Comparative graph of pH analysis (Before and after treatment by the activated carbon)

CONCLUSIONS

Activated carbon is effective in removing the dissolved organic matter from the textile wastewater. The test showed that Activated carbon filter was the most efficient in reducing

BOD, COD, TDS and TSS of the effluent sample and as well as increase the dissolved oxygen remarkably. The treatment of such heavily polluted water is essential because the untreated effluent will affect the biota severely by significantly reducing dissolved oxygen. The adsorption can be influenced by a number of factors, such as, adsorbent mass, contact time, agitation speed, temperature and pH etc. Hence, there is a need to optimize these factors to maximize the treatment efficiency of activated carbon and minimize the treatment cost for textile wastewater. Decolonization process is not specific and depends upon many factors. Although there are lots of adsorbents which can act as a substitute for the expensive commercial activated carbon. Though activated carbon is costly, its accuracy level is very high. When accuracy is the higher priority then activated carbon can be used commercially.

REFERENCES

1. "Removal of Dye from Textile Waste Water by using Activated Carbon in a Fixed Bed Adsorber". Removal of Color from Textile Waste water 19.1, *ICChE*: 1 (2008).
2. Textile Dying and Coloration. USA: American Association of Textile Chemists and Colorists, Print (1997).
3. Environmental Pollution Monitoring and Control. Mumbai: New Age International (P) Ltd., Print (2004).
4. Frederick H. Pough. Physical Properties of Minerals. In: A Field Guide to Rocks and Minerals. Newyork: Houghton Mifflin Company. 42-43 (1953).
5. D. Barcelo, M. Petrova. Advanced Sorbent Materials for treatment of Wastewater. In: Aguero, A Emerging Contaminants from Industrial and Municipal Waste. Germany: *Springer-Verlag Berlin Heidelberg*. 243-244 (2008).
6. Frank Morosky. (2012). Basic Knowledge about Charcoal Filters. Available: http://http:www.flat-d.com/charcoalfilter.html. Last accessed 29th Sep (2015).
7. Claude, E. Water Quality: An Introduction. 2nd ed. Switzerland: *Springer International Publishing*. 113 (2015).
8. Jivendra. Physicochemical and Biological Charateristics. In: Water Pollution Management. New Delhi: Cambridge Printing Works. p215-216 (1995).
9. Shuchismita Dey, Ashraful Islam: A Review on Textile Wastewater Characterization in Bangladesh doi:10.5923/j.re.20150501.03; scientific &academic publishing co.. ;p-ISSN: 2163-2618 , e-ISSN: 2163-2634, (2015).