

An investigation on the effects of bleaching powder with dyeing industries' effluents

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Abstract

This paper depicts an investigation of the harmful effects of the waste water effluents coming from dyeing industry. A wide study was accomplished through the treatment of the wastes from dyeing industry. Mainly emphasize has been given on the oxidation process for removal of color and other pollutional loads. The color removal efficiency has been studied by adding different amount of oxidizing agent. Bleaching powder was used as an oxidation agent. The parameter considered in this study was pH, turbidity, total solids, suspended solids, chemical oxygen demand, and biochemical oxygen demand. Optimum pH and dose of oxidation agent were determined by batch studies. Dose of oxidation agent 500 mg/l and the pH was 8.8. It is found that color removal efficiency of waste water was 90%. It is also seen that the pollutional loads (BOD₅, COD, and SS) reduced to a tolerable limit by oxidation process. The color decreased after treatment with bleaching powder which consequently increases the total solid in the final effluent. The effects of using bleaching powder in TSS, BOD and COD have been shown.

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Keywords: Biochemical Oxygen Demand, Chemical Oxygen Demand; Suspended Solids; Total Dissolved Solids

1. Introduction

Textile manufacturing is among the major industrial water users. A lot of chemicals are added to the process for cleaning and dyeing purposes. Obviously, the wastewater effluents from textile mills contain considerable amounts of hazardous pollutants, and where heavy metals are very common. In Bangladesh, most of the effluents from the textile industries are discharged untreated into rivers. Now-a-day in Bangladesh, 70% of available water is polluted by the textile effluents and two thirds of illness is related to water-borne diseases. Water treatment is a very important step to change these conditions and to achieve a sustainable situation. In newly developed industrial areas,

advanced waste water treatment is used for textile effluents to save the environment from serious pollution. There are of course more industries, but these are not that much polluting or do not use that much non-biodegradable chemicals like textile (Babu et al., 2007).

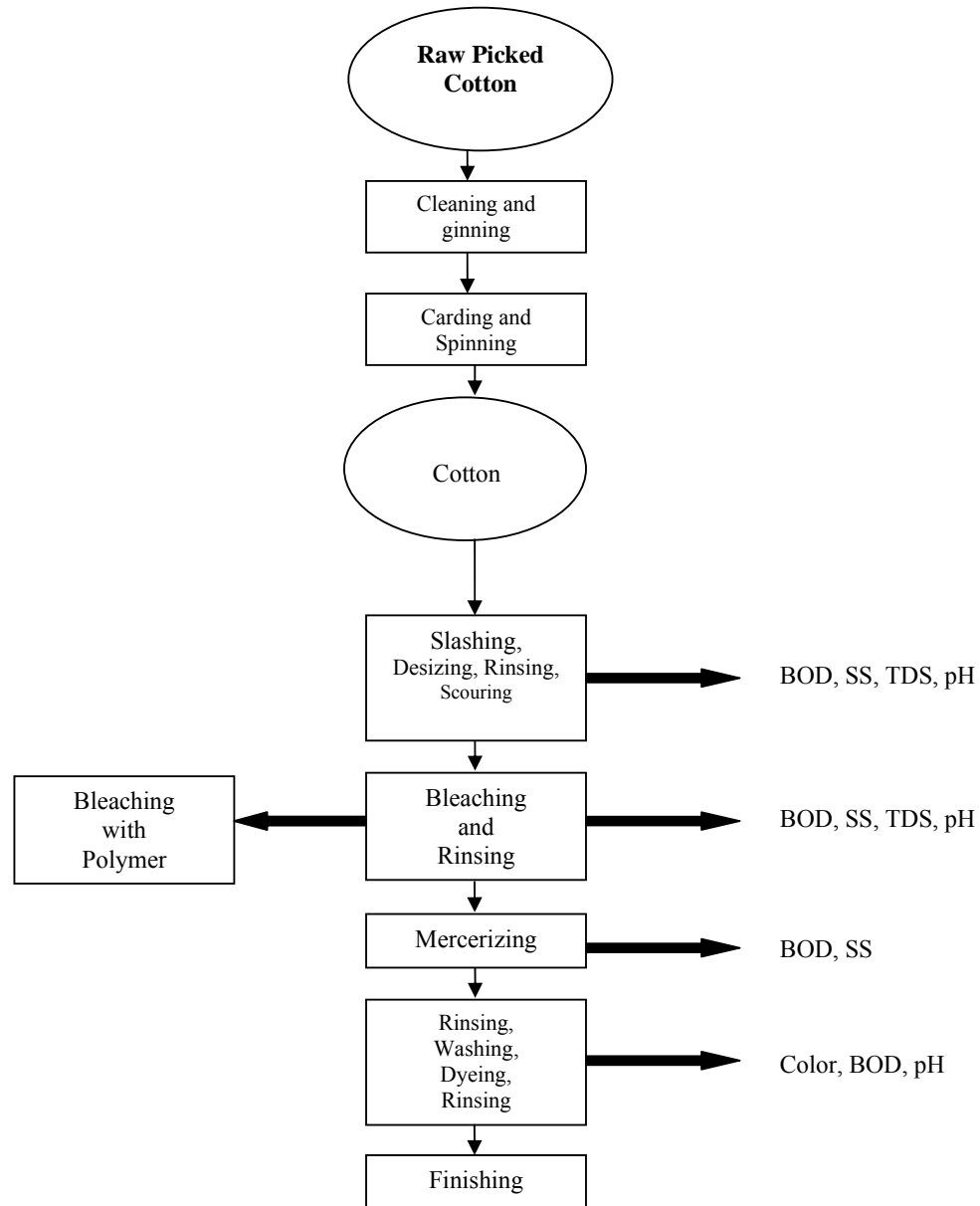


Figure 1. Cotton Fabric Production and Associated Water Pollutants

The textile industry is distinguished by the use of raw materials and this determines the volume of water required for production as well as wastewater generated. Production may be from raw cotton, raw wool, and synthetic materials that can be shown by a flow diagram in Figure 1. The six major industries selected for having a studied are mainly

raw cotton-based. In this type of production, slashing, bleaching, mercerizing, and dyeing are the major water consumption activities as well as wastewater generation.

Oil and grease, ammonia, sulphide, and color, are potential air pollution sources from these effluents. Meteorological conditions which include wind speed and annual average temperature (USEPA, 2002) are important factors. It confirms that high temperature of the cities especially during the long dry season increases the potential of the discharged effluents from the textile mills to pollute air in the environment. High color associated with these effluents should be adequately treated before discharge.

When the effluents are discharged into the river, heavy metals present are adsorbed on the river's soil and sediments during the dry season, water evaporation could expose them to the environment. High TSS and TDS detected could be attributed to the high color (from the various dyestuffs being used in the textile mills) and they may be the major sources of the heavy metals. Increased heavy metals concentrations in river sediments could increase suspended solids concentrations. During the dry season, the occasional dust re-suspension could introduce these metals into the atmosphere along with the particulates. With this, they could constitute health problems in the form of air pollution. In addition to these, the products of reactions between some of the chemicals present in the effluents (Soldan, 2003) that may be toxic to the environment. Removal of the pollutants from these effluents is the only sure way of safer environment and this can be achieved by proper treatment of effluents to the required level.

The most important measure of water quality is the dissolved oxygen (DO) (Peirce et al, 1997). The low level of DO recorded could result in the non maintenance of conditions favorable to the aerobic organisms. This could lead to anaerobic organisms taking over with the resultant creation of conditions making the water body uninhabitable to gill-breathing aquatic organisms. Hydrogen Sulphide is formed under conditions of deficient oxygen in the presence of organic materials and Sulphate (WHO, 2000). This could be a possible reason for the high Sulphide measured in the effluents analyzed. The high levels of BOD are indications of the pollution strength of the wastewaters. They also indicate that there could be low oxygen available for living organisms in the wastewater when utilizing the organic matter present. High COD levels imply toxic condition and the presence of biologically resistant organic substances (Sawyer and McCarty 1978). The settleable and suspended solids are high and this will affect the operation and sizing of treatment units. Solids concentration is another important characteristic of wastewater (Lee and Lin, 1999). High alkalinity increases with wastewater strength. It shows the capacity of wastewaters to neutralize acids, and is undesirable. Heavy metals in the wastewaters could be of negative impact to the environment, trace heavy metal contamination of an area to industrial effluent (Sekhar et al, 2003). The negative impacts from textile mills effluents could be felt as far as all the regions covered by the River basin, the main receptor of these effluents. High heavy metal concentration has found in these rivers attributed this to industries. The textile industry generally has difficulty in meeting wastewater discharge limits, particularly, with regard to dissolved solids, pH, BOD, COD, sometimes, heavy metals and color of effluent (Chen et al, 2005) Effluents from textile industries contain different types of dyes, which because of high molecular weight and complex chemical structures, that show low level of biodegradability. Hence, direct deposition of these effluents into sewage networks, produce disturbances in biological treatment processes. Industrial emission and waste effluent generated from factories are associated with heavy disease burden (WHO, 2000 and 2002) and this could be part of the reasons for the current shorter life expectancy, 61.4 years both for male and female in the country (WHO, 2003) when compared to the developed nations. Some

heavy metals contained in these effluents (either in free form in the effluents or adsorbed in the suspended solids) from the industries have been found to be carcinogenic (Tamburlaine et al, 2002) while other chemicals equally present are poisonous depending on the dose and exposure duration (Lawrence and McCabe, 2002). These chemicals are not only poisonous to humans but also found toxic to aquatic life (WHO, 2000 and 2002) and potential sources of food contamination (Novick, 1999).

Ammonia is harmful to fish or other aquatic organisms at free (un-ionized) concentration of 10- 50 µg/L or higher pH and the sulphide in the effluent are of environmental concern (WHO, 2000 and 2002) because they can lead to poor air quality of an area if not properly taken care of thus becoming threat to humans, vegetation, and materials. The same is applicable to pH that has been identified to raise health issues if water available for human use is not of the required pH level (WHO 1993). Textile industries are major sources of these effluents (Ghoreishi and Haghighi 2003) due to the nature of their operations which requires high volume of water that eventually results in high wastewater generation. They are one of the largest water users and polluters (Babu et al 2007).

A strong influence on the potential impacts associated with textile manufacturing operations due to the different characteristics associated with the effluents are shown in Table 1. Specific water use varies from 60-400 L/kg of fabric, depending on the type of fabric (Bruggen et al, 2001 and EPA, 1998).

Table 1
Textile Industry Processes and Effluent Characteristics

Process	Effluent Composition	Pollutant Nature
Sizing	Starch, waxes, Carboxymethyl Cellulose (CMC), Polyvinyl Alcohol (PVA), wetting agents.	High in BOD, COD
Desizing	Starch, CMC, PVA, fats, waxes, pectins	High in BOD, COD, SS, dissolved solids (DS)
Bleaching	Sodium Hypochlorite, Cl ₂ , NaOH, H ₂ O ₂ , acids, Surfactants, NaSiO ₃ , Sodium Phosphate, short cotton fibre	High alkalinity, high SS
Mercerizing	Sodium Hydroxide, cotton wax	High pH, low BOD, high DS
Dyeing	Dyestuffs Urea, reducing agents, oxidizing agents, Acetic acid, detergents, wetting agents.	strongly colored, high BOD, DS, low SS, heavy metals
Printing	Pastes, urea, starches, gums, oils, binders, acids, Thickeners, cross-linkers, reducing agents, alkali	Highly colored, high BOD Oily, appearance, SS, slightly alkaline

Source: (Bruggen et al, 2001 and EPA, 1998)

2. Literature Review

Ever since the beginning of humankind, people have been using colorants for painting and dyeing of their surroundings, their skins and their clothes. Until the middle of the 19th century, all colorants applied were from natural origin. Inorganic pigments such as soot, manganese oxide, hematite and ochre have been utilised within living memory. Palaeolithic rock paintings, such as the 30,000 year old drawings that were recently discovered in the Chauvet caves in France, provide ancient testimony of their application 54. Organic natural colorants have also a timeless history of application, especially as textile dyes. These dyes are all aromatic compounds, originating usually from plants

(e.g. the red dye alizarin from madder and indigo. The color removal rate in respect of concentration of bleaching powder is as shown in Figure 1 (from woad) but also from insects (e.g. the scarlet dye kermes from the shield-louse *Kermes vermilio*), fungi and lichens. Synthetic dye manufacturing started in 1856, when the English chemist W.H. Perkin, in an attempt to synthesise quinine, obtained instead a bluish substance with excellent dyeing properties that later became known as aniline purple, Tyrant purple or mauveine. Perkin 18 years old patented his invention and set up a production line. In the beginning of the 20th century, synthetic dyestuffs had almost completely supplanted natural dyes (Pandey and Carney, 1989).

Key environmental issues associated with textile manufacture are use of water, its treatment and disposal of liquid effluent. The risk factors are primarily associated with the wet processes desizing, scouring, bleaching, mercerizing, dyeing and finishing. Desizing, scouring and bleaching processes produce large quantities of wastewater. Treatment for color removal can increase the risk of pollution. For instance, treating azo-dyes results in production of amines which could be a greater environmental risk than the dye itself. It is reported that textile effluents is very low in terms of LC50 and exhibit very high toxicity with acute toxicity unit (ATU) levels between 22 and 960 (Novarro et al, 2001).

Table 2
Water pollution source and their ranking in Bangladesh

Industry	Water Pollution	Pollution Product	Ranking
Agriculture	Moderate	1.08	3
Textile	Big	3.35	1
Transport	Small	0.02	6
Construction	Small	0.14	5
Paper	Very big	0.67	4
Leather	Extreme	1.88	2
Sugar	Extreme	1.72	2

Dyes are contributing to overall toxicity at all processing stages. Also, dye baths could have high level of BOD, COD, color, toxicity, surfactants, fibers and turbidity, and contain heavy metals (EPA, 1998). They generally constitute a small fraction of total liquid effluent, but may contribute a high proportion of total contaminants. Note that textile effluents are highly colored and saline, contain non-biodegradable compounds, and are high in Biochemical and Chemical Oxygen Demand (BOD, COD) given in Table 3. It is reported that the presence of metals and other dye compounds inhibit microbial activity and some cases may cause failure of biological treatment system (Wynne et al, 2001). USEPA reported that the pollution parameters in textile effluents are suspended solids, BOD, COD, nitrogen, phosphate, temperature, toxic chemicals (phenol), chromium and heavy metals, pH, alkalinity-acidity, oils and grease, Sulphide, and Coliform bacteria (EPA, 1974). Pakistan Environmental Protection Agency also supported these and demands for their proper monitoring in the textile effluents in the country (PEPA, 2000). Textile effluents are high in BOD due to fiber residues and suspended solids (EPA, 1998). They can contaminate water with Oils & Grease, and waxes, while some may contain heavy metals such as chromium, copper, zinc and mercury (PEPA, 2000) Dyeing process usually contributes chromium, lead, zinc and copper to wastewater (Benavides, 1992) Copper is toxic to aquatic plants at concentrations below 1.0 mg/l while concentrations near this level can be toxic to some fishes (Sawyer and McCarty, 1978 and Nergis et al, 2005).

There are a lot of different kinds of industries in Bangladesh. All these industries have different waste problems^[6]. The index of the level of pollution is shown in Table 2.

3. Methodology of experimental works

3.1 Determination and presentation of color contents

Most water available to us is colored to some extent, due to the presence of various impurities (i.e. iron and manganese in association with organic matter from decaying vegetation). Impurities may be in the colloidal form in water or it may be in suspended state. Color caused by dissolved and colloidal matters, is called apparent color. Dyeing waste water may show color due to the presence of organic matters. Even the water is not harmful, it is not preferred by people for aesthetic reason. Also, disinfection by chlorination of waters containing natural organics (which produces color) result in the formation of problems which is major concern in water treatment. So it is important to limit the color of water for domestic supplies. According to Bangladesh environment preservation act (1997) drinking water standard for color is 15 units. Color is usually expressed in platinum-cobalt units (Pt-Co Units) which is based on the intensity of color produced by a solution of Platinum and Cobalt salts which is approximately yellow-brown in natural color^[2]. The sample has been compared with the color discs and the color is determined. How does this color changes with the concentration of bleaching powder, is shown in Fig 2.

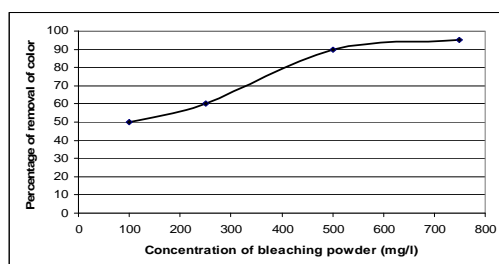


Figure 2. Concentration of bleaching powder vs percentage of color removal at 1st stage

3.2 Determination and presentation of Turbidity concerns (Rao and Datta, 1987)

The term “turbid” is applied to water containing suspended matter that interfaces with passages of light through the water or in which visual depth is restricted. Turbidity may be caused by a wide variety of suspended substance of various sizes ranging on size from colloidal to coarse particles, depending on the degree of turbulences^[4]. For filtration, turbid water is not suitable as it causes quick clogging of filter bed which necessaries the use of pre- treatment plant. Turbidity is also an important parameter in disinfections process. Disinfections are usually accomplished by means of chlorine, ozone, or chlorine dioxide. To be effective, there must be contact between the agent and the organisms to be killed. However, in cases in which turbidity is caused by dyeing wastewater many of the pathogenic organisms may be encased in the particles and protected from the disinfectant. Hence USEB has placed a maximum level of 0.5 to 1.0 units of turbidity, depending on the disinfection process used, as the maximum amount allowable in public water supplies. According to Bangladesh environmental Preservation Act (1997), drinking water standard for Turbidity is NTU. The current standard method for

measurement of turbidity upon instruments that employ the principles of nephelometry. In this instrument a light source illuminates the sample and one or more photoelectric detectors are used with a readout device to indicate light. It is customary to use a particular formazine suspension as a standard, or commercially available preparations may also be used. When using formazine standard, 40 NTU are equivalent to 40 Jackson candle turbidity units (JTU). Turbidities as low as 0.02 NTU can be determined by this procedure provided that water with sufficiently low turbidity can be obtained for use in instrument calibration. Samples with turbidities greater than 30 to 40 NTU are obtained. The turbidity is then determined by multiplying the measured factor.

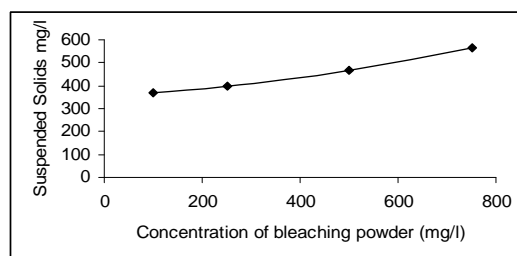


Figure 3. Concentration of bleaching powder vs suspended solid

3.3 Determination of Biological Oxygen Demand (BOD) ^[3]

When biodegradable organic matter /waste (the most common category of pollutant affecting surface water) is released in to a water body, microorganisms (especially bacteria) feed in the wastes, breaking in down to simpler organic and inorganic substances. When this decomposition takes place in an aerobic environment (i.e., in the presence of oxygen), it produces non-objectionable, stable end products (e.g. CO₂, SO₂, PO₄ and NH₃) and in the process draws down the dissolve oxygen (DO) content of water. Organic matter + O₂ → CO₂ + H₂O + new cells + Stable products . When insufficient oxygen is available or when oxygen is exhausted by the aerobic decomposition of wastes. Different set of microorganisms carry out the decomposition aerobically producing highly objectionable products including H₂S, NH₂ and CH₄: Organic matter + CO₂ → CH₄ + New cells + unstable products^[7].

The amount of oxygen required by micro-organisms to oxidize organic wastes aerobically is called biochemical oxygen demand (BOD) BOD, may have various units, but most often it is expressed in mg of oxygen required per liter of water/wastewater (mg/L). The total amount of oxygen that will be required for bio-degradation of is an important measure of the impact that a given waste stream would have on the receiving water body. Dissolve oxygen is the most commonly used indicator of the general health of a surface water body. If DO goes below 4 to 5 mg/L (due of decomposition of organic waste), forms of life that can survive began to be reduced. When anaerobic condition exists, higher life forms are killed or driven off. Noxious condition, including floating sludge, bubbling, odorous gases, and slimy fungus growth prevails. The biochemical oxygen demand (BOD) determination is an empirical test in which standardized laboratory producer are used to determine the oxygen requirement of wastewater, effluents and polluted waters. It has become a standard practice to simply measure and report the oxygen demand over a 5-days period, realizing that the ultimate oxygen demand (for complete degradation of organic matter) is considerable higher (and would take a much longer time to determine in the laboratory). The 5 days BOD or BOD₅ is the amount of oxygen consumed by micro-organisms during the first 5 days of biodegradation. In it simplest form, a BOD test would involved putting a sample of

water /wastewater into a Stoppard bottle, measuring the dissolve oxygen (DO) of the sample at the beginning of the test and again at the end of five days. The difference in DO would be the BOD₅ of the wastewater. Light must be kept out of the bottle to keep algae from adding oxygen by photosynthesis and the stopper is used to keep air from replenishing DO from outside. To standardize the procedure, the test is run at a fixed temperature of 20°C^[8].

Since the oxygen demand of typical waste is several hundred milligrams per liter, and since the saturated value of DO for water at 20°C is only 9.1 mg/l, it is usually necessary to dilute the sample to keep the final DO above zero. If during the five days of experiment, the DO drops to zero, then the test is invalid since more oxygen would have been removed had more been available. The five day BOD of a diluted sample is given by, $BOD_5 = (DO_i - DO_f)$. The relation involves in the various steps of the Winker Method dissolve oxygen (DO) determination are presented below:

Manganous sulfate reacts with potassium hydroxide in the alkaline potassium iodide solution to produce a white precipitate of manganous hydroxide: $MnO_4 + 2KOH = Mn(OH)_2 + K_2SO_4$

If the white precipitate is obtained there was no dissolved oxygen in the sample and there is no need to proceed further. A brown precipitate shows that oxygen is present and reacted with the manganous hydroxide. The brown precipitate is manganic basic oxide and formed as: $2Mn(OH)_2 + O_2 = 2MnO(OH)$. Upon the addition of (sulphuric) acid, this precipitate is dissolve, forming manganic sulfate: $MnO(OH)_2 + 2H_2SO_4 = Mn(SO_4)_2 + 3H_2O$. This compound immediately reacts with potassium iodide liberating resulting in the typical iodine (blue) coloration of the water : $Mn(SO_4)_2 + 2KI_2 = MnSO_4 + K_2SO_4 + I_2$

The quantity of iodine liberated by this reaction is equivalent to the quantity of oxygen present in the sample. The quantity of iodine is determined by titrating a portion of the solution with a standard solution of sodium thiosulphate solution. $2Na_2S_2O_4 + I_2 = Na_2S_4O_6 + 2NaI$. The experimentally obtained variation of BOD against the amount per litre of bleaching powder is shown in Fig 4 indicates how does it vary with respect to concentration of bleaching powder solution

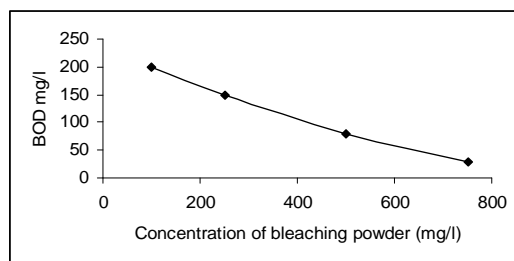


Figure 4. Concentration of bleaching powder vs BOD

3.4 Determination of Chemical Oxygen Demand(COD)^[4]

The chemical oxygen demand (COD) test is widely used as a means of measuring the organic strength of domestic and industrial wastes. This test allows measurement of a waste in term of the total quantity of oxygen required for oxidation to carbon dioxide and water. The test is based on the fact that all organic compounds, with a few

exceptions, can be oxidized by the action of strong oxidizing agents under acid conditions. During the determination of COD, organic matter is converted to carbon dioxide and water regardless of the biological assimilability of the substance. For example, glucose and lignin are both oxidized completely. As a result, COD values are greater than BOD values, especially when biologically resistance organic matter (e.g., lignin) is present. One of the chief limitations of BOD test is its inability to differentiate between biologically oxidizable and biologically inert organic matter. In condition, it does not provide any evidence of the rate at which the biologically active material would be stabilized under conditions that exist in nature. The determination can be made in about 3 hours rather than the 5 days required for the measurement of BOD. For this reason, it is used as a substitute for the BOD test in many instances. Potassium dichromate or potassium permanganate is usually used as the oxidizing agent in the determination of COD. Potassium permanganate is selective in the reaction and attacks the carbonaceous and not the nitrogenous matter. In any method of measuring COD an excess of oxidizing agent must be present to ensure that all organic matter is oxidized as completely as possible within the power of the reagent. It is necessary, therefore, to measure the excess in some manner so that the actual amount can be determined. For this purpose, a solution of reducing agent (e.g. ammonium oxalate) is usually used. The experimentally obtained variation of COD is presented in Fig 5 indicates how does it vary with respect to the concentration of bleaching powder solution^[8].

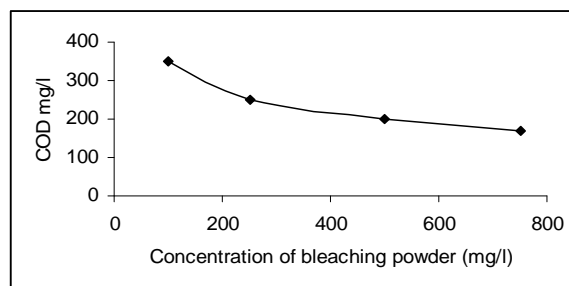


Figure 5. Concentration of bleaching powder vs COD

4. Sample Collection and Testing

Waste water was collected from different industries reactive dye water. The concentration of dye was 100 mg/l. Bleaching powder was used as an oxidation agent having chlorine content of about 30%. The bleaching powder grade was commercial grade. 0.1 N NaOH and 0.1 N H₂SO₄ was used for increasing or decreasing the pH of waste water respectively. In the 1st stage pH of waste water was kept constant (pH = 8.8) but dosages of oxidation agent (Bleaching powder) was varied. The dosage was varied from 100 mg/l to 750 mg/l. 2.5 gm of bleaching powder dissolved in the 500 ml distilled water. The concentration of bleaching powder of this solution was 5000 mg/l. The 1st stage of the batch studies were done by jar test apparatus with 100 ml of waste water in the different beakers and then adding the stock solution of bleaching powder 10 ml, 25 ml, 50 ml and 75 ml to obtain the concentrations of bleaching powder which were 100 mg/l, 250 mg/l, 500 mg/l and 750 mg/l respectively. In the 2nd stage bleaching powder concentration was kept constant (500 mg/l) but pH of waste water was varied. Variations of pH were done by adding the acid (0.1 N H₂SO₄) or alkali (0.1 NaOH) in the waste water as required.

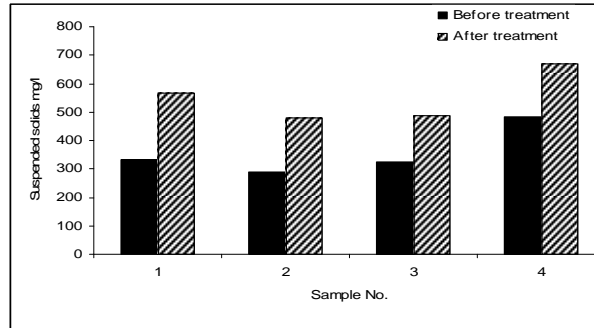


Figure 6. Amount of suspended solid present before and after the treatment

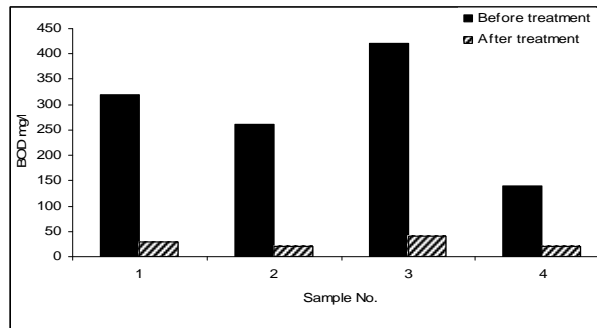


Figure 7. Amount of BOD before and after the treatment of wastewater

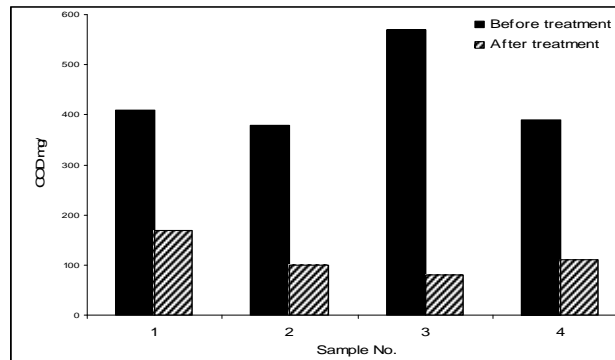


Figure 8. Amount of COD before and after the treatment of wastewater

5. Appraisal of results

Generally the effluents characteristics need to be properly monitored for better environmental protection. All the textile mills had their effluents had temperatures between 34.7°C and 48.8°C, which are higher than the set limit by the National Environmental Quality Standards (BEPA, 2000), the pH range 7.85-11.52, calls for more attention. These effluents were basic in nature. The colors of all the effluents were very high in concentration. They ranged from 612-4637 Pt-Co with effluents from some of the Textile mills having values above 100 Pt-Co. With the exception of wastewater from some other Textiles that have a TDS concentration of 3040 and 1056 mg/L the other

effluents had TDS levels higher than the acceptable limit of 3500 mg/L. Though the total suspended solid level in the effluent samples from some Textile mills could be acceptable, the effluents from the other Textile had TSS levels more than 2 folds of the acceptable limit. Both measured BOD and COD levels also exceeded the set limits by about 2 and 10 folds respectively. Apart from two Textiles, the sulphide levels in the effluents were high (1.58-3.14 mg/L) as against the standard limit of 1 mg/L. Except one Textile. Ammonia levels were within limits in almost all effluents 6.82-34.8 mg/L. Oil and grease was detected in the effluents from five Textiles, were below the 10.0 mg/L NEQS limit while in four Textiles has higher than the limit. Heavy metals concentrations were higher than the set limits in the effluents. Effluents samples had copper levels range between 0.07-5.14 mg/L as against lower set (less than 1.0) limit. While chromium was ranging between 0.5 to 1.57 mg/L, Two Text have high concentration of 1.57 and 1.07, set limit is 1.0 mg/L, in six of the textile effluents. Similarly Mn, Fe, and Zn concentration are within the limits except in two. Mercury was not detected in all the samples tested.

6. Important Precautions that should be adapted in dyeing for pollution abatement

Benzidine-based azo-dyes should not be used at all. Carriers containing chlorine should not be used Reduction of dyes by sulphide should be avoided. Dichromate oxidation of vat dyes and sulphur dyes should be substituted by peroxide oxidation Azo-dyes which can, under reductive conditions, release aromatic amines, which are suspected carcinogens, should not be used. Halogenated solvents and dispersants for dyes and chemicals should be substituted where possible by water-based systems Metal containing dyes (Cu, Cr, Ni, Co, etc.) should be Substituted by other dyes or techniques In order to minimize the discharges of BOD, COD, etc. as well as of colored substances in case of repeated dyeing, the rinsing bath should be used as next dye bath, it the after-treatment chemicals are compatible with the dye bath chemicals. Wastewater generated from dyeing, should receive a dedicated treatment to remove the persistent pollutants.

7. Conclusions

From the experimental results, it has been found that color removal efficiency is well approximately 90%. Before conducting the treatment, the characteristic of effluent of dyeing industries in respect of suspended solids were found within the range 289 mg/l to 458 mg/l and biochemical oxygen demand within the range 1400 mg/l to 420 mg/l, and the chemical oxygen demand within the range 380 mg/l to 570 mg/l. After having the treatment the characteristic is found to be, in case of suspended solids, is within the range 43 to 139 mg/l, in case of biochemical oxygen demand within the range 20 mg/l to 40 mg/l and in case of chemical oxygen demand within the range 80 mg/l to 170 mg/l. It is seen that in the 1st stage, with the increase of concentration of oxidation, the color removal rate was also increased. But in the second stage, it was seen that the color removal rate was increasing with the increase of pH, but finally, it was found that the pH level was very high which is harmful for our environment. So, we should not follow the 2nd stage treatment procedure. BOD₅ and COD were decreasing with the increase of oxidizing agent and which is not hazardous for our environment. But in our experiment of suspended solids, it was increasing with the increase of oxidizing agent and which is treated as activated sludge system and forms as solid and which is not harmful for our environment. We know the standard values of pH, BOD₅, COD and SS for Bangladesh water, which are 6.0 - 9.0, 50 mg/l, 200 mg/l and 150 mg/l respectively. So, the qualities

of effluents, were found grossly below the set limits given by the Bangladesh Environmental Protection Agency and some world bodies like the World Health Organization in all textile mills. Lower levels of some of these parameters found in a Textile mill (with effluent treatment plant) when compared to the other four Textiles (with no effluent treatment plant) indicate that uniform characteristics are attainable for all the effluents if a measure of treatment could be introduced at textile mills. The experimental results also show that air quality of the area covered by the entire city could be negatively affected by both the gaseous emissions and particulates that are released from the effluents. In addition, incorporation of appropriate heavy metal recovery plant could be proposed that could be of great advantage for environmental protection, especially, around the river banks where animals do concentrate. The impacts around these banks will be very much if adequate measures are not taken before the final discharge.

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