

The Environmental Impacts of Textile Dyeing Industries in Bangladesh

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Abstract— For the developing countries, textile sector is a great asset for their economic specially in the South Asian countries. Behind the story of gorgeous, fashionable dresses, there are lots of stories are going on. Consumer smiles when he/she wears a new dress. But, there is a great environmental impact even in making a new single garment. The growth of Bangladeshi RMG sector is associated with different environmental issues due to the dyeing industries. Different dyes, chemicals and fixing agents are used in dyeing of textiles. Synthetic dyes comprised with sulphur, naphthol, vat dyes, nitrates, acetic acid, soaps, enzymes chromium compounds and heavy metals like copper, arsenic, lead, cadmium, mercury, nickel, cobaltic and certain auxiliary chemicals all collectively make the textile effluent highly toxic. The ecosystem of Bangladesh is greatly affected by this. The rivers, soil and air are being polluted. The COD, BOD, SS, alkalinity, Chlorine, DO, TDS, EC are not in the range of EQS standard for surface of the rivers. In this study, water samples from the top five polluted rivers were collected, then different quality parameters were tested and later the effect of environment has been discussed. The outcome of the result shown that, the surface water quality of those five rivers are being greatly polluted by the textile industry's effluents. Some parameters have crossed the limit of EQS standard which are also harmful to the ecosystem as well as human body.

Keywords— COD, BOD, SS, TDS, EC, Textile effluents, Hazardous substances.

I. INTRODUCTION

According to a recent industry report, Fashion Apparel and footwear industries currently account for 8 per cent of global greenhouse gas emissions which is nearly as much as that of the whole European Union. In another report, The United Nations estimates that fashion industry is responsible for 10 percent of total global emissions. The statistics show that by 2030, the climate impact of the apparel industry alone is forecast to nearly equal today's total annual US greenhouse gas emissions, emitting 4.9 giga-tonnes of carbon dioxide equivalent (Taylor, 2018).

Textile production produces 1.2 billion tonnes of greenhouse gas every year, according to the Ellen MacArthur Foundation. The United Nations estimates that 10 percent of total global emissions come from the fashion industry. The impact of textiles and clothing industry on the environment is becoming worse day by day. Different dyes and mordents are used to produce toxic chemicals pollute waterways. Besides, textile fibers come from the natural sources i.e wood-based fabrics like rayon, modal and viscose contributes to

deforestation. When polyester fabrics washed in domestic washing machine, shed of microfibers get mixed with into drinking water and aquatic food chains (including in fish and shellfish eaten by humans) (Schipani, 2019).

Case Study

One of the biggest garments manufacturing countries is Bangladesh. According to the World Trade Organization (WTO), Bangladesh is the second largest Ready Made Garments Exporter in the world contributing 6.5 percent of global apparel market share. In 2017, Bangladesh exported garment items worth of \$29 billion. Bangladesh is a nature of beauty and called country of rivers. But unfortunately, many of these rivers are highly polluted by the hazardous effluents of textile dyeing industries as almost 50 percent of textile dyeing industries have not proper Effluents Treatment Plant (ETP). Their dyeing effluents directly or indirectly flows to these rivers. Water quality of those rivers are highly effected by these hazardous untreated dyeing effluents. The survey was done on five big rivers Buriganga River, Shitalakkha River, the Turag River, the Dhaleshawari River and Brahmaputra River which are being mostly polluted by the textile dyeing industries in the Bangladesh.

The water from those rivers are being collected and tested. The testing of the water quality was done in the lab of Department of Environment, Ministry of Environment and Forests, Government of the People's Republic of Bangladesh. Some data on water quality of top five polluted rivers has been collected. Some data from the area of Textile polluted area are shown in the below table.

Result Analysis:

The pH in all the rivers are in between the standard one, so its not an issue of discussion. pH is under control due heavy raining in the monsoon season. Dissolved oxygen is in good condition for the rivers Buriganga River, Shitalakkha River And the Turag River. But for the Dhaleshawari River and Brahmaputra River, it is not in the acceptable range which are 20.4 mg/L and 7.5 mg/L respectively and those are higher than the European Quality Standard (EQS) (≤ 6 mg/L) set by the European Union.

TABLE 01: Sample water quality parameters of five major polluted rivers in Bangladesh

Parameter	EQS Standards (mg/L)	Buriganga River	Shithalakkha River	Turag River	Dhaleshawari River	Brahmaputra River
pH	6.5-8.5	6.58-7.98	6.5-8.5	6.14-8.79	6.7-8.78	7.08-7.98
Dissolved Oxygen (DO)	≤6	5.7	5.5	5.9	20.4	7.5
Biological Oxygen Demand (BOD)	≤6	35	18	86	17	8
Chemical Oxygen Demand (COD)	200	124.3	69.28	233	53	-
Total Dissolved Solids (TDS)	2100	639	484.2	804	129.7	280
Chlorine	600	5.9	35.98	129.7	21	7.99
Alkanity	150	344	170	280	476	150
Electrical Conductivity (EC)	1200 (µmhos/cm)	1238	930	1682	992	366
Suspended Solid (SS)	150	100	76	-	-	56



Figure 01: Samples water test tube of five rivers

A=Buriganga, B= Turag, C= Shithalakkha River, D= Dhaleshawari River, E= Brahmaputra River

Biological Oxygen Demand (BOD) is higher for every rivers than the standard which is an important water quality factor. The chemical Oxygen demand is in standard range for the all the rivers except Turag (233 mg/L) due to highly polluted by the textile effluents. TDS and Chlorine is in between the standard one. Alkanity is higher for all of those rivers. Electrical Conductivity (EC), is under the EQS standard (1200 µmhos/cm) Shithalakkha River, the Dhaleshawari River and Brahmaputra River. It is high for the Buriganga River and Turag River which are 1238 and 1682 respectively. Suspended Solid (SS) for all the rivers is under the tolerance level (150 mg/L),

Effects on Environment:

There are different sectors which are being polluted by textile waste and its hazardous chemicals. Some aspects are discussed below.

Soil pollution: The soil is polluted by the textile waste in different ways. Without soil, plant, bushes, crops can be grown. Crops and plants take nutrition and water from the soil. So the quality of the crops depends on the quality of the soil. The lower lands become more polluted by the textile waste compare to the higher lands. The use of water flows for irrigating agricultural land is worldwide practice. Generally it is very common in developing countries, where it is expensive for the farmer to take water from other sources. They normally depend on the rivers, canals for water to irrigate their lands. Water of from these sources often get polluted by the textile effluents. When the farmer irrigate their lands by this water, hazardous substances like heavy metal like Cu, Pd, Cd, Zn etc get mixed with their land soil. Besides, irrigation with sewage

effluents provides with water organic and inorganic matter like nitrogen (N) and phosphorus (P) to the soil. These are beneficial for the soil, but at same time sewage disposal at the same time it provides a convenient mean of sewage disposal through land treatment. This uncontrolled flow of waste water cause health and environmental hazards.

Air pollution: Most processes performed in the textile mills produce atmospheric emissions are produced in most of the textile mills. After waste effluent pollution, gaseous emissions is considered the second greatest pollution in textile industry. Normally in the finishing stages, most of the air pollution occurs. Because, finishing stages relate with coating of the fabrics where different chemicals, lubricating, coating materials, plasticizers, paints and water repellent chemicals essentially, organic compounds such as waxes, oils or solvent, acid vapor, odors and boiler exhausts are used (Mahmoud, 2007). These elements get mixed with the atmosphere or air in vaporous form while they are processed in high temperature in the finishing stages of textile. Besides, the cleaning and production produces extra sludge and waste which in sludge in the tanks with process chemicals. This may contain toxic compounds and metals (Modak,1991).

Solid waste pollution: The primary residual wastes are non-hazardous which is generated from the textile industry. These include packaging waste, scraps of fabric and yarn, off-specification yarn. Some wastes are also generated from the storage and production of yarn sand textiles, such as chemical storage drums, cardboard reels for storing fabric and cones used to hold yarns for dyeing and knitting. High volume off fabric scraps are generated from the cutting room, which can often be reduced by increasing fabric utilization efficiency in cutting and sewing. (Chokalingam et al., 2009).

Hazardous waste: In the textile processing, a large amounts of textile effluents produced and those textile effluents contain organic and inorganic compounds (Elliott, et al.,1954). In dyeing processes, different dyes are applied on the fabric, some dyes are fixed permanently on the fabric and some portion of dyes are washed out. These unfixed dyes contain high concentration of textile effluents (Hassaan & Nembr, 2017). Different dyes and chemicals exist into these effluents, some of which are non- biodegradable and carcinogenic. Those are a major threat to health and the environment. To treat these effluents, several primary, secondary and tertiary treatment processes like flocculation, trickling filters and electro dialysis are being used. But unfortunately these treatments are not so much effective to remove all those dyes and toxic chemicals (Eswaramoorthi, et al., 2008). When it is

the environmental impact of textile pollution, Bangladesh can be an example which is one of the leading textile manufacturing country.



Figure 02a: Waste water disposal into river from textile (Source: WIN, 2017)



Figure 02b: Waste water affect directly to the industries in Bangladesh (Source: Yardley,J., 2013)

Maximum of the textile industries are located in the North Central region in Bangladesh which account for just under half of the total sector. About 33 per cent of the industries in the North Central region are textiles, finished garments and tanneries of which Dhaka district (Gazipur, Savar, Ashulia, Tongi, Mirpur) accounts for almost half and Narayanganj for about 32 percent. A large among of textile industries, dyeing mills, pharmaceutical plants are situated just beside the bank of the Turag river. Solid waste and effluent are regularly dumped into Turag river by these industries. Thus the water of Turag is being polluted. The water in Turag has almost lost its quality for the living fish. The water is dark in colour and has no strong odour. Besides, the old and new EPZ zones were established in Savar which is one of the largest industrial belt in Bangladesh. There are over 100 textile industries including local and foreigner industries in this belt and where most of them are textile and dyeing industries. Everyday, the

industries of Savar generate a large amount of effluent which are being directly discharged into the surrounding land, agricultural fields, irrigation channels and surface water and finally enter into the river.

Another industrial zone in Bangladesh is Narayanganj zone. Naranganj is known as river port town. Shitalakshya River flows in a southwest direction and then east of the city of Narayanganj. Moreover many textile industries are situated along side of the river. Most of them are dyeing/printing factory. Many of these industrial units drain out their effluents directly into the river Shitalakkhya. Others drain out effluents into nearby irrigation canals, water bodies and crop fields (H.R.Textile Mills Ltd. (2008). In Bangladesh, most of the industries haven't any Effluent Treatment Plant (ETP). So, after textile processing like dyeing, the effluents get directly mixed into the land or river water. This effluents contain high amount of heavy, medium metal which is already discussed. Normally mordents are used in dyeing process as a fixing agents. Most of the mordents contain Chromium (Cr). Besides in dyes, it is found different heavy metals like Na, Fe, Cr, Pb, Mg, Na, Zn, Ni, Cu etc. At different time, the water samples from point sources, upstream areas and rivers were collected and analyzed by Bangladesh Water Development Board (BWDB) for Na, K, Mg, Ca, Fe, Cu, Cd, Cr, Pb, pH, Temperatures, DO, BOD, COD, Total hardness, Total alkalinity, EC, Chloride, TDS, TSS. Most of the values are far from the standard value which is set by the Government of Bangladesh.

Moreover, most of the parameters were highly intolerable at the point source to discharge points. When these waste water get mixed into water, land and river water are being polluted highly. People of Bangladesh are greatly dependent on river. There are almost 700 rivers including small river in Bangladesh. Rivers are a great source of fish. For this pollution from textile industry, these rivers are being polluted and the bio life of the rivers are effected highly. The quantity of fish from these river are being reduced day by day. The fish population are being affected seriously by the deadly poisonous toxic industrial effluent and the farmers are also losing their crops, fruits and vegetables because the surrounding lands have become unsuitable for cultivation.

Effects of Hazardous Waste on Human

Besides, different types of birds and animals also live on these rivers. Their lives are also being affected. Moreover, during flood river water get mixed with the farming land. Thus farming land are also being polluted. These effect the crops. The environmental pollution caused by textile wastes significantly effects of the healthof flora and the general health of the residents of the area or the peoples using marine foods. Inorganic heavy metals has a good affinity towards water and heavy inorganic metals, like Cd, Cu, Cr, Fe, Mn, Ni, Zn in ionic salts are directly absorbed by the marine and fresh water. They can be also incorporated in ground water in both cases. These ground water and the marine foods are extensively used by human being. When they drink or take food from this polluted sources it may cause diseases like cancer, tumor, brain diseases, psychiatric diseases, sexual diseases etc.

TABLE 02: Some effect of water pollution (Source: Imtiazuddin, S.M., 2018)

No	Process	Chemical discharge	Pollutants	Health effects
1	Sinzing	Benzene, Starch, PVA, Gum.	Resin, Fats, Wax, Starch and Glucose.	Carcinogenic, Mutagenic & effects central nervous system.
2	Bleaching	Hydrogen, NaOH, Detergent	Wax, Sodiumsilicate, Caustic	Prolonged exposure with effect Kidney and lever
3	Dyeing	Sulfate, Salt	Dyes, Sulfate, Urea	Eye & respiratory problem.
4	Printing	Nitrate, Phosphate, Dyes	Starch, Gum, PVAPigment, Colors	Harmful health hazards
5	Finishing	Fats, Silicone	Starch, Finishing Agent	Suppression of hematological system

Moreover, aquatic toxicity of the waste water generated from the textile industry varies considerably among production facilities. The sources of aquatic toxicity can include salt, ionic metals and their metal complexes, surfactants, biocides, toxic organic chemicals and toxic anionic. Low aquatic toxicity is found in most textile dyes (Imtiazuddin et al., 2012). Some dyes and pigments of organic nature are classified as toxic chemical such as C.I. Pigment Yellow-12 (3,3-dichloroBenzedine), C.I. Disperse Yellow-7 (P-Amino azobenzene), C.I. Direct Yellow-1 (Benzedine) etc. Additionally salt, alkalis, acid, bleaching and finishing agent are also highly harmful and effect the health of biota to a great extent. The effects of the pollutants may not be immediate result but gradually it affects the human being (Babu et al., 2007).

II. CONCLUSION

The study shows that the untreated textile dyeing effluents directly affects the surface water of rivers, soil as well as the ecosystem. In the long term which causes different diseases in human body as well as other living animals or fishes. The important factor of water COD, BOD, SS, TDS, DO, EC, alkanity, pH and some heavy metals like Cu, Cr, Fe, Mn, Ni, Zn in ionic salts some cases excess the EQS standards. That is a major warning for the environment. Many industries don't have Effluent Treatment Plant to treat their dyeing effluent. Government should monitor the textile industries whether they are following the government's guidelines. Besides, now European Union is also much concern towards the environment impacts and imposing different guidelines and standards which have to be followed by the fashion retailers brands who are importing Ready made garments from those manufacturing countries. Nevertheless, there should be brought up some changes in the dyeing processes. Latest technology and research results have to be implemented in dyeing manufacturing processes such as technologically improved dyeing machine where M:L ratio, better cotton which consumed less water during dyeing can be applied. Moreover, consciousness among the consumers, suppliers and fashion buyers are more important to bring up the sustainability in the textile dyeing industries.

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