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# Waste Water Production in Fabric Processing in Bangladesh

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**Abstract**

Textile industry is one of the fastest growing industries and significantly contributes to the economic growth in different developing countries like Bangladesh, India, Pakistan, Srilanka, Vietnam etc. At the same time, this industry has high water consumption (one of the most water consuming industries) and subsequently produces a large amount of waste water containing high load of contaminants. Such waste water may be environmentally hazardous because of many toxic substances including lead, mercury, and arsenic, etc. This paper reviews the current scenario of water consumption by the textile industries in Bangladesh. It has also identified the quantity of consumed water in different textile processing and the amount of textile waste effluent, characteristics of this effluent and its effect on the environment are reviewed in details. In this study, some of the data have been collected from the online journals and experimental data has been collected from a textile dyeing manufacturing industry (Interstoff Apparels Ltd., 1703-Gazipur, Bangladesh). Besides, total consumption of water on different activities and fabric processing have been shown and analyzed. The result of this study gives a clear idea that different internal activities are also responsible for a huge amount of water consumption in a textile industry. At the end, some recommendations have been suggested which can be applied in the reduction of water usage in textile footprint.

**Keywords:** Effluent, Dyeing, ETP, COD, BOD, CmiA cotton, BCI cotton

## Introduction

We can identify textile industry as a multiple industrial chain in manufacturing industry. Textile production includes such stages as spinning, knitting, weaving, and garment production, which also includes the wet treatment processes like sizing, desizing, scouring, bleaching, mercerizing, dyeing, printing and finishing operations. There is a strong interrelation between consecutive wet treatments and dry processes.

Generally water consumption varies depending on the various types of fabrics and dyeing industry. It also depends on the processes which are used in the dyeing process. In fact, it has been found that during bleaching process 38 % of water is used, in dyeing 16%, in printing 8%, in boiler 14% and 24 % for other uses (Ntuli et al., 2009). So, we can see, in those processes, considerable amounts of polluted water are released. The fact is that the water which is let out after the production of textiles is well beyond the standard and contains a large amount toxic chemicals and dyes which are harmful to the environment. In textile fabric processing, the various types of waste water is produced mainly in the stages sizing, desizing, scouring, bleaching, mercerizing, dyeing and finishing. South Asian countries are one of the major textile suppliers for the apparel buyers. In India, water consumed by textile industries was around 1900 $Mm^3$ (Million cubic meters) in the year of 2010 and effluent water generated was around 75 per cent of its intake (Kumar & Stephan, 2013).

There are 4560 textile industries in Bangladesh (2017-18) (BGMEA, 2018). The number is increasing day by day. There are 500-700 wet processing units in Bangladesh (Sargis & Abbot, 2015). Nevertheless the amount should be more. It was estimated that around 1,700 wet processing units in Bangladesh were dedicated to the washing, dyeing, and finishing (WDF) of textiles (ADSL & SEDF, 2009).

The main four manufacturing processes of the textile and garment manufacturing are yarn production, fabric production, wet processing and garment production. The WDF textile units are responsible for imposing the largest environmental footprint of the industry due to intensive fresh-water abstraction for dyeing, washing and finishing. A large volume of wastewater is generated along with extensive use of hazardous chemicals and high energy use for heating of water and steam generation.

Water use of the textile units in Bangladesh is estimated to be around 250-300 L/kg fabric produced, which is equivalent to daily water use for two people (Restiani, 2016). For a typical textile industry, the water consumption in different wet processing processes is given in the below table. The total water consumed during wet process and the water usage of different purposes in a typical cotton Bangladeshi textile mill and synthetic textile processing mill is given in table 1 and table 2 respectively.

**Table 1. Water consumption in different wet processing processes (Garrett et al., 2010)**

| **Activities** | **Water consumption** | | **Effluent** |
|---|---|---|---|
| | **Variation** | **Average** | **Variation** |
| Sizing/slashing | 50-820 | 435 | 50-80 |
| Desizing | 250-2100 | 1175 | 250-2100 |
| Bleaching | | | |
| e.Yarn (hypochloride) | 2400-4800 | 3600 | 2250-4600 |
| f.Yarn (H2O2) | 2400-3200 | 2800 | 2250-3050 |
| g.Cloth (hypochloride) | 4000-4800 | 4400 | 3800-4600 |
| h. Cloth (H2O2) | 1700-3200 | 2450 | 1700-3200 |
| Mercerizing | 3600-17000 | 10600 | 3500-17500 |
| Dyeing | | | |
| g. Yarn (light & medium shade) | 3600-4800 | 4200 | 3500-4700 |
| h. Yarn (dark shade) | 4800-6400 | 5600 | 4700-6300 |
| i.Yarn (very dark shade) | 6600-8800 | 7700 | 6500-8700 |
| j. Cloth (light & medium shade) | 7800-9600 | 8700 | 7700-9500 |
| k. Cloth (dark shade) | 10400-12800 | 11600 | 10300-12700 |
| l. Cloth (very dark shade) | 14300-17600 | 15950 | 14200-17500 |

Certain simple operations such as sizing requires less water, while others with sequential operations such as dyeing many washings and rinsing, requires large quantities. The quantity of water will vary depending on the material processed and requirements of finish. Water consumed not only in the dyeing process but also in the different activities and energy production such as in steam generation, cooling water, sanitary etc.

**Table 2. Water usage of different purposes in a typical cotton textile mill and synthetic textile processing mill (Chougule M.B, 2018)**

| Sr. no | Purpose | Percentage water use | |
|---|---|---|---|
| | | Cotton Textiles | Synthetic Textiles |
| 1 | Steam generation | 5.3 | 8.2 |
| 2 | Cooling water | 6.4 | - - |
| 3 | Deminerelized water for specific purpose | 7.8 | 30.6 |
| 4 | Process water (Raw water) | 12.3 | 28.3 |
| 5 | Sanitary use | 7.6 | 4.9 |
| 6 | Miscellaneous and Fire fighting | 0.6 | 28.0 |

**Materials and Methods**

For practical data, I have visited the Interstoff Apparels Ltd. ( Gazipur-1750, Bangladesh) to collect data on dyeing machine, capacity of dyeing machine and consumption of water in dyeing process. Some data has been collected from the Technical Services Department (TSD) of Interstoff Apparels Ltd. Besides, data is collected on different activities such as water usages in toilet, car washing, floor cleaning, cooling, steam generation are also considered. The method of data collection was manually which is directly taken from the specific department of the industry.

***Consumption water by dyeing machine***

**Table 3. Machine Capacity of the dyeing machines (Interstoff Apparels Ltd.)**

| S.L | Machine Capacity(Kg) | No. of Machine | Capacity(Kg) |
|---|---|---|---|
| 01 | 1500 | 1 | 1500 |
| 02 | 1000 | 3 | 3000 |
| 03 | 750 | 2 | 1500 |
| 04 | 600 | 1 | 600 |
| 05 | 500 | 1 | 500 |
| 06 | 450 | 1 | 900 |
| 07 | 300 | 1 | 300 |
| 08 | 250 | 1 | 250 |
| 09 | 150 | 1 | 150 |
| 10 | 100 | 1 | 100 |
| 11 | 60 | 1 | 60 |
| 12 | 30 | 5 | 150 |
| 13 | 10 | 1 | 10 |
| Total Machine Capacity | | | 9020 |

The calculation for the consumed water for the dyeing fabric is given below:
No. of batch per day = 2 times
Machine Efficiency = 80%
Total Machine Capacity= 9020Kg/day (from the table 3)
So, Dyeing Capacity = 9020Kg/day x 2 times x 80% = 14,432Kg/day
Now, Liquor Ratio = 1:8
Average no of Bath = 12

Amount of water for Dyeing = 14,432 x 8 x 12 (for 14,432Kg/day fabric) = 1385.472$m^3$/day = 57.73$m^3$/hr.

Water used in Blower blow down and others = 50$m^3$/day = 2.5$m^3$/hr.

So, total amount of wastewater produced in dying process = 1,435.47$m^3$/day = 59.81$m^3$/hr.

***Consumption of water in different activities***

Not only the processing steps of fabric are consumed water but also other internal activities within the industry require water. The calculation for the consumed water for the different activities is given below:

Water Calculation for Toilet Flushing:

Total no of employee and worker = 4500 person.

Water require = 30 liter per capita per day (Working hours = 12 Hr.)

So, amount of water required = 4500x30 liter/day= 13500 liter/day = 135 $m^3$/day

Water Calculation for Car Washing:

Total No of Car = 30

Water require = 200 liter per car.

So, total amount of water for car washing = 30x200 liter/day = 6$m^3$/day.

Water Calculation for Floor Washing:

Area of Total Floor (Dyeing + Washing) = 349,400sft.

Water require = 0.20 liter per sft floor area.

So, total amount of water require for floor washing = 349,400 x 0.20 sft/day = 69.88 $m^3$/day.

Water required for Washing Process = 426.86 $m^3$/day (data taken from the Washing unit)

Water required for ETP Chemical Tank =10 $m^3$/day (data taken from the ETP unit)

Water required for Chemical Drum Washing = 5 $m^3$/day

Water required for Fire Fighting (On Demand) = 6 $m^3$/day

Water required for Road Watering = 4 $m^3$/day

Water required for Cooling Pad = 30 $m^3$/day

So, total water used in different activities =135 $m^3$/day +v6$m^3$/day +v69.88 $m^3$/day+ 426.86 $m^3$/dayv+10 $m^3$/day + 5 $m^3$/day + 6 $m^3$/day + 4 $m^3$/day + 30 $m^3$/day = 692.74 $m^3$/day

***Wastewater Recycling***

The ETP capacity of the industry is 75 $m^3$/hr. But for safety margin, the factory has ensured 62.5$m^3$/hr or 1500$m^3$/hr. flow rate of the waste water to the ETP (Effluent Treatment Plant) plant. That means 1500 $m^3$ of waste water can be recycled in the ETP plant in a day. 1,435.47 $m^3$ of waste water is produced in dyeing process and the entire quantity is recycled in the ETP plant. \About 54% of recycled water is exposed to the environment and rest of the 46% of recycled water is reused again in dyeing process.

Total amount of total recycled water = 1,435.47$m^3$/day

The amount of total recycled water used water used =46% x1,435.47$m^3$/day=660.32 $m^3$/day = 27.51 $m^3$/hr.

**Treatment Process:** Modern technology is used in the ETP mechanism so that the water can be recycled and purified completely. Treatment of waste water is done in different segmentation

such as Treated Water Reservoir cum Sedimentation Tank, Filter Feed Pump, Multistage Filter, Activated Carbon Filter, Softener Unit, Flocculation, Lamella Clarifier, RO & Micron Filter Feed Sump, Micron Filter, Reverse Osmosis Reservoir, UV Sterilizer.

**Results and recommendation**

So, it is clear that day by day the consumption of water and pollution from textile industry is increasing. The study shows that in different activities in a fabric dyeing industry a large amount of water is consumed. Most of the water used is clean water and it doesn't need to be recycled to purify. Moreover, in every stages of textile processing, a large quantity of water is used. Besides, the quantity of virtual water footprint in cotton production is so much higher than in other productions. A huge amount of textile waste effluent is produced during different textile operations. The effluents are varied based on type of textile industries.

The main task of this research was to identify the present scenario of water consumption in the textile industries. The textile industry management is now much conscious about the Environment effect compare to the previous situation. But still, the environment pollution is getting worse day by day due to water pollution. These effluents carry toxic compounds like chromium compounds lead, cadmium and heavy metals like copper, arsenic, cobalt, mercury, nickel, and certain auxiliary chemicals, COD (Chemical Oxygen Demand) and BOD (Biological Oxygen Demand). Very often those harmful compounds get mixed with the environment and can harm the aquatic environment in many ways. These effluents are being treated by ETP (Effluent Treatment Plant) to separate the toxic chemicals. But, in real case, many industries are not using properly the ETP.

Here are some recommendations which will help to minimize the usage of waste water in textile processing.

**Raw materials**: According to WWF, it can take up to 2,700 liters to produce the cotton needed to make a single t-shirt. The Better Cotton Initiative (BCI) is trying to minimize this environmental impact by educating farmers on reducing water and pesticide use. Besides, different research on cotton is going on and some species of cotton is discovered which need less water to be produced such as BMP cotton, CmiA cotton, Clear cotton, BCI cotton.

**Technology:** To minimize waste water production, modern machine (low M:L ratio) with modern facilities & modern technologies have to be implemented in the production processes. Meanwhile, Novzymes has been working on creating water savings in textile processing. They are researching on different innovative enzymes which accelerate the dying process and with presence of this enzymes, dyeing process can be done with less water. Novzymes's global marketing director Peter Faaborg, says that enzymatic textile processing can save up to 25% of the water traditionally used in cotton textile manufacturing. Textile industries should adopt advance ETP plant dropping the conventional ETP. Modern and functionally advanced ETP plant has more efficiency. Besides, they are more cost effective.

.**Proper enforcement of environmental law**: Every country has its own laws in regards environment. The government of this textile processing countries should take more strict decision to establish the environment law. All the industries should be brought under proper monitoring system. The inspection from the concern department should be carried out in a regular basis. Moreover, the industries which are disobeying the environment rules, discharging their waste effluents directly to the environment without purifying it, should be punished and fined.

**Fashion Retailers:** Fashion brands can influence sustainable water use beyond factory walls. As fashion buyers, those fashion retailers have some ethical value towards the environment. They can educate and train the factory management and workers on sustainable water and energy. They can stop sourcing from the factories which are not breaking the environment rules. Moreover,

they can take different initiative steps. For an example, Levi's recently worked with one of its Chinese suppliers to make 100,000 pairs of jeans using 100% recycled water.

**Conclusion**

From the study it is clear that the present scenario of water consumed in textile industry in Bangladesh is increased day-by-day. Almost every step of fabric processing consumes a huge amount of water. Not only in fabric processing but also in different activities in industry like cleaning (floor, car etc), washing different things (chemical drums, chemical tanks etc) cooling, road watering water is used. Most of the textile industry in Bangladesh has ETP but often textile effluents containing hazardous toxic chemicals are directly exposed to the environment due to lack of proper monitoring by the government. Although some standard has been set up which should be followed but the industries are not following strictly these standards. With proper monitoring by the law enforcement agency, consciousness among the manufacturers, fashion retailer and consumer as well as development in fabric processing technology and research in cotton development, the amount of consumption water can be reduced.

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