Orinigal Article

A Study on the Performance Evaluation of Roughing Filter on Textile Effluent

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Abstract: An important part of Bangladesh's economy is being played by the industrial sector's rapid growth. Bangladesh's Ready-Made Garments (RMG) industry has become the country's top foreign currency generator in recent years. These textile and dyeing industries are now seen as a massive environmental hazard in the industrial area of Bangladesh due to environmental concerns. This study has evaluated the textile effluent's quality and establish how a roughing filter would perform if it is positioned between treatment plant systems. A cylindrical up-flow vertical roughing filter was made with a 14" diameter and 24" height. Three layers of various grade materials measuring 2" each make up the 6"-high filter bed. The filter bed is also hollow cylindrical, with an outer diameter of 14", an inner diameter of 6", and a height of 10". Three layers of bed with stone chips are used in roughing filter. At bottom layer 18mm dia stone chips, middle layer 12mm dia stone chips and top layer 10mm dia stone chips were used. The height of each layer is 2 inch therefore total height of filter bed is 6 inch. It has two taps, one for filtered water and another for sledges. The two textile factories in Dhaka city, which samples were taken from Cottonfield BD Ltd., based on Gazipura 27, and Knitex-Dresses Ltd., located on Sreepur in the Gazipur district. Facilities of Knitex Dresses Ltd. and Cottonfield BD Ltd. (Printing, Cutting, Sewing, and Finishing) (Knitting, Dyeing, Yarn Dyeing Placement, and Printing). Five parameters like TSS, TDS, turbidity, pH, and COD are tested. Finally, based on the laboratory test, it was found that the removal percentage of turbidity is in the range of 44.75% to 94.30%, the maximum TSS removal efficiency is 65.50% to 72.48%, and the COD removal percentage is 69.19% to 83.70%. The performance of the clarifier of Cottonfield BD Ltd. and Knitex Dresses Ltd. both are quite good. So, we can conclude by saying that our roughing filter has very good impact on TSS, COD and Turbidity of textile factories wastewater from where collected our samples.

Keywords: performance evaluation, roughing filter, textile effluent

1. INTRODUCTION

An important part of Bangladesh's economy is being played by the industrial sector's rapid growth. Bangladesh's Ready-Made Garments (RMG) industry has become the country's top foreign currency generator in recent years. The industry makes a considerable contribution to Bangladesh's GDP. Additionally, it employs about 2 million Bangladeshis. These textile and dyeing industries are now seen as a massive environmental hazard in the industrial area of Bangladesh due to environmental concerns (Karim et al. 2006). The long process sequence that results in large waste production throughout the textile manufacturing process is characterized by a significant use of resources like water, fuel, and a range of chemicals. The main water-using procedures and those that produce wastewater are cutting, bleaching, mercerizing, and dyeing. Strong acids, strong alkalis, inorganic chlorinated compounds, sodium hypochlorite, organic compounds such dyes, bleaching agents, finishing agents, starches, thickeners, surface-active chemicals, wetting and dispensing agents, and metal salts are utilized during each stage (Dey et all. 2015). Water body contamination brought on by the discharge of untreated effluents is frequently one of the main environmental issues connected to the textile industry. Many untreated wastewater discharges from small and medium-sized RMG industries are discharged into rivers and ponds throughout Bangladesh. The Effluent treatment plant (ETP) owners contribute a significant amount of sludge to the process. Sludge's characteristics are influenced by the treatments used for sludge stabilization and waste water treatment, but it still includes significant levels of harmful heavy metals (Chen et al., 2005). Particularly in regions with a high concentration of anthropogenic sources, heavy metals are significant environmental contaminants. A global issue that poses an increasing hazard to humanity is the presence of toxic heavy metals in the air, land, and water. These pollutants have a very long half-life in the environment, are not biodegradable, and are not thermodynamically degradable, thus they might easily build up to dangerous levels (Sharma et al., 2007). Some environmental protection organizations throughout the world have implemented regulations tasked with safeguarding human health and the environment from pollution brought on by the textile industry because the effluent from the sector is hazardous to both the environment and people. These organizations set restrictions on how effluents might be released into the environment. A few of the rules that other nations have implemented. However, the regulations of the wastewater emission include too many elements since there are differences in raw materials, finished goods, colors, technology, and equipment. It is created by the national environmental protection agency in accordance with the different environmental protection standards and local situations. It changes depending on the circumstances in a variety of regions (Mostafa, 2015). In order to treat the wastewater from the textile industry, various pollutant removal technological methods have been developed in recent years. The composition, qualities, and concentration of the material contained in the effluents are taken into consideration when selecting the treatment methods. Depending on the type, order, and method used to remove the unacceptable and hazardous ingredients, these operations are classified as pre-treatment, preliminary, primary, secondary, tertiary, or combined treatments (Babu et al., 2007).

2. LITERATURE REVIEW

One of the biggest industrial water consumers is the textile industry, which is notable for the amount of water required for the production of waste water and the amount of water required for the processing of raw materials. The primary water-consuming steps in this type of manufacturing are cutting, bleaching, mercerizing, and dyeing. Waste water is also produced throughout these operations. Numerous chemicals, including as oil, grease, ammonia, sulphide, lead, colour, hazardous pollutants, heavy metals, and other hazardous substances, are introduced to the process for cleaning and dyeing purposes (Munnaf et al., 2014). Gazipur (Konabari) textile dying factories constantly produce significant volumes of waste water that are discharged directly into surrounding waterways, agricultural fields, irrigation channels, and surface water, where they eventually merge with the Turag and Shitalakkhya Rivers (Sultana, 2009). Because of this, a sizable portion of the water that is readily available is being contaminated by textile effluents. Textile and dyeing effluents can alter the temperature, turbidity, noise level, and other physical, chemical, and biological aspects of the aquatic environment. This can have a negative impact on fish, other biodiversity, livestock, and human health (Islam et al., 2011). In addition to biological treatment for the removal of metals, organic matter, and nitrogen, the effluents from the textile sector undergo a range of physico-chemical processes, such as flocculation, coagulation, and ozonation (Adin & Asano, 1998). One of the disadvantages of the physico-chemical treatment process is the need for space and the production and removal of sludge (Chipasa, 2001). Textile effluents are treated using three different methods: primary, secondary, and tertiary treatments. The initial step in treating textile effluent is to remove suspended particles, excessive levels of oil and grease, and grit (Eswaramoorthi et al., 2008). Initially, the effluent is filtered via bar and fine screens to remove coarse suspended materials such rags, skeins, lint and pieces of cloth (Chipasa, 2001). After that, the suspended particles are settled out of the screened effluent. The floating particles are eliminated by mechanical scraping techniques, neutralization is used to reduce the acidic concentration of the effluents. Boiler flue gas and sulfuric acid are the two materials that are most commonly used to adjust pH. According to Eswaramoorthi et al., (2008), the ideal pH range for the treatment process is between 5 and 9. To protect the effluent from damage caused by plastics, metals, paper, and rags, it is sent through coarse screening, the first stage of screening. Coarse screens are defined by an aperture of 6 mm or greater. Coarse screening (0.2–1.5 mm opening) is followed by extremely fine screening (1.6–8 mm opening) and fine screening. According to Babu et al., (2007) fine screening helps reduce the amount of suspended particles in the effluent. Reducing the amounts of BOD, phenol, and oil in the wastewater and controlling its colour are the primary objectives of the secondary treatment process. Both aerobic and anaerobic conditions can allow microorganisms to help physiologically accomplish this. Aerobic bacteria eat organic substances as a source of nourishment and energy. While oxidising dissolved organic matter to produce CO2 and water, they decompose nitrogenous organic compounds into ammonia. Aerated lagoons, trickling filters, and activated sludge systems are a few of the aerobic systems used in the secondary treatment. According to Das (2000), stabilising the resulting sludge is the main goal of anaerobic treatment. Aerated lagoons are among the frequently used biological treatment techniques. After the first treatment, the effluent is pumped into a large rubber- or polythene-coated holding tank and left to aerate for two to six days, during which time the accumulated sludge is cleaned out. Up to 99% of BOD can be effectively removed, while 15%–25% of phosphorus can be removed. It has been noted that ammonia nitrification also occurs in aerated lagoons. It's possible that the lagoon's algae will improve TSS removal (Mostafa, 2015). The space requirements of this approach and the potential for bacterial contamination in the lagoons are its primary limitations (Etter, 2011). Trickling filters are a prominent secondary treatment method that mostly operates in aerobic circumstances. The filter is covered with a spray or drop of the initial treatment effluent. The filter is often comprised of a rectangular or circular bed made of coal, gravel, PVC, broken stones, or synthetic resins. Trickling filters are a prominent secondary treatment method that mostly operates in aerobic circumstances. The filter is covered with a spray or drop of the initial treatment effluent. Typically, the filter is composed of a rectangular or circular bed of coal, gravel, PVC, broken stones, or synthetic resins. Bacteria create a gelatinous layer on the filter media's surface. These microorganisms help the organic components in the wastewater oxidise to carbon dioxide and water. Trickling filters require less space and are therefore more advantageous than aerated lagoons. However, a disadvantage is the high capital cost and smell emission. Aerobic activated sludge technologies are widely used. The aerobic bacteria in an effluent tank need to be regularly aerated in order for the soluble and suspended organic compounds to be broken down by the bacteria. According to District, M. N. et al., (2006) some of the organic components are oxidised into CO2, while the remainder is transformed into new microbial cells. Several technologies are used in tertiary treatments, such as ion exchange, reverse osmosis, and electrodialysis. Electrodes are used to pass an electric current through the wastewater in the process of electrolytic precipitation of textile effluents. According to Elangovan et al. (2018), electrochemical interactions between the dissolved metal ions and finely dispersed particles in the solution cause the bigger metal ions to precipitate and potentially be removed later. The process by which solutes or other particles become stuck to the membrane or inside the membrane hole is known as membrane fouling, and it must be avoided by removing suspended solids, colloids, and turbidity prior to electro dialysis (Marcucci, 2002). Generally, tiny particles that stilling basins or sedimentation tanks cannot fully contain or are not able to hold are removed from water using roughing filters. Primarily, roughing filters function as physical filters to reduce the solid volume. But the huge surface area of the filter that is available for sedimentation and the slow filtering rates not only encourage chemical and biological activity, but they also make absorption easier. Roughing filters not only remove solids from water, but they also improve the water's bacteriological quality and, to a lesser extent, change other aspects of its quality, such colour or the amount of dissolved organic matter (Wegelin, 1996). Roughing filters fall under the category of deep-bed filters, where a well-designed filter promotes particle removal all the way down the filter bed, increasing the filter's capacity to retain the removed particles. According to Boller (1993), the effectiveness of roughing filters in removing particles is dependent on several parameters, including filter design, particulate content, and water quality. The potential of treating water naturally was welcomed even before chemical methods such as flocculation and chlorination were invented and put into practice. Sand and gravel used as filter material are essential components of natural treatment processes. Sand continued to play an important part in water treatment when the first slow sand filters were developed at the turn of the 20th century, but the use of roughing filters was gradually replaced by chemical processes (Wegelin, 1986). The roughing filter technique is an ancient water treatment technique that has only lately been rediscovered, as demonstrated by the following instances. Throughout Europe, a large number of castles and forts were constructed during the Middle Ages. They were often difficult to subdue, often situated in highly important areas, and often tricky to hydrate. In effective water treatment systems, the first and most basic step is the separation of coarse materials. Smaller solids and microorganisms are eliminated in the last stage of water treatment after a second pretreatment procedure separates the smaller particles. These varied pretreatment techniques will reduce the dangerous germs. The germs adhering to the suspended materials' surface will become stranded when they separate. Furthermore, some of the floaters in the water might be pushed up to the surface of the treatment plants, where they will adhere to biological films. For this reason, there are various treatment obstacles for both microorganisms and solid materials. Because each barrier's treatment efficiency bar rises in the direction of flow, impurities find it increasingly difficult to pass through each additional barrier. For the RF to remove suspended particles, laminar flow is required (Galvis, 1998). Hydrodynamic forces drive water through the pore system, causing flow patterns to accelerate and slow down and creating pockets of still water close to the media surface where particles can settle. Scattered solids are retained in the media by mass-particle attractions, Vander Waals forces, electrostatic interactions between charged particles, and an organic coating that sticks to the surface of the medium (Babu et al., 2007).

3. MATERIALS & METHODS

The goal of this study is to determine the quality of the textile effluent and to know how a roughing filter would perform if it were placed in between systems of treatment plants. A cylindrical up-flow vertical roughing filter with a 14" diameter and 24" height was made by us. Three layers of various grade materials measuring 2" each make up the 6"-high filter bed. The filter bed is also hollow cylindrical, with an outer diameter of 14", an inner diameter of 6", and a height of 10". It has two taps, one for filtered water and another for sledges. Figure of roughing filter is given below.

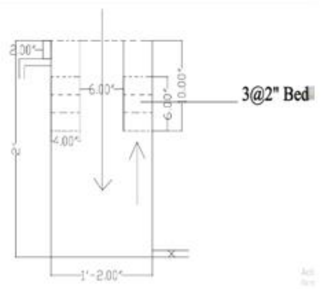

Figure 01: 2D View

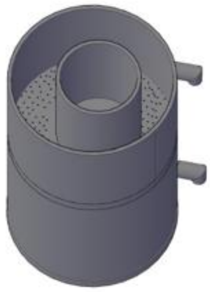

Figure 02: 3D View

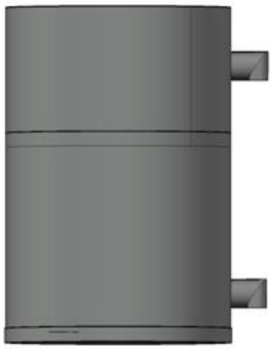

Figure 03: Front View

Figure 04: Top View

Three layers of bed with stone chips are used in roughing filter. At bottom layer 18mm dia stone chips, middle layer 12mm dia stone chips and top layer 10mm dia stone chips are used. The height of each layer is 2 inch therefore total height of filter bed is 6 inch.

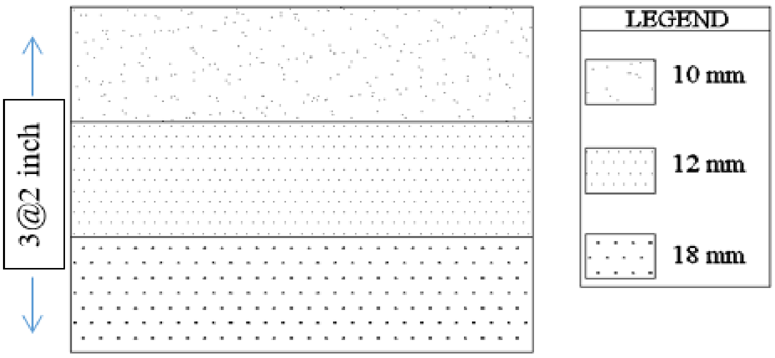

Figure 05: Filter Bed

Cottonfield BD Ltd., located on Gazipura 27, Gazipur, and Knitex-Dresses Ltd. are the two textile factories in Dhaka city where we have worked which is situated on Sreepur under the district of Gazipur. Facilities of Cottonfield BD Ltd. (Printing , Cutting , Sewing and Finishing) and facilities of Knitex Dresses Ltd. (Knitting , Dyeing , Yarn Dyeing Placement and Printing).

Table 01: Comparing between Cottonfield BD Ltd. and Knitex Dresses Ltd.

Particulars	Cottonfield BD Ltd.	Knitex Dresses Ltd.
Product Category	T-shirt , Polo shirt , Tank top , Sweat shirt , Sweat pant , skirt , legging , Nightwear set , Bodysuit , Knit woven combo, Hoodies, Jackets.	T-shirt , Polo shirt , Tank top , Sweat shirt , Sweat Pant, skirt, legging, Nightwear set , Bodysuit .
Workers	2750	3500
Sewing Capacity	72,000 pcs/day	80,000 pcs/day (Circular knit, Flat Knit, Lingerie).
Production Facilities	Printing , Cutting , Sweing , Finishing	Knitting, Dyeing, Yarn Dyeing Placement Printing. .
Printing Capacity	36,000 pcs/day screen print 40,000 pcs/day label print	40,000 pcs/day screen print 53,000 pcs/day label print
Knitting Capacity	12 Tons/day	12 Tons/day
Dyeing Capacity	Central Facility	16 Tons/day
Y/D Capacity	Central Facility	Central Facility

First, Cottonfield BD Ltd. started off by working. In their operational flow-diagram of the treatment plant, roughing filter has been placed after the primary clarifier. The working flow-diagram has been given below.

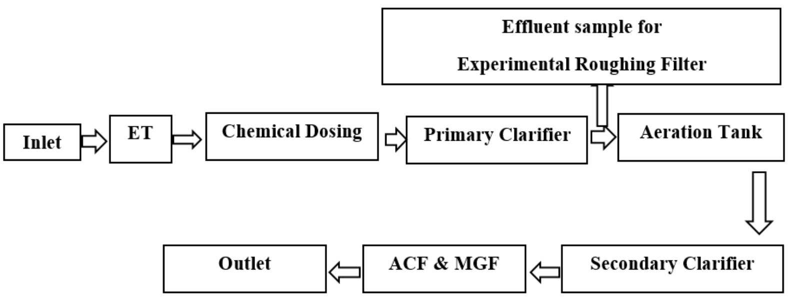

Figure 06: Working flow-diagram of treatment plant (Cottonfield BD Ltd.)

Then sample was collected from Knitex Dresses Ltd. Then sample was collected from Knitex Dresses Ltd. After the clarifier in their operational flow diagram of the treatment plant, water was collected our experimental roughing filter. The working flow-diagram has been given below.

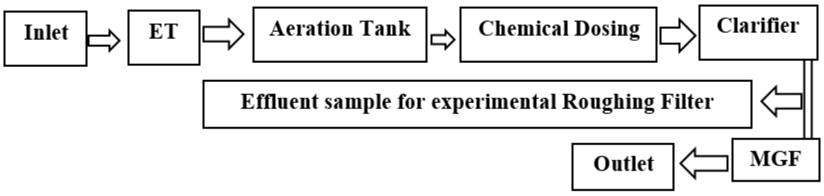

Figure 07: Working flow-diagram of treatment plant (Knitex Dresses Ltd.)

Two samples were obtained, one for before filtration and the other for after filtering. After each 100 liters of filtration, a sample is taken. The appropriate indication, equipment, and reagents were chosen. The recommendations were followed while creating the solutions for titration. To measure pH using the pH meter, TDS using TDS meter and Turbidity using Turbidity meter. 47mm diameter with 0.45µm thickness filter paper is used for TSS measuring. Titration method was used for determination of COD.

4. RESULTS & DISCUSSION

4.1 General

Physical and experimental inquiry of the studied region is both included in the investigation. Turbidity, Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and PH are all measured as part of the evaluation process for two times for each set of sample. The investigation covers comparison with the experimental value for before filtration and after filtration also tested different parameter of wastewater of two particular textile factories from where we have collected sample.

4.2 Wastewater Sample Data Collected from Cottonfield BD Ltd.

Table 01: Difference between Raw Effluents with Roughing Filtrated sample data for Turbidity

COD (mg/L)						
Date	**Sample**	**Raw Water**	**Roughing Filter**	**Mean ± SD**		**Removal Percentage**
29/08/2022	1	0	0	Raw Water	Filtered Water	9.03
	2	0	0	35.4 ± 39.53	32.2 ± 37.24	
	3	89	83			
	4	63	59			
	5	25	19			
30/08/2022	1	191	132	268.33 ± 67.57	209.3 ± 78.53	22
	2	298	289			
	3	316	207			
31/08/2022	1	736	387	772 ± 199.304	237.8 ± 155.7	69.19
	2	554	357			
	3	1037	114			
	4	761	93			
Average Value				358.58	159.77	

Table 02: Difference between Raw Effluents with Roughing Filtrated sample data for pH

pH						
Date	**Sample**	**Raw Water**	**Roughing Filter**	**Mean ± SD**		**Removal Percentage**
29/08/2022	1	6.2	5.9	Raw Water	Filtered Water	-1.4
	2	5.7	5.7	5.72 ± 0.54	5.8 ± 0.071	
	3	5.9	5.8			
	4	4.8	5.8			
	5	6	5.8			
30/08/2022	1	7.1	6.9	7.1 ± 0	6.867 ± 0.058	3.28
	2	7.1	6.9			
	3	7.1	6.8			
31/08/2022	1	7	6.9	6.78 ± 0.22	6.7 ± 0.245	1.18
	2	6.9	6.9			
	3	6.7	6.6			
	4	6.5	6.4			
Average Value				6.53	6.45	

4.3 Wastewater Sample Data Collected from Knitex Dresses Ltd.

Table 03: Difference between Raw Effluents with Roughing Filtrated sample data for Turbidity

Turbidity (NTU)						
Date	Sample	Raw Water	Roughing Filter	Mean ± SD		Removal Percentage
08/09/2022	1	22.45	14.51	Raw Water	Filtered Water	
	2	31.12	13.22	42.07 ± 30.83	14.91 ± 3.483	64.56
	3	26.69	19.9			
	4	88	12			
09/09/2022	1	27.23	17.49	40.35 ± 21.35	18.57 ± 2.766	53.98
	2	72	15.71			
	3	27.76	22.25			
	4	34.4	18.82			
10/09/2022	1	361	18.95	484.5 ± 90.81	27.61 ± 7.001	94.3
	2	472	25.28			
	3	546	31.3			
	4	559	34.89			
Average Value				188.97	20.36	

Table 04: Difference between Raw Effluents with Roughing Filtrated sample data for COD

COD (mg/L)						
Date	Sample	Raw Water	Roughing Filter	Mean ± SD		Removal Percentage
08/09/2022	1	42	38	Raw Water	Filtered Water	
	2	82	40	69.25 ± 28.99	55.75 ± 25.06	19.5
	3	49	53			
	4	104	92			
09/09/2022	1	237	123	177.25 ± 143.9	84.75 ± 38.3	52.03
	2	352	97			
	3	44	32			
	4	76	87			
10/09/2022	1	25	33	486.25 ± 325.32	79.25 ± 35.29	83.70
	2	768	115			
	3	489	73			
	4	663	96			
Average Value				244.25	73.25	

Table 05: Difference between Raw Effluents with Roughing Filtrated sample data for TSS

TSS (mg/L)						
Date	Sample	Raw Water	Roughing Filter	Mean ± SD		Removal Percentage
08/09/2022	1	70	40	Raw Water	Filtered Water	
	2	50	30	70 ± 21.6	42.5 ± 12.58	39.28
	3	60	40			
	4	100	60			
09/09/2022	1	110	80	97.5 ± 22.17	65 ± 23.8	33.33
	2	70	30			
	3	90	70			
	4	120	80			
10/09/2022	1	170	50	263.5 ± 102.8	72.5 ± 22.17	72.48
	2	200	60			
	3	280	80			
	4	400	100			
Average Value				143.67	60	

Table 05: Difference between Raw Effluents with Roughing Filtrated sample data for TDS

TDS (mg/L)						
Date	Sample	Raw Water	Roughing Filter	Mean ± SD		Removal Percentage
08/09/2022	1	0.42	0.42	Raw Water	Filtered Water	
	2	0.41	0.41	0.418 ± 0.005	0.413 ± 0.005	1.19
	3	0.42	0.41			
	4	0.42	0.41			
09/09/2022	1	0.41	0.4	0.403 ± 0.005	0.398 ± 0.005	1.24
	2	0.4	0.4			
	3	0.4	0.39			
	4	0.4	0.4			
10/09/2022	1	0.42	0.41	0.42 ± 0	0.41 ± 0	2.38
	2	0.42	0.41			
	3	0.42	0.41			
	4	0.42	0.41			
Average Value				0.4137	0.407	

Table 06: Difference between Raw Effluents with Roughing Filtrated sample data for pH

pH						
Date	Sample	Raw Water	Roughing Filter	Mean ± SD		Removal Percentage
08/09/2022	1	8.1	7.1	Raw Water	Filtered Water	
	2	7.8	7	7.75 ± 0.26	6.975 ± 0.096	10
	3	7.6	6.9			
	4	7.5	6.9			
09/09/2022	1	7.2	6.6	6.9 ± 0.24	6.55 ± 0.058	5.07
	2	7	6.6			
	3	6.7	6.5			
	4	6.7	6.5			
10/09/2022	1	7	6.7	7.05 ± 0.06	6.8 ± 0.082	3.54
	2	7	6.8			
	3	7.1	6.8			
	4	7.1	6.9			
Average Value				7.23	6.76	

4.4 Wastewater Sample Data Collected from every station of ETP (Cottonfield BD Ltd.)

Table 07: Test of different parameters of wastewater at every station of ETP (Cottonfield BD Ltd.)

Serial	Sample	Parameters									
		Turbidity (NTU)		TSS (mg/L)		COD (mg/L)		pH		TDS (mg/L)	
		Value	Mean	Value	Mean	Value	Mean	Value	Mean	Value	Mean
1	Equalization Tank	1420	1464	2000	2025.5	969	891	7.6	7.75	0.29	0.305
		1508		2051		813		7.9		0.32	
2	Primary Clarifier	78	82.5	80	86.5	85	91	6	6.1	0.51	0.52
		87		93		97		6.2		0.53	
3	Aeration Tank	8.57	9.45	50	46.5	43	44.5	6.9	6.7	0.38	0.36
		10.34		43		46		6.5		0.34	
4	Secondary Clarifier	8.47	9.33	40	43.5	65	67	8.7	8.55	0.43	0.425
		10.19		47		69		8.4		0.42	
5	ACF & MGF (Outlet)	12.49	14.86	21	22.5	6	6.5	8.2	8	0.39	0.38
		17.23		24		7		7.8		0.37	

4.5 Wastewater Sample Data Collected from every station of ETP (Knitex Dresses Ltd.)

Table 08: Test of different parameters of wastewater at every station of ETP (Knitex Dresses Ltd.)

Serial	Sample	Parameters									
		Turbidity (NTU)		TSS (mg/L)		COD (mg/L)		pH		TDS (mg/L)	
		Value	Mean	Value	Mean	Value	Mean	Value	Mean	Value	Mean
1	Equalization Tank	823	861	1800	1945	1441	1540	9.5	9.47	0.43	0.42
		851		1919		1561		9.6		0.44	
		910		2117		1619		9.3		0.39	
2	Aeration Tank	229	198	1500	1508	102	101	7.9	7.67	0.39	0.396
		189		1550		94		7.5		0.38	
		177		1473		107		7.6		0.42	
3	Chemical Dosing	737	745	6500	6269	176	195	8.3	7.87	0.41	0.41
		719		6343		195		7.7		0.39	
		780		5963		213		7.6		0.43	
4	Primary Clarifier	87	95	40	40	142	146	8.5	8.4	0.43	0.416
		92		37		139		8.5		0.41	
		105		43		156		8.2		0.41	
5	Final Outlet	29	38	30	31	85	74	8	8.06	0.42	0.413
		45		36		65		8		0.41	
		40		29		73		8.2		0.41	

4.6 Discussion

Textile factories Cottonfiled BD Ltd. and Knitex Dresses Ltd. collected wastewater. They gathered wastewater in their treatment plant clarifier. Each sample set had two bottles. One bottle before filtration, one after filtration, and wastewater from various treatment plant locations. We tested each sample group for turbidity, COD, TDS, TSS, and pH. The sample came from Cottonfiled BD Ltd. The sample lasted 3 days. After that, Knitex Dresses Ltd. provided a sample. Sampled here for 3 days. Laboratory measurements show that the roughing filter has little effect on pH and TDS. We found turbidity reduction rates of 44.75% to 94.30%. This result matches (Jabbar H. et al. 2016)'s 'Treatment of Water and Wastewater by utilising Roughing Filter Technology of Local Materials' turbidity removal percentage of 85% to 89%. They reported maximal TSS elimination effectiveness at 89%–92%. The maximum TSS elimination efficiency in our trial was 65.50% to 72.48%, which matches theirs. The maximum TSS removal percentage was 75% in "Suspended Solid Removal of Palm Oil Mill Effluent Using Horizontal Roughing Filter and Calcinated Limestone" by Arezoo Fereidonian Dashti et al. 2020. Our TSS elimination efficiency was 65.50% to 72.48%, similar to theirs. We compared our COD result to (Mtsweni, S. 2016), they found 81.28% COD removal in their study "Performance of a horizontal roughing filtration system for the pretreatment of greywater." Our experiment found 69.19% to 83.70%, which is similar. Comparing TSS and COD results with (Dey, S., & Islam, A. 2015). In "A Review on Textile Wastewater Characterization in Bangladesh," they showed COD removal 59% to 98% and TSS reduction 75% to 97%, which matches our results. Our roughing filter had no significant influence on

TDS or pH, but it did affect turbidity, TSS, and COD, which is consistent with earlier research. At finally, the removal percentage of turbidity is in range of 44.75% to 94.30% that was founded by us. It has been compared this result with (Jabbar H. et all. 2016), they worked on 'Treatment of Water and Wastewater by using Roughing Filter Technology of Local Materials' and they found the turbidity removal percentage 85% to 89% which is very matching with our result. They founded maximum TSS removal efficiency in between range of 89% to 92%. In our experiment, the maximum TSS removal efficiency was 65.50% to 72.48% which is very close to their result. Also the TSS result has been compared with (Arezoo et al., 2020), they worked on "Suspended Solid Removal of Palm Oil Mill Effluent Using Horizontal Roughing Filter and Calcinated Limestone" and they found the maximum removal percentage of TSS was 75%. Performance of a horizontal roughing filtration system for the pretreatment of greywater has been studies this study founded the removal percentage of COD 81.28% and in our experiment the COD removal percentage was 69.19% to 83.70% which is very similar to their result. Also it has been compared the TSS and COD result with (Dey & Islam, 2015).

5. CONCLUSION

During this study, wastewater samples were collected from two textile factories situated in Dhaka city. As a filter media, gravel was tested in the current study. Based on the result analysis of the current study, we can see that the performance of the roughing filter is increasing as it filtrates more wastewater. The first day at Cottonfield BD Ltd., the turbidity removal percentage was 22.10%, on the second day it increased to 41.35%, and on the third day it increased to 44.75%. The turbidity removal percentage at Knitex Dresses Ltd. was 64.56% on the first day, 53.98% on the second day, and 94.93% on the third day. We can see that the turbidity removal percentages increased from 22.10% to 94.93%, which is very satisfying. Similarly, focusing on COD, we can see that the COD removal percentage at Cottonfiled BD Ltd was 9.03% on the first day, 22% on the second day, and 69.19% on the third day. The first day at Knitex Dresses Ltd, the COD removal percentage was 19.5%, the second day it increased to 53.03%, and the third day it increased to 83.70%. We can see that when we worked at Cottonfiled BD Ltd, the COD removal percentage increased from 9.03% to 69.19%, but after that, when we went to Knitex Dresses Ltd., it increased from 19.5% to 83.70%, which is a very good sign. Similarly, if we concentrate on TSS, we can find that Cottonfiled Bd Ltd. TSS removal percentage was 5.63% on the first day, increased to 50% on the second day, and increased to 65.5% on the third day. The proportion of TSS removed on the first day at Knitex Dresses Ltd. was 39.28%; on the second and third days, it increased to 33.33% and 72.48%, respectively. So based on the result, we can see that for the highly turbid wastewater, the removal efficiency of Turbidity, TSS, and COD increased gradually. When the raw wastewater Turbidity was 76 NTU, the removal efficiency was 22.10%, and on the last day, the raw wastewater turbidity was 715 NTU, and the turbidity removal percentage was 44.75%. That is, if the raw water is more turbid, the roughing filter will perform better. The performance of a roughing filter not only depends on the quality of the wastewater, but also on how much water it filtrates before washing the filter bed. Roughing filter has very little impact on pH and TDS of wastewater. The performance of the clarifier of Cottonfield BD Ltd. and Knitex Dresses Ltd. both are quite good. So, we can conclude by saying that our roughing filter has very good impact on TSS, COD and Turbidity of textile factories wastewater from where collected our samples.

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