PERFORMANCE STUDY OF DYEING INDUSTRIAL EFFLUENT TREATMENT PLANT (ETP) OF SAVAR, ASHULIA AREA

By

SHANTA KHANDAKER

RAKIB HASAN SOJIB

NADIM HASAN

MD ZIAUR RAHAMAN

POLE AKTER CHAMIE

A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering

Department of Civil Engineering

Sonargaon University

147/I, Green Road, Dhaka-1215, Bangladesh

Section: 18C

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SHANTA KHANDAKER	BCE 1703012008
RAKIB HASAN SOJIB	BCE 1703012015
NADIM HASAN	BCE 1903018022
MD ZIAUR RAHAMAN	BCE 1903018049
POLE AKTER CHAMIE	BCE 1903018144

Supervisor

Asma Ul Hosna

Lecturer

Department of Civil Engineering, SU

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……………………………………….

1. Asma Ul Hosna — Chairman

Lecturer

Department of Civil Engineering.

Sonargaon University

……………………………………….

2. Internal / External Member — Member

……………………………………….

3. Internal / External Member — Member

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STUDENT NAME	STUDENT ID.	SIGNATURE
SHANTA KHANDAKER	BCE 1703012008	
RAKIB HASAN SOJIB.	BCE 1703012015	
NADIM HASAN	BCE 1903018022	
MD ZIAUR RAHAMAN	BCE 1903018049	
POLY AKTER CHAMELE	BCE 1903018144	

Dedicated

to

“Father of the Nation Bangabandhu Sheikh Mujibur Rahman and Our Freedom Fighters “

ABBREVIATIONS

ETP = Effluent Treatment Plant

EIA = Environment Impact Assessment

BOD = Biochemical Oxygen Demand

DO = Dissolved Oxygen

TDS = Total dissolved Solid

TSS = Total Suspended Solid

pH = Potential of Hydrogen

COD = Chemical Oxygen Demand

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ABSTRACT

Bangladesh's textile industry is crucial to its economy, with factories built on rivers and canals. The industry became export-oriented in the 1970s and expanded rapidly, leading to increased income and lifestyle changes. Over 300 textile factories have been built in Ashulia, using more water for fabric making. Bangladesh's GDP grew from $6.29 billion in 1972 to $368 billion by 2021, with 82% of exports being ready-made garments. As of 2016, Bangladesh is the world's second-largest apparel exporter of Western fast fashion brands. Wastewater treatment plants use collection tanks, screen chambers, dosing tanks, equalization tanks, primary clarifiers, diffused aeration, and secondary clarifiers. Textile industry pollutants can be treated using chemical, biological, and membrane processes. The collection tank collects wastewater from the textile industry, while the screen chamber removes large particles of floating and suspended matter. The equalization tank acts as a buffer to collect raw effluent. The operation of wastewater treatment are screening, equalization, reaction, reserve, oxidation, secondary clarifier, and post-oxidation tanks. The screening unit screens sludge and separates substances particles to produce clothes. Equalization tank ensures homogeneous mixing of water and other substances. Reaction tank adds polymer to hasten the floc formation process and adds lime, serrous, sulphate, and polymer coagulants. Reserve is a large tank that provides enough time to settle down the suspended particles. Primary clarifier removes other floating substances like oil and grease. Oxidation Tank 1 removes organic substances and increases DO value. Secondary Clarifier removes bacteria and increases activated sludge. Post-Oxidation Tank increases DO level and transfers water to the drain, which is sound and safe. Analytical results (Alliance Knit Composite Ltd) of treated liquid effluents all parameters are within acceptable standards as per Environment Conservation Rules 1997.Textile waste water treatment and management are important for reducing pollution, protecting human health, and promoting sustainability. Alliance Knit Composite Ltd wastewater disposal in a river meets regulatory standards.

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CHAPTER 1

INTRODUCTION

1.1 Background and Motivations

At present, the clothing industry is progressing a lot. For which the amount of textile industries is very high at present. A lot of water is used for spinning, dyeing, printing and finishing. According to the statistics of 2021, 349 million cubic meters of wastewater is generated. Typically, textile industries generate 1.5 trillion liters of water as wastewater every year. If these waters are purified, as the water pollution will be reduced, the purified water can be reused by the factories. It will reduce the amount of water shortage. Typically 14 million square meters of wastewater are discharged into surface water bodies annually. Due to which the water becomes polluted and creates problems in our public life. If this water was purified and discharged into the reservoir, then the water of the river or sea and other bodies of water would not be polluted. We would not have had a problem with our life.

1.2 Research Overview

Our research aims to find out what is most effective in wastewater management in sludge management in the garment industry. Sludge management, product production and output capacity of factories in Ashulia affect how waste is generated and how waste is managed**.**

1.3 Research Objectives

The main objective of the research are:

- Compare operation phases of ETP of textile industry
- Compare the performance of ETP of textile industry

1.4 Organization of the thesis

This thesis consists of five chapters as described below:

Chapter 1: Background, Motivation. Objective and Overview.

Chapter 2: Importance of textile industry. Overview of the related works in the wastewater management of textile Industrial ETP. The field with a special focus on the ETP process and the variation of different ETP parameters also understands the textile industry production process.

Chapter 3: Methodology. This chapter describes the methodology adopted to carry out the research. Describe our process of data collection and the treatment phase of ETP and its operation.

Chapter 4: Results and Discussion. Here we compared different industries data and processes and expressed our findings.

Chapter 5: Conclusions and Future work. Conclusions and major contributions of our study and limitations and recommendations for future studies.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

At present, the textile industry is at the root of the progress in the economy of Bangladesh. Due to the large amount of use in the textile industry, the factories are usually built on the banks of various rivers and canals.

From the latter half of the 1970s, the development of the Bangladesh-made garment industry was primarily an export-oriented sector. The domestic market of the ready-made garment industry also expanded rapidly and the income of all concerned with the sector increased and the lifestyle changed.

More than three hundred textile factories have been built in Ashulia. In these factories, more water is used in fabric making, printing, dyeing etc. In 1972, the World Bank approximated the gross domestic product (GDP) of Bangladesh at US$6.29 billion, and it grew to $368 billion by 2021, with $46 billion of that generated by exports, 82% of which was ready-made garments. As of 2016 Bangladesh held the 2nd place in producing garments just after China. Bangladesh is the world's second-largest apparel exporter of Western fast fashion brands.

2.2 Literature Review Overview

Bangladesh's textile and apparel industry is contributing as the sole source of growth to the country's growing economy. [1] Textile and clothing exports are one of the country's major sources of foreign exchange earnings. In 2002, 77 percent of Bangladesh's exports were from the textile, apparel and ready-made garment industry. [2] In 1972, according to the World Bank, the GDP of Bangladesh was 6.29 billion US dollars, which increased to 368 billion US dollars in 2021. Of this GDP, $46 billion came from US exports, of which 82 percent were garment exports. [3] As of 2020, Bangladesh has maintained the 2nd position in textile production in the world after China. [4] Bangladesh is the 2nd largest apparel exporter of Western fast fashion brands worldwide. In the fiscal year 2016-2017, the readymade garment industry earned USD 28.14 billion, which was 80.7 percent of total export earnings and 12.36 percent of GDP. At this time, this industry of Bangladesh started to implement environmentally friendly production methods. [7] In 2022, Bangladesh ranked first in the number of environmentally friendly factories. [8][9] Bangladesh's textile industry has been a subject of trade versus cooperation debate. Encouraging Bangladesh's garment industry as an open trade system is considered more effective than foreign aid. Quota facilities such as Textiles and Clothing (ATC), Everything But Arms (EBA) and the US 2009 Tariff Relief Assistance in the global apparel market have benefited entrepreneurs in the Bangladeshi garment industry. In 2012, 45 percent of the total employment in Bangladesh was under the textile industry, but it contributed only 5 percent to the total national income. [citation needed].

2.3 Production overview of Textile Industries

Textile Manufacturing Process:

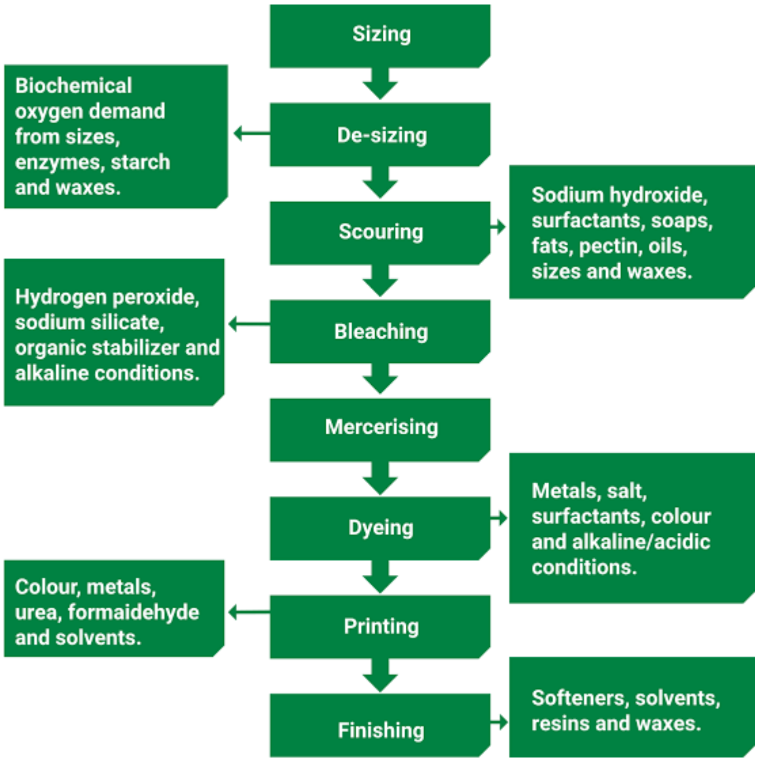

Figure 2.1: Manufacturing Process of Textile Industry

Cloth is made through the following processes:

1. Yarn Manufacturing (Spinning)
2. Fabric Manufacturing (Weaving)
3. Wet Processing (Dyeing + Printing + Finishing)
4. Apparel Manufacturing (Cutting + Sewing)

2.4 ETP Overview

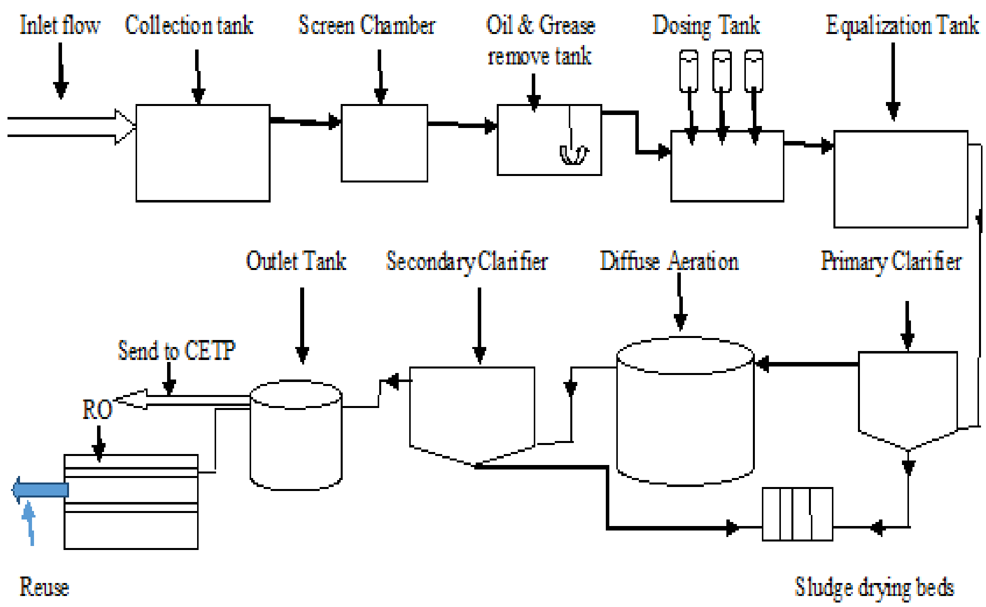

Figure 2.2: Effluent Treatment Plant (ETP)

Collection tank: The wastewater generated in the textile industry is first collected in a tank for treatment. This tank is called collection tank.

Figure 2.3: Collection tank

Screen Chamber: Screen is the first unit operation in a wastewater treatment plant. This is used to remove large particles of floating and suspended matter by coarse screening. This is accomplished by a set of inclined parallel bars, fixed at a certain distance apart in a channel. The screen can be of circular or rectangular opening.

Figure 2.4: Screen Chamber

Dosing Tank: Dosing tank means a tank compartment or basin that provides for storage of effluent from a septic tank or other treatment unit intended to be delivered to a soil treatment area at a high rate periodic discharge.

Figure 2.5: Dosing Tank

Equalization Tank: Effluent from the collection tank comes to the equalization tank in wastewater treatment. The main function is to act as a buffer. To collect the incoming raw effluent that comes at widely fluctuating rates and position the rest of the ETP at steady (Average) flow rate. During the peak hours ETP comes at a high flow rate. The equalization tank stores this effluent and lets it out during the non peak time when there is no /little incoming effluent. The inlet pipe of the equalization tank carries filtered effluent from the cooling tower. The effluent NPSH lifting pumps move the effluent to the EC SKID.

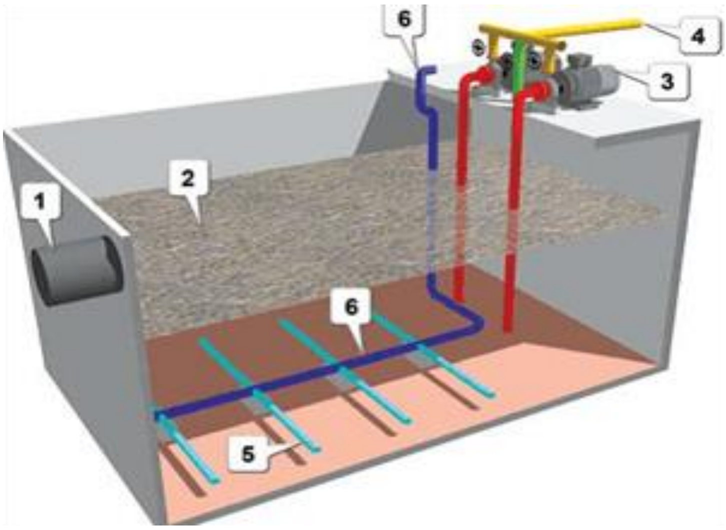

Figure 2.6: Equalization Tank

Primary Clarifier: Primary clarification is the physical treatment process of removing solids before biological treatment. It is the most cost effective way to remove these solids after basic screening. Process water enters the clarifier tank and floatable solids (scum) are removed from the surface by skimmers while settle able solids (sludge) are collected on the bottom by a rake and removed via a sludge removal system. Effluent destined for biological treatment leaves the clarifier over a weir. The expected range for percent removal in a primary clarifier is 90%-95% settle able solids, 40%-60% suspended solids, and 25%-50% total BOD_5.

Figure 2.7: Primary Clarifier

Diffuse Aeration: In diffused aeration, oxygen is mixed with the wastewater to allow the anaerobic bacteria to digest bio solid particles in the water. The purpose is to introduce air into the water, which increases the wastewater's dissolved oxygen content. The benefits of this include removing items that produce both taste and odors, including gasses, metals like iron, and other substances.

Figure 2.8: Diffuse Aeration

Secondary Clarifier: A circular basin in which effluent from the activated sludge process is held for a period of time during which the heavier biomass settle to the bottom as “activated sludge.” This sludge teaming with hungry microorganisms, can be returned to the first aeration basin to begin the activated sludge treatment process all over again.

Figure 2.9: Secondary Clarifier

2.5 Performance of ETP

Pollutants from the textile industry can be treated using chemical , biological and membrane processes. Changes in the mill's internal processes and management efforts have been claimed to have resulted in a big decrease in pollution load and wastewater volume. By using screening, coagulation, flocculation, sedimentation, flotation, adsorption, etc., physicochemical treatment techniques climate suspended particles, colors, and even BOD and COD. Using chemical methods, dissolved materials and heavy.

2.6 Legislation and Policy to protect Environment

National Environmental Policy 1992 (Policy)

National Environmental Management plan 1995 (Policy)

Environment Conservation Act 1995 (Law)

Environment Conservation Rules 1997 (Law)

Environment Conservation Act 2000 (Law)

Environmental Impact Assessment Guidelines for Industry (Guideline)

2.7 Summary

The management of industrial wastes (Solid waste & Waste water) ETP (Effluent Treatment Plant) is mandatory. Textile industries should have maintained specific rules and processes according to DOE, ELA, ECR, ECA, CASE, The Environment Conservation Rules, etc. DOE supervises this process every month. The maximum industries are located beside the rivers. So that DOE also observes rivers water quality which was polluted by industrial wastes and wastewater. Some industries are concerned about this and they maintain proper rules and procedures to sound river water quality.

CHAPTER 3
METHODOLOGY

3.1 Introduction

In the textile industry, water is polluted due to various types of inorganic chemicals. Different types of chemicals are used in the textile industry for different steps like spinning, cleaning, dyeing and printing. Among them, soap, detergent, sodium carbonate, sodium chloride, caustic soda, acetic acid, hydrogen peroxide are used in different types of chemicals. They mix with water and pollute the water. Because that water is directly drained into the river water body, the water becomes polluted. Due to polluted water, various types of diseases such as breathing problems, heart diseases, skin diseases etc. are occurring in aquatic organisms and animals and humans. Ashulia area has the largest number of textile factories and the rivers around it have the highest level of pollution.

So we observed many textile mills in Ashulia and saw how they affect the environment. We conducted our analysis on many textile mills and looked at the treatment process of the waste. We collected various data from various points and input and output. We compared all of the textile mill's treatment processes. We compiled all data to understand the impact of wastewater from the textile mills on the environment.

3.2 Methodology Overview

We visited textile industry “ALLIANCE KNIT COMPOSITE LTD” and we also collected data to analyze the Sources, Process and observed checked requirement to see if they are okay to be released on the water body.

ALLIANCE KNIT COMPOSITE LTD Industry

Location: 8/118 Pukurpar, Zirabo, Ashulia

Source: On site visit

Wastewater Sources from Production: Dyeing, Printing, Cleaning, Spinning

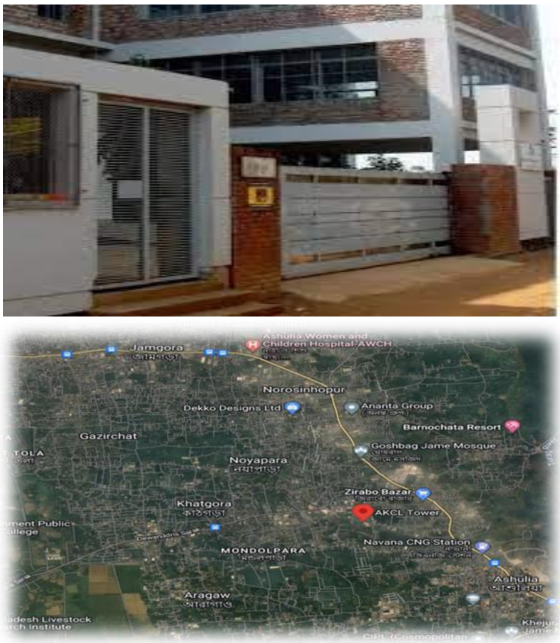

Figure 3.1: Location of Alliance Knit Composite Ltd. (Google map).

3.3 Operations

Screening Unit: It is the first stage of wastewater treatment. It screens sludge from wastewater and separates substances particles to produce clothes.

Equalization tank 1: The major purpose of the equalization tank is to ensure homogeneous mixing of water and other substances that are present in water by aeration in the Dissolved Air Flotation (DAF) process.

Equalization tank 2: Repeat the process described in Equalization tank 1. Reaction Tank: It is also known as a chemical dressing reaction tank. The wastewater from equalization tank 2 made gravity fall into the reaction tank. There is also added polymer (chemical) in this tank to hasten the floc formation process and add lime, serrous, sulphate, polymer coagulants.

Reservoir: Water was reserved here, mixed with air by gravity Tall area pumped to the primary clarifier wastewater.

Primary clarifier: It is a large tank that provides enough time to settle down the suspended particles (sludge). Then sludge passes through into a sludge thickener by a mechanical process and water passes into the oxidation tank by overflowing its scum baffle. It also removes other floating substances like oil and grease.

Oxidation Tank 1: It consists of an extended aeration (by mechanical systems) type of activated sludge process. In this process activated sludge removes organic substances and also increases DO value.

Oxidation Tank 2: Repeat the process described in Oxidation tank 1.

Oxidation Tank 3: Repeat the process described in Oxidation tank 1.

Secondary Clarifier: Bacteria getting lost and blowing sludge and increasing return activated sludge day by day. It will be found at the bottom of the secondary clarifier by aeration. Then sludge goes through in the sludge thickener. On the other hand, water passes into the post-oxidation tank.

Post-Oxidation Tank: Increasing the DO level in the Post-Oxidation Tank by the Dissolved Air Flotation (DAF) process. At this stage, the water's turbidity was good and the pH was about 7.

MGF: The water from the post-oxidation tank passes through the MGF and transfers to the drain.

Drain: Drain is connected to the river. The water is sound and safe at this stage and we won't find any toxic substances in this water.

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Here are some of the images for field visit,

Figure 3.2: Clarifier Tank 1.

Figure 3.3: Clarifier Tank 2

Figure 3.4: Equalization tank

Figure 3.5: Sludge thickener

Figure 3.6: Oxidation tank

3.4 Summery

Different types of operational phases and production capacity have been seen in this industry.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Introduction

We conducted our research on the selected textile industry "Alliance Knit Composite Ltd" and collected all data. Looking at data analyzed. We get the general idea that the textile industry has almost similar sources from where wastewater is generated. But size and capacity are different between industries and output from ETP varies depending on those things but also based on those ETP's design a bit differently based on them. But in most cases, they do pass the requirements to release treated water into rivers. Some do it better than others, but most follow the rules and standards well.

4.2 Differences in water treatment plants

Since raw chemicals components and management systems are almost the same in the treatment plants for those the same pattern also alike technology can be found. But there are differences in terms of sizes and units and also how well they are maintained. Then there are a few key differences we see in the field where Alliance Knit Composite Ltd do seem to go one step beyond to do more efficiently in terms of reusing water or release and Additional material from scanning is saved or sold. Here is the Standard for Sector -wise industrial Effluent or emission.

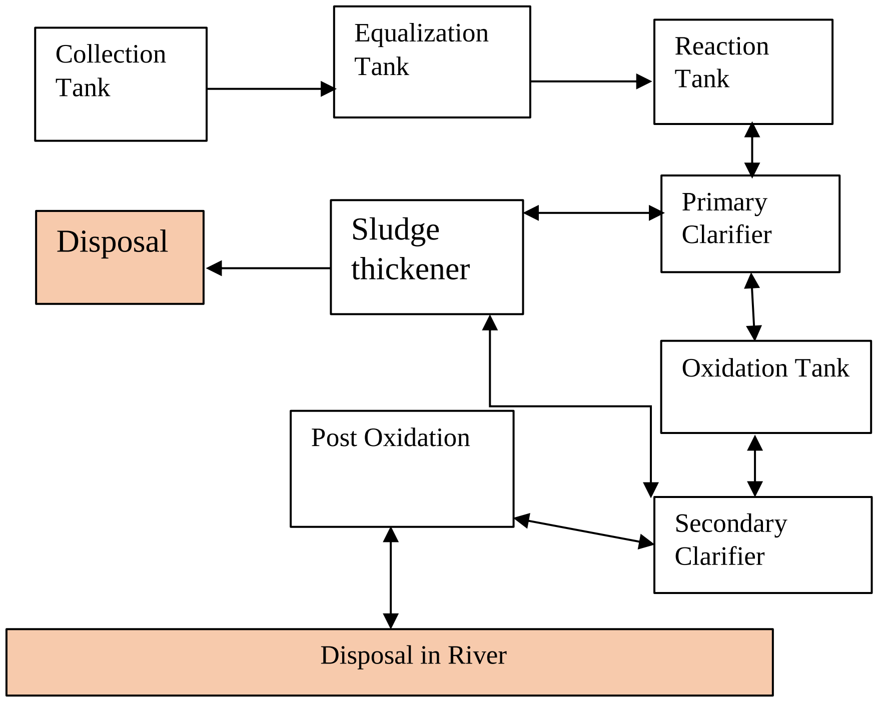

Figure 4.1: According to Environmental Conservation Rules 1997

Parameters	**Standard and presence in a unit of mg/1, except pH**	
	Large plant with production capacity of above 50 tons per day.	Small plant with production capacity of above 50 tons per day.
pH	6 - 9	6 – 9
Suspended Solids	100	100
BOD5 20oC	30	50
COD	300	400
Wastewater flow	200 cubic meter per ton of paper.	200 cubic meter per ton of paper produced of agricultural raw materials. 75 cubic meter per ton of paper produced of wastepaper.

Table 4.1: According to Environmental Conservation Rules 1997

4.3 Fabric production process:

Textile manufacturing involves converting fiber into yarn, then fabric, and finally textiles. The process includes getting raw materials, fiber making, yarn manufacturing, fabric manufacturing, wet processing, garments manufacturing or clothing, fashion design, textile calculation, and marketing. Basic cost includes process costing, production, cloth consumption, all types of direct and indirect costing.

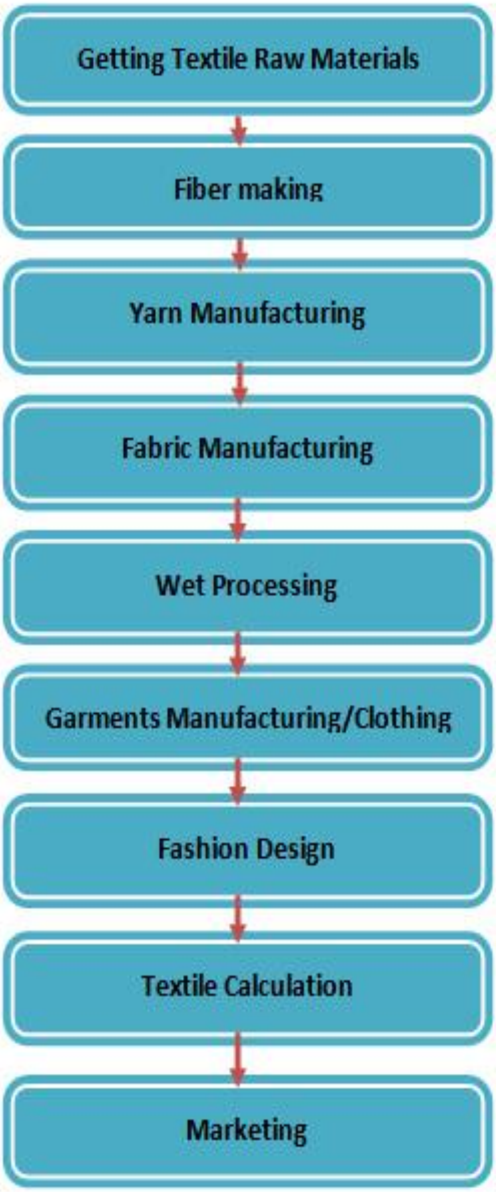

Figure 4.2: Fabric production process

4.4 Fabric chemical process:

Textile manufacturing involves a long process of chemical and non-chemical treatments, including preparation, pretreatment, dyeing, printing, and refinement. There are over sixty distinct textile chemical product classes used in yarn formation, fabric pretreatment and finishing, textile laminating and coating, and other miscellaneous applications. Textile chemicals include specialized chemicals such as biocides, flame retardants, water repellents, and warp sizes. Different chemical-based procedures of textile manufacturing include scouring, bleaching, desizing, softening, Mercerization, Dyeing, etc. During weaving, warp threads are coated with an adhesive substance known as 'size'. After weaving, the 'size' is removed again in order to prepare the fabric for dyeing and finishing. Different textile chemicals are used in various categories and subcategories, from pretreatment of textile to its finishing.

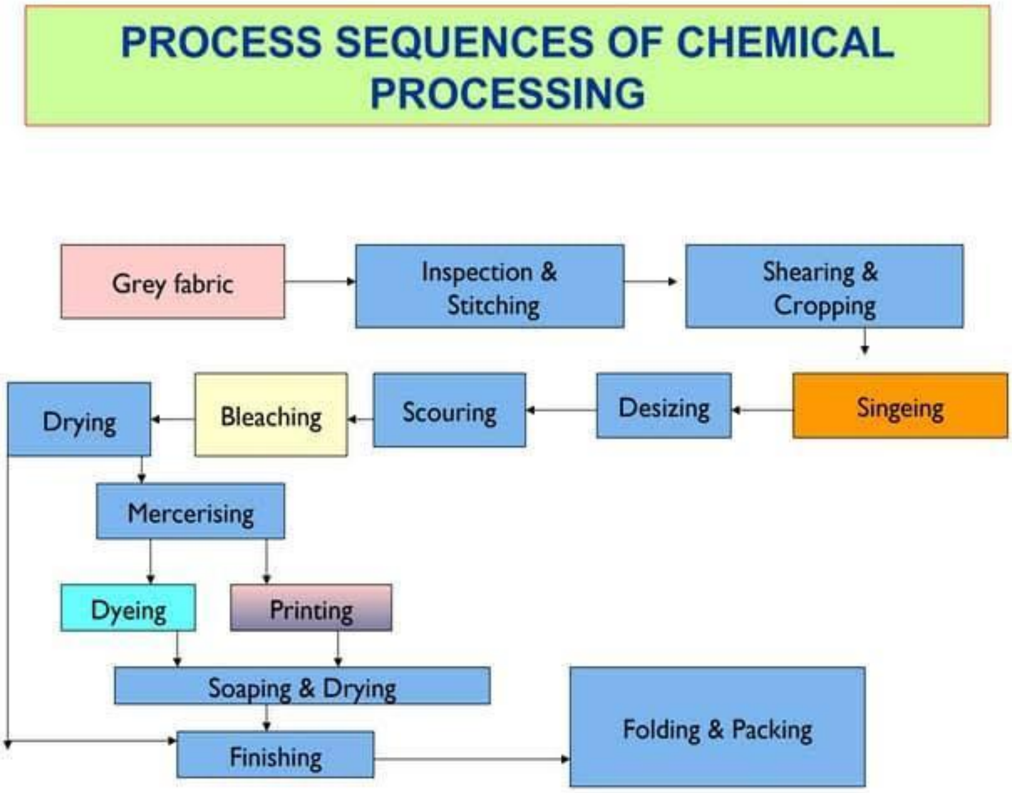

Figure 4.3: Fabric chemical process

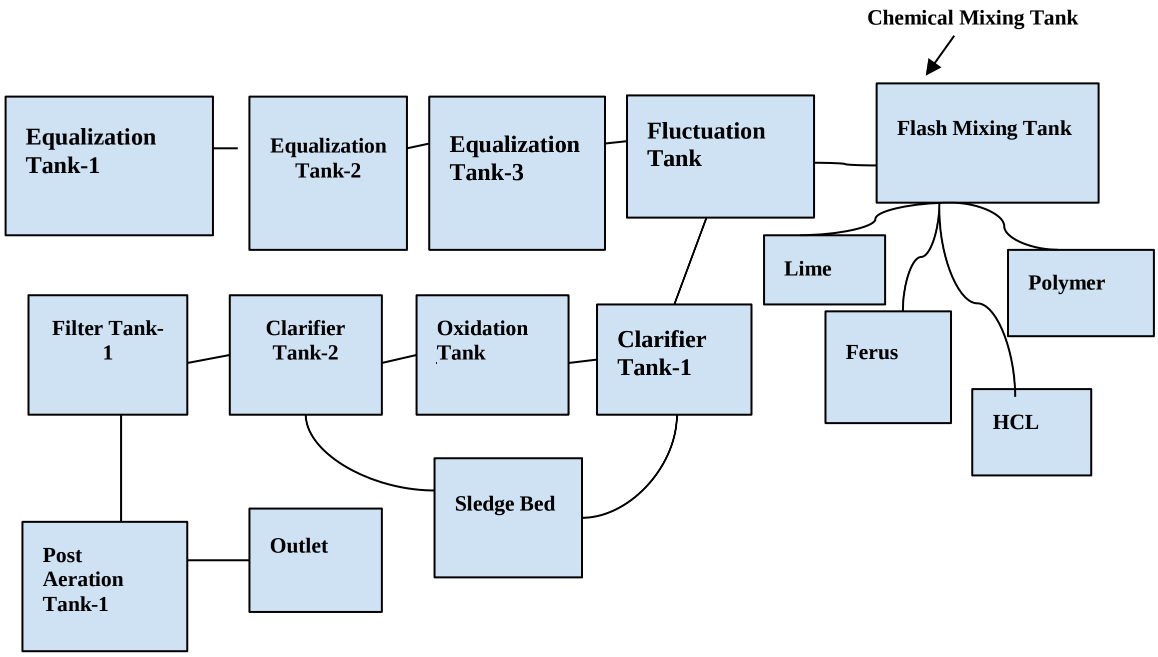

Figure 4.4: Alliance Knit Composite Ltd 80m3/hr ETP Flow Chart

Parameters

Name of the Industry**:** Alliance Knit Composite Ltd

Location of Industry: Zirabo, Ashulia, Savar, Dhaka-1341

Production Capacity (Ton/hrs)	Waste generation (Ton/hrs)
80	163 m3/hrs

Location	Sampling Date	Lab Code	pH	DO mg/L	BOD mg/L	COD Mg/L	TDS Mg/L
Inlet of ETP	2023-01-21	C-28	8.56	0.0	70	227	1740
Outlet of ETP	2023-01-21	C-19	8.74	8.0	38	122	966
As per ECR 1997 Bangladesh Standard for Waste Water from Industrial Units, discharging to inland surface water			6-9	4.5-8.0	50	200	2100

Table 4.2: Data of Alliance Knit Composite Ltd

Production Capacity (Ton/hrs)	Waste generation (Ton/hrs)
80	163 m3/hrs

Location	Sampling Date	Lab Code	pH	DO mg/L	BOD mg/L	COD Mg/L	TDS Mg/L
Inlet of ETP	2023-03-23	C-28	8.52	0.0	70	227	1740
Outlet of ETP	2023-03-23	C-19	8.64	8.0	33	118	955
As per ECR 1997 Bangladesh Standard for Waste Water from Industrial Units, discharging to inland surface water			6-9	4.5-8.0	50	200	2100

Table 4.3: Data of Alliance Knit Composite Ltd

Here we have compared the pH value, DO, BOD, COD values among our tested values

4.3 Results & Findings

Sample no.	Location	Lab Code	pH	DO mg/L	BOD mg/L	COD Mg/L	TDS Mg/L
Sample 1	Inlet of ETP	C-28	8.56	0.0	70	227	1740
	Outlet of ETP	C-19	8.74	8.0	38	122	966
Sample 2	Inlet of ETP	C-28	8.56	0.0	70	227	1740
	Outlet of ETP	C-19	8.74	8.0	38	122	966

Table 4.4: Results of Alliance Knit Composite Ltd

Analytical results (Alliance Knit Composite Ltd) of treated liquid effluents all parameters are within acceptable standards as per Environment Conservation Rules 1997.

4.4 Learning about ETP's in general also Textile plants

A widely used type of treatment plant is Biochemical. For cost related reasons, most use the biochemical treatment plant. Installing the biological system can be higher upfront. It needs tanks, mixers and pumps for chemical reactions, but that is usually a lower capital cost then a biological system that was aeration , pH control, temperature control, maybe some picking media etc.

4.5 Summery

There is the pattern of treatment plants are alike but depending on size and capacity, they tend to have few differences or smaller units to either get shorter cycle run or cost-effective capacity depending on needs.

CHAPTER 5

CONCLUSIONS AND FUTURE WORK

5.1 Conclusions

Waste water treatment and management in the textile industry are essential for minimizing environmental pollution, protecting human health, and promoting sustainability. The variation of production capacity in different industries is significant. By implementing effective treatment processes, recycling wastewater, and adhering to regulatory standards, the industry can contribute to a cleaner and sustainable future. We found that there is variation in the treatment phrases of ETP and also variation in ETP's parameters such as BOD, COD, DO, TSS,TDS, pH, wastewater flow etc. Our selected industry (Alliance Knit Composite Ltd) is located beside a river or canal. All values of ETP parameters satisfy the ECR1997 and DOE Standards. We found that if production increases then waste water generation also increases. So, the wastewater from selected Alliance Knit Composite Ltd industry disposal in the river is safe for the environment.

5.2 Limitations

The small number of textile industries that have active treatment plants that are currently active and allow on-site visits. But, our research was limited due to time limitations and other factors. Having data for several months could give us rich data, more unknown factors and more knowledge about the performance of ETP. Over a long time 36 months' worth of data can give us performance over time and progressive impact. Alongside that, we can get the best and optimal treatment systems from different sizes of industries.

5.3 Recommendation for Future Works

- Real-time monitoring and control systems can improve ETP performance
- Energy efficiency can be achieved through energy-efficient equipment and processes
- Incorporating green features and water recycling can improve natural treatments

- Adopting sustainable chemicals can minimize the environmental impact of ETP activities
- Embracing a circular economy approach can help recycle and reuse byproducts

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