STUDY AND PERFORMANCE TEST OF BIOCHEMICAL ETP

A thesis

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Department Of Mechanical Engineering

SONARGAON UNIVERSITY (SU)

MAY- 2024

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Submitted to the

DEPARTMENT OF MECHANICAL ENGINEERING

SONARGAON UNIVERSITY (SU)

In partial fulfillment of the requirements for the award of the degree

Of

Bachelor of Science in Mechanical Engineering

MAY- 2024

DECLARATION

We hereby declare that this project has been done by us under the supervision of Shahinur Rahman, Department of Mechanical Engineering, Sonargaon University (SU). We also declare that, neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ACKNOWLEDGEMENT

Firstly, we express our gratefulness to almighty Allah for his divine blessing makes us possible to complete this project successfully.

We are grateful to our supervisor Shahinur Rahman, Lecturer, Department of Mechanical Engineering, Sonargaon University (SU). Deep knowledge and keen interests of our supervisor in the field of ETP influenced us to carry out the project work. His endless patience, scholarly guidance, continual encouragement, energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting these at all stages have made it possible to complete this project.

We would like to express our thanks to Prof. Md Mostofa Hossain, Head, Department of Mechanical Engineering, Sonargaon University (SU) for his kind help to finish our project report.

We would like to deliver thanks to our entire course mates in Sonargaon University (SU), who took part in the discussion while completing the course work.

Finally, we would like to express a sense of gratitude to our beloved parents and friends for their mental support, strength, and assistance through.

Author's

ABSTRACT

ETP or Effluent Treatment Plant is one of the most crucial parts of wet process. As Global warming is increasing at an alarming rate, and we may lack water to use or consume, ETP is a must for every factory with dyeing/printing/washing department. For this project we studied on biochemical treatment plant. We are working to know more about biochemical treatment plant, what procedures are used in this plant and what tests are done before discharging water. While working for this project we've found how much water is withdrawn every day, how much is used and how much is discharged. Different tests have been done to see the results of water ready to discharge or not, also studied the chemical consumption and cost also electricity cost. The results have been studied to comply with the government-approved limit or not. The lab was rich with enough instruments and manpower to have an estimated result. All the tests were done almost every day, only two of them were taken once a week. All the results are documented daily to overview at the end of the month. They had every day and months entry on their doc-book. 7 days of data have been taken, daily chemical consumption, water consumption for the processes and discharged water. Not all of the tests were taken daily, some of them such as BOD and COD tests were done only once a week. Then the results were compared to the government standard. The results were never out coming as fail, because the industry uses the chemicals in a limit and never let the chemicals exceed their limit. We found the most used chemicals are Sulfuric Acid, Ferrous Sulphate Heptahydrate, and Water Decoloring Agent (Bluwat.). And on average more than 4000m3 wastewater is processed biochemically. And every day on average temperature is found near 31°C, pH is found 7.7, BOD is found 15, COD 90.85, TSS 12.14 and TDS 2503. These are average amount that are found on discharged water after treatment. To run the biochemical ETP, the industry spends taka 20228 for electricity, 192593 takas for chemical per day, and for maintenance 1200000 takas. After working on this project, we've learned what procedures should be followed and what criteria should be used before discharging wastewater.

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LIST OF ABBREVIATIONS

BOD: Biological oxygen demand.

COD: Chemical oxygen demand.

DO: Dissolved Oxygen.

ETP: Effluent Treatment Plant

TDS: Total dissolve solid.

TSS: Total suspended solid.

CHAPTER 01

INTRODUCTION

1.1 Importance

The rapidly expanding garments industry of Bangladesh continues to play an important role in the country's main economy. It is also contributing greatly to reduce. The internal unemployment problem of the country. Many reputed and established international buyers are showing their interest in the readymade garments of Bangladesh. This is creating scope for expansion of this industry as well as strengthening the economic growth of the country but the untreated wastewater from garment industries having serious effect on the environment. Rivers and canals are getting contaminated biodiversity is hampered. Agriculture at risk as well as people's livelihoods. To keep the momentum of the garments industry forward, there is no alternative but to treat the wastewater of the factories. Here, we have seven thousand industries producing 1.3 million tons factory waste every day and throwing them in the river, canal, and water bodies if these continues not only industrial growth will be hampered but own existence will be at risk. It is very hopeful that some industries are installing effluent plants to treat wastewater and conserve the environment, but it is not enough the following types of effluent treatment plants are being used in our country.[1]

Biochemical Treatment plant

Bio-Logical Treatment Plant

Biochemical & Bio-Logical Plant

The ETP plant we can see here is a Biochemical type.

1.2 Objectives of the study

- To learn about Biochemical treatment plant (ETP).
- To know different chemicals used in Biochemical plant (ETP).
- To know treatment cost of Biochemical plant (ETP) and Chemical plant (ETP), Also cost of power consumption of ETPs.
- To know which are cost effective between Biochemical (ETP) and Chemical (ETP)

CHAPTER 02

LITERATURE REVIEW

2.1 Effluent Treatment Plant

To protect the environment from the hazardous effect of wastewater from textile industry, industries started setting ETP in their areas. So that no wastewater can harm no biological creature.

On ETP the treatment of industrial effluents and waste waters is done. ETP plants are used vastly in the industrial sectors.

During the manufacturing process, varied effluents and contaminants are produced. Effluent treatment plants are used in the removal of high number of organics, debris, dirt, grit, pollution, toxic, non-toxic materials, polymers etc. from wastewater. ETP plants use evaporation and drying methods, and other auxiliary techniques such as centrifuging, filtration, incineration for chemical processing and effluent treatment.

Effluents are generated of extremely by textile wet process, variable composition and constitute an environmental risk specially water pollution of major concern. Rapid disposal of untreated water disturbs the ecosystem 9600 m3 of effluent is produced each day by any 70-ton capacity textile factory. which contains chemicals including salts, dyes, and bleaches. Under the 1997 rules fabric dyeing and chemical processing "Red industries" are bound to use effluent treatment plant.[1]

2.2 Other types

Biological ETP

Biological Growth Equation's=(λS)/(KS+S) BB1 μ = Specific Growth Rate Coefficient

λ = Max growth rate

S= Concentration of limiting nutrient Ks= Monod Coefficient

Organic + Bacteria + Nutrients + Oxygen → New Bacteria + $CO_2 + H_2O$+ Residual Organics + Inorganics

The activity of bacteria is affected by several environmental factors. As well as the rate of biochemical reaction. Toxic materials, nutrient concentration, dissolved oxygen, pH, temperature are the most important factors. These all can be controlled by the biological treatment system named bioreactor, to make sure that the growth of microbial is under maintenance of bioenvironmental condition. For biological treatment the optimal temperature ranges from 20-400 Celsius. Aeration tank and filters operate at 12-25 degree Celsius. The air temperature rate has an important and outstanding effect on heat loss. High temperature increases the biological activity, which helps to increase the substrate removal rate. But sometimes it may cause problem with oxygen limitation.[1]

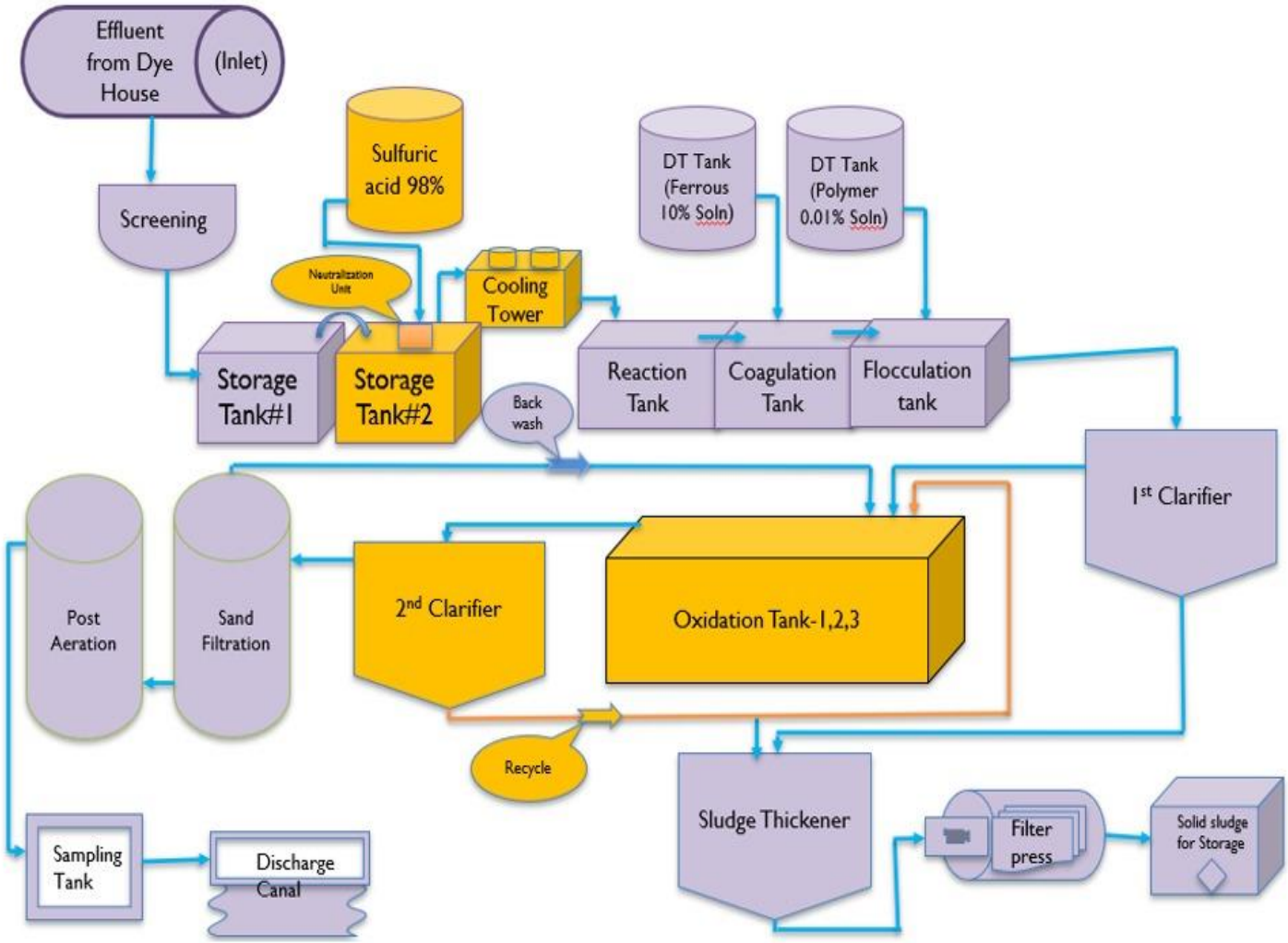
2.3 Biochemical ETP

By adding acid or alkali or by changing temperature or by precipitation as solid, dissolved inorganic compounds are removed usually. Then the precipitate is removed either by sedimentation, flotation, or other solid removal process. Coagulation,

Flocculation is implemented and recommended for substituting the chemical precipitation process by phytoremediation.[3]

2.4 Process flow chart

Biochemical ETP Flow Diagram



2.6 ETP Plant Operation

2.6.1 Pre-treatment

2.6.1(i) Screen chamber

Screen chamber: Remove relatively large solids to avoid abrasion of mechanical equipment's and clogging of hydraulic system.[4]



Fig. 2.1: Screen chamber

2.6.1(ii) Equalization Tank

Industrial waste includes the water parameters such as COD, BOD, SS are screened, then they are settled in equalization tank. Here, different liquids from different sectors are mixed, then their concentration is made lower. In an equalization tank, pH can be balanced, color of wastewater can be changed into light color. Hydraulic retention of this tank must be minimum 8 to 10 hours. Air bower and diffuser converts all the materials in same concentration for oxidation, the bio-organisms start to rot away. As well as the temperature increases a bit. Temperature increases 10% - 20%. The biological process happens in optimum temperature. Pre-aeration accelerates the reduction of ammonia. And as a result, nitrification happens on the liquid.[2]



Fig. 2.2: Equalization Tank

2.6.1(iii) Neutralization

Controlling of the pH of wastewater, no matter if its acidic or alkaline. If there is not sufficient alkali an addition of base is required to adjust pH to reach an adjustable range.

CaO, Ca(OH)2, NaOH, Na2CO3, these are usually used for adjusting the pH. And for the lack of acidity base addition will be of H2SO4, H2CO3 and other common chemicals.[2]





Fig. 2.3: Neutralization Tank

2.6.1(iv) Cooling Tower

Cooling towers are an essential component in many industrial processes, particularly in power plants and chemical plants. However, the discharge of cooling tower water can have a significant impact on the environment if not treated properly.

The effluent from cooling towers is often contaminated with suspended solids, dissolved solids, and microorganisms, which must be removed before discharge. [5]



Fig. 2.4: Cooling Tower

2.6.2 Primary Treatment

2.6.2(i) Coagulation

Coagulation is a process in which coagulants are added for the purpose of rapid settlement of minute solid particles in a liquid into larger mass. It permits particle removal by sedimentation and for filtration.

Chemical is added.

Ferrous 10% Solution

Ferrous sulfate and ferrous chloride are used in water treatment for the purpose of dechlorinating Hydrolyzed chlorine in water primarily exists as hydrochloric acid (HCI), a strong oxidizer in its ionized form.

Poly electrolyte: (0.2 ppm) to settle the suspended matters & reduce SS, TSS. The addition of the above chemicals by efficient rapid mixing facilitates homogeneous combination of flocculates to produce micro flocs.[1]



Fig. 2.5: Coagulation Tank

2.6.2(ii) Flocculation.

Flocculation is a physical process and does not involve the neutralization of charge. It involves the addition of destabilized particles together into large aggregates so that they can be easily separated from the water.

Chemical is added.

Polymer 0.01% Solution

To settle the suspended matters & reduce SS, TSS. The addition of the above chemicals by efficient rapid mixing facilitates homogeneous combination of flocculates to produce micro flocs.[1]

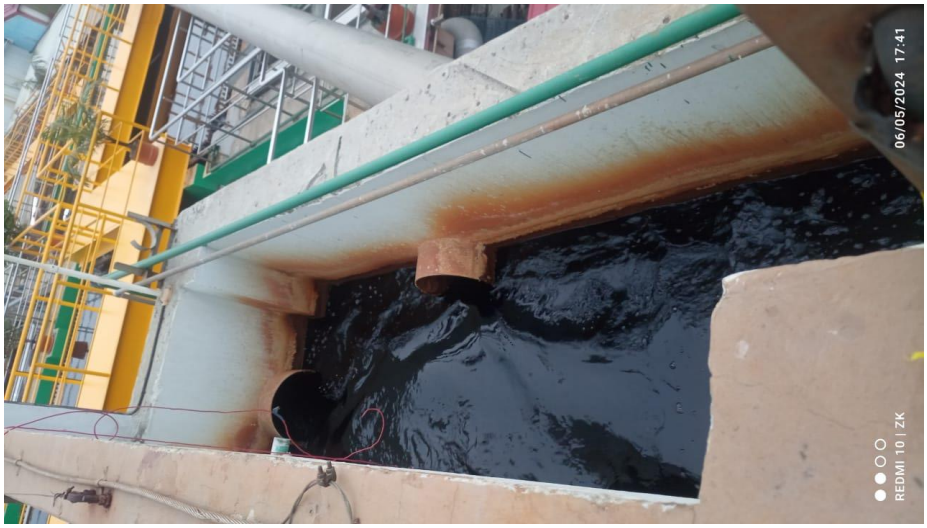


Fig. 2.6: Flocculation Tank

2.6.2(iii) Primary Clarifier

The flocculants are turned into suspension here. There are two types of clarifiers. Bridge clarifier and round clarifier. Its hydraulic retention time is 3-4 hours. Suspensions are found on the bottom of this tank. The size of the flocculants here are 0.1 to 3 mm. Fiber sheets are used under it, which should be cleaned once a week, and after every 15 days, fiber sheets need to be changed. Sludge's bottom of it is removed after every 1 to 2 hours. Water temperature should be between 30-350 Celsius. For the floating waste, a V-notch is used. And water overflow should be maintained. And sludge setting should be maintained here.[8]



Fig. 2.7: Primary Clarifier Tank

2.6.2(iv) Biological or Oxidation unit

In this tank, bacteria culture and bacteria wastewater treatment is done. This tank is called biological or aeration tank because air is supplied here by a diffuser with the help of a blower. Hydraulic retention of this tank should be between 12-24 hours. Bacteria can be live properly because of proper air supply. DO here should be between 2.5- 4 ppm. In this tank aerobic and facultative bacteria are present. For bacteria activity, nutrition is a must. Such as urea, DAP, Potassium, Calcium. pH limit is 7.5-8. Temperature must be 29-32 degree Celsius.[8]



Fig. 2.8: Biological Tank

2.6.2(v) Secondary Clarifier

From the biological tank, some biogas and floating bacteria are transferred into this clarifier. In this tank activated sledges are gathered. From this tank some sludges are recycled. And some sludge is sent to sludge thickener. Hydraulic retention is 3-4hours.[8]



Fig. 2.9: Secondary Clarifier

2.6.2(vi) Sludge thickener

In this tank, sludge from primary and secondary clarifier are brought. Hydraulic retention time is 45 minutes to 1 hour. Everyday sludge dewatering should be donefor 2 to 3 times. In this tank aeration filter is used. [8]

2.6.2(vii) Rapid sand filter

It clears the water and reduces the amount of suspended solids. Reduces a small amount of TDS. This tank should be backwashed twice a day. [8]



Fig. 2.10: Rapid sand filter

2.6.2(viii) Post aeration

In this tank, DO is increased by aeration. Hydraulic retention time should be 30-40 minutes.



Fig. 2.11: Post aeration Tank

2.6.2(ix) Sample collection tank

In this tank treated water is collected for the lab test before discharge to the environment.



Fig. 2.12: Sample collection tank

2.6.2(x) Discharge to the Environment



Fig. 2.13: Discharge to the Environment

CHAPTER 03

METHODOLOGY

3.1 Operation &identification

An ETP installation needs to equip itself with proper protocol for O & M. The first step in preparation for O & M is preparing inventory of maintenance requirements. This inventory is generally included in the Operation & Maintenance (O&M) Manual written down for the installation by the contractor who designs and builds the installation. He on completion of the work hands over this manual to the principal for whom he builds the installation. The following sections of the O & M Manual would lay down the maintenance requirements:[6]

3.2 Maintenances of Equipment

Maintenance of Equipment: This section provides schedules that list periodic maintenance requirements for the various equipment and includes record-keeping forms as necessary. A list of equipment suppliers and service representatives along with telephones is also given therein. Also, the manufacturer's O & M requirement is provided in this section. The ETP maintenance staff/the Operation & Maintenance contractor should particularly review this section of the O&M manual.[4]

3.3 Chemicals used to for the treatment of wastewater.

- FeSO4
- Potash
- Lime powder (CaO)
- Poly Aluminum Chloride
- Water decoloring agent
- Poly acrylamide
- Poly electrolyte
- Polymer (Anionic)
- Urea
- DAP
- Sodium Hypochlorite (NaOCl) (15% solution)

3.4 Functions of the chemicals

FeSO4: Ferrous sulphate can increase the sludge quantity. The water content within the sludge gradually decreases. Then the sludge is added in the coking charge.

Potash: Potassium permanganate is used vastly in water treatment. It acts as a regeneration chemical to remove iron and hydrogen sulfide from well water.

Lime powder (CaO): Lime water is to remove water hardness from the wastewater.

Poly Aluminum Chloride: Poly aluminum chloride known simply as PAC, is used as a coagulant in water purification. It is more effective at destabilizing and removal of suspended materials than other aluminum salts. PAC increases the speed of flocs forming and settling makes quicker. Flocs formed are easy to filter from the wastewater.

Water decoloring agent: Water Decoloring Agent is a type of highly efficient decolorizing flocculants which is a color removal chemical and a special product for de-coloring, flocculating. Water decoloring agents can be used both before and after the biochemical treatment. It is suggested to be dosed after the biochemical treatment which can be with low consumption, and low effect to the bacteria.

Poly acrylamide: The PAM as a chemical act as flocculating agent to wastewater causes suspended particles in wastewater to aggregate, forming what is known as a floc. And again, PAM products react with water and form insoluble hydroxides, trapping small particles into a larger floc. As a result, floc can be filtered or removed more easily.

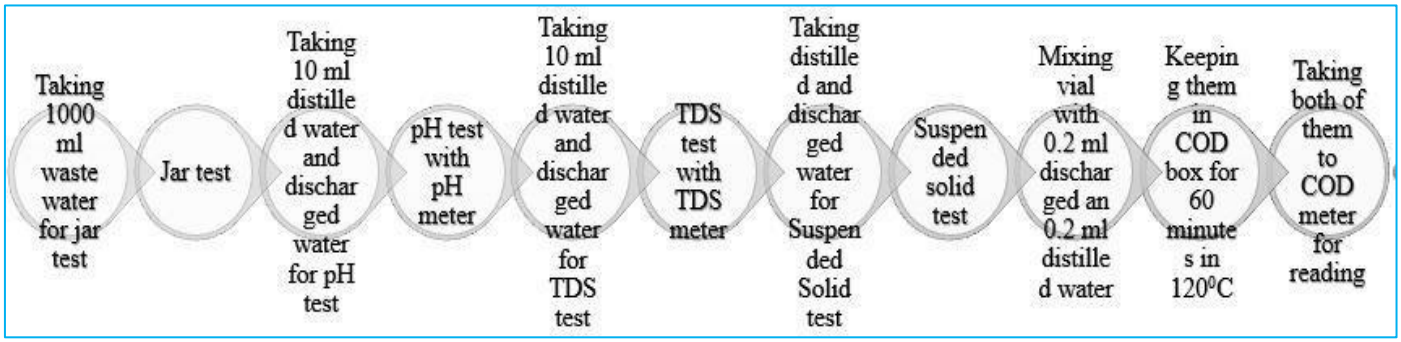
Polymer (Anionic): Polymers are used to coagulate suspended solids and produce large curds of solid materials (floc).

Urea: Adding urea increases the bacterial growth which is later helpful for coagulation and flocculation.

DAP: DAP is also used for the of bacterial colony.

Sodium Hypochlorite (NaOCl) (15% solution): It's used for water purification mainly. Any kind of bad odor, bleaching smell, can be removed by using sodium hypochlorite.[1]

3.5 Lab tests



3.5.1 Watercolor test/ Jar test

Watercolor test/ Jar test: At first the wastewater of previous day is collected. 1000 ml water is taken, and 5 ml decolor and 12ml PAC is mixed. Then the

Solution is mixed at 80 r.p.m. for 10 minutes. After 10 minutes the solid particles start to precipitate.

According to this test, the lab manager decides how much PAC and decolor will be needed for bulk wastewater.[3]



Fig. 3.1: Watercolor test/ Jar test

3.5.2 Measurement of TDS

TDS is measured with a TDS meter. Here, they usethe water that is going to be discharged, not the wastewater. After the result they match it with the standard result and take decision of discharging it.[1]



Fig. 3.2: TDS Measurement

3.5.3 Measurement of pH

pH is also measured with a pH meter. The reading is taken from discharged water. The result is compared to the standard.[2]



Fig. 3.3: pH Measurement

3.5.4 Measurement of TSS

For suspended solid both discharged water and distilled water are needed. On the meter, distilled water is used for calibration. After calibration is done, discharged water is placed in the box and result is compared to thestandard.[1]



Fig. 3.4: TSS Measurement

3.5.5 Measurement of COD

COD is done only once a week. COD test is the costliest of all tests. To test COD there is two instruments.[3]

3.3.5(i) Test with vial

Vial is a solution of potassium dichromate. For vial test, two tubes of vial are used. One will contain vial with 0.2 ml of distilled water, and other will contain vial with 0.2 ml of discharged water.

After they are mixed, the temperature increases in the tubes immediately. The tubes are then kept inside a compact glass jar. There both tubes are kept for 30 /60/ 120 minutes for 100/120/1500C temperature.

After that, they are kept 60 minutes to be cool. After cooling they are taken to COD meter. Where at first calibration is done with distilled water, and then reading of discharged water is taken. Then compared to the standard.[3]



Fig. 3.5: COD measurement

3.5.6 Measurement of BOD

BOD test is the lengthiest test of all. It almost requires 5 days to give a result. BOD test is done inside a glass bottle. Where 244 ml water is taken. Then Nitrification drop 5ml is added inside the bottle with water, and 5 drops of potassium is added on the cap of the bottle. Then the bottle is kept inside the BOD machine at a low temperature. After 5 days the result is taken and compared [1]



Fig. 3.6: BOD Measurement.

CHAPTER 04

DISCUSSION OF RESULTS

4.1 Quantity of incoming water to ETP inlet

Table 4.1

Day	Time	Inlet From Dye house m3	Outlet to the Environment m3
Day-01	06.00AM	3965	3565
Day-02	06.00AM	4745	4317
Day-03	06.00AM	4460	4103
Day-04	06.00AM	4370	3933
Day-05	06.00AM	4698	4275
Day-06	06.00AM	4352	3916
Day-07	06.00AM	5143	4628

4.2 In house wastewater test result

These are the weekly test result of wastewater. Every test is done according to their test process. After test if we see the result is more than BSR and DOE limit then we have to be treated again to follow those limits we can see the reduction of temperature as per BSR and DOE limits

Table 4.2

Day	Temperature		pH		Biological oxygen demand (BOD)		Chemical oxygen demand (COD)		Total suspended solid (TSS)		Total dissolve solid (TDS)		Dissolved Oxygen (DO)		Color	
	°C		-		ml/L		ml/L		ml/L		ml/L		ml/L		pt/L	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Day 01	41	37	10.09	7.88	495	15	1129	84	50	17	2341	2570	1.45	4.8	2170	354
Day 02	40	36	10.22	7.88			1097	93	57	13	2195	2450	1.56	4.65	2568	379
Day 03	43	36	10.05	7.83			987	85	55	13	1838	2350	0.6	4.3	1952	284
Day 04	44	37	10.18	7.9			947	100	100	12	2018	2480	0.86	4.36	1758	266
Day 05	44	35	10.07	7.09	490	14	995	96	75	10	2450	2550	0.67	4.2	1857	300
Day 06	45	37	10.45	7.97			1094	87	65	9	2375	2620	0.19	4.38	2160	328
Day 07	41	36	10.11	7.86			1013	91	70	11	2350	2501	0.58	4.39	2120	320

4.3 Quantity of Chemical used.

Table 4.3

Chemical Name	Consumption per day Unit: Kg						
	Day-01	Day-02	Day-03	Day-04	Day-05	Day-06	Day-07
Sulfuric Acid	625	613	622	629	600	595	623
Ferrous Sulphate Heptahydrate	1983	2010	2001	1972	1981	2011	1985
PAM C-400 Sires Polymer	19.5	20	19	18.8	19.3	19.5	20.2
Water Decoloring Agent (Bluwat.)	300	305	298	304	298.5	301.5	303
Jingen AFC (Anti-Foaming Agent)	2.9	2.8	2.75	2.95	3	2.98	2.67

4.4 Consumption of electricity per day

Table 4.4

Day	Consumption per day Unit: KW/h
Day- 01	3000
Day- 02	3000
Day- 03	3100
Day- 04	3100
Day- 05	2100
Day- 06	1900
Day- 07	1500

4.5 Cost of chemicals and electricity

Table 4.5

Day	Cost of chemicals tk	Cost of electricity tk
Day- 01	166875	24000
Day- 02	192436	24000
Day- 03	190604	24800
Day- 04	191071	24800
Day- 05	206918	16800
Day- 06	209015	15200
Day- 07	191234	12000
Total	1,348,153	141,600

4.6 Some other costs

- Annual maintenance (Repair or instrument) cost Taka 12,00,000.

CHAPTER 05

CONCLUSION & FUTURE RECOMANDATION

5.1 Conclusions

After completing this project, we have come to know what factors should be considered while using an ETP, we've learned which parameters are tested of a treatment plant. And which tests are brought to test in the effluent as well as the discharged water. We also learn about the types of chemicals used in ETP and their function and costing.

In the bio-chemical treatment plant of GAD on average more than 2200m3 wastewater is processed in 24 hours. The ETP runs for 24 hours. If the amount of wastewater is about 4500m3 in 24 hours, not all of them can be processed. About 4000/4100m3 can be processed in 24 hours. And the rest is added in next hour, which is entered in next day data.

The amount of waste material that are found, TDS is found the most. Though in both DOE and BSR limit, TDS's limit is 2500mg/l, so 800mg/l is safe. BOD and COD can only be measured once in a week, as they both require time. Yet these also do not cross the BSR and DOE limit which is 30mg/l and 200mg/l respectively. On average we only found BOD 15mg/l and COD 90mg/l, which is eventually on the safe side. And rise in temperature and pH shows no abnormality. There is a very little rise in temperature, and pH is near to the neutral value.

In case of chemical cost and power consumption, about 5,777,790 takas are spent in one month for chemical, for maintenance cost about 1,20,0000 takas and for electricity about 606,840 takas are spent in a month. GAB not just only bear the whole properly cost and do all the tests but also every month ITS visits once to get monthly report about the treatment process and the quantity of materials that are found.

5.2 Guidelines for safety in ETP

Effluent treatment plant operators work both indoors and outdoors and are exposed to noise from machinery and to unpleasant odors. Operators' work is physically demanding, and work is often performed in unclean locations. Moreover, plants operate 24 hours a day,7 days a week therefore, operators work one of three 8-hour shifts, including weekends and holidays, on a rotational basis. Operators may be required to work overtime.

Also, ETP operators are exposed to a variety of hazardous chemical agents, contained in the effluents and to the reagents used in the wastewater processing, or generated during the waste waters treatment. These chemical agents may cause acute poisoning, chemical accidents (e.g.: skin burns, injury to the eyes, etc.) damage to the respiratory system allergies, dermatitis, chronic diseases, etc.

Occupational safety and health (OSH) considerations are becoming integral part of modern-day operations. In view of this it is necessary to identify hazards and devise preventive and remedial measures to mitigate OSH risks in ETP operation. The hazards in ETP O & M are listed below:

1. Slips and falls on floors made slippery by water, aqueous solutions, or solvents.

2. Blows and contusions caused by falling heavy articles, including containers of chemical reagents, e.g., from overhead conveyers, or by contact with moving machinery or vehicles.

3. Falls into ponds, pits, clarifiers, or tanks causing injuries or drowning.

4. Hazards related to entry into confined spaces - suffocation due to oxygen deficiency, poisoning (e.g.by hydrogen sulfide) etc.

5. Burns, by steam or hot vapors, by splashes of hot plating baths, solvents and other liquids, by contact with hot surfaces (e.g., annealing ovens) etc.

6.Electric shock caused by contact with faulty electrical equipment, cables, etc.

7. Injuries (especially of eyes) caused by flying particles, from rotating brush cleaning or wheel grinding.

8. Fire and explosions due to the formation and release of flammable gases during processing (e.g., methane, hydrogen).

9. Vigorous chemical reactions caused by uncontrolled mixing of chemicals (e.g., if water is mixed with concentrated Sulfuric acid) during the preparation of reagents for wastewater treatment.

10. Acute poisoning caused by various chemicals present in the wastes, used as reagents (e.g., gaseous chlorine), or released during the treatment; a particular hazard is caused by the possible release of several poisonous gases, e.g., hydrogen-cyanide (from metal plating or heat treatment wastes upon acidification), hydrogen-sulphate etc.

11.Acute intoxication caused by erroneous drinking of untreated wastewater.

12.Poisoning by phosgene, which may be formed if a worker smokes in the presence of chlorinated-solvent vapors, or if welding or other flames or arcs are used.

13. Chemical burns by corrosive liquids Damage to eyes by splashes of irritating or corrosive liquids. It is good use to prepare a good obligation and danger signaling system on the installation. The most important signals are the following:[4]

5.3 ETP Operation for safety cases

1. Use safety shoes or boots with non-slip soles.

2.Wear personal protective equipment and chemical resistant clothing to avoid exposure of skin to corrosive and/or polluted solids, liquids, gases, or vapors.

3. Do not mix chemicals without the supervision of a qualified chemist or safety professional.

4. Obey all safety-instructions regarding the storage, transport, handling or pouring of Chemicals.

5. Check electrical equipment for safety before use; verify that all electric cables are properly insulated; take faulty or suspect electrical equipment to a qualified electricity.

6. Wear safety goggles in all cases where the eyes may be exposed to dust, flying or splashes of harmful liquids.

7.Wear respirator, or gas mask, when exposed to harmful aerosols, dusts, vapors or gases.

8.Take extreme care when handling highly corrosive agents such as liquid or gaseous chlorine, concentrated acids, or alkalis, or when toxic gases may be emitted from the reagents, etc.

9. Obey all safety instructions concerning entry into confined spaces, e.g., check atmosphere for oxygen or for poisonous gases, use respiratory protection equipment if

10.Do not smoke, eat, or drink in areas where chemical or biological contamination may be expected.

11.Use non-latex gloves if sensitivity to latex has been diagnosed.

12.All workers should undergo periodic examinations by occupational physician to reveal early symptoms of possible chronic effects or allergies.

13. Learn and use safe lifting and moving techniques for heavy or awkward loads such as containers of chemicals; use mechanical aids to assist in lifting.

14.If the tank depth is more than 1.5m when the worker down to the tank they must have to use safety belt.

15.In every tank at least one tube must have for swim to get rid of any type of accident.

5.4 Hazard of ETP

While planning the list of PPES, the following types of situations should be faced:

1.Impact/Penetration/Compression while doing maintenance tasks

2.Chemical Handling

3.Heat/cold and wetting

4.Harmful dust

5.Oxygen deficiency

6. Obnoxious odors of decomposing matter

7.Hydrogen sulfide presence

8.Light (optical)radiation

9.Noise of machines and vibrations.

10.Electric shock

11. Rain/ Storm

5.5 PPE for ETP

1.Safety Boots with non-skid soles and Steel Toes.

2.Electrical Hazard safety Toe shoes

3. Gas Masks and Face Shields

4. Oxygen meters for ascertaining type of atmosphere in a confined area.

5.Safety Goggles

6.Helmets/Hard Hats

7.Latex Rubber/Butyl Rubber/Fabric/ Chemical Resistant Gloves

8.Overall Clothing

9.Aprons for laboratory Personnel

10.Safety Belts

11.First Aid Box

12.Fire extinguishers

5.6 Safe handling of chemicals and corrosive substances

Since handling of chlorine and corrosive chemicals form part of many ETPs, special attention should be given to safe handling of these chemicals and corrosive substances such as Acids (Sulfuric acid), Alkaline etc. [6]

5.7 Acute health Effects

Inhalation	**Irritation of mucous membranes, difficulty in breathing, fits of coughing, pulmonary edema**
Ingestion	Irritation and burning sensation of lips, mouth, and throat; pain in swallowing; swelling of the throat; painful abdominal cramps; vomiting; shock; risk of perforation of the stomach
Skin Contact	Burning, redness and swelling, painful blisters, profound damage to tissues, and with alkalis; a slippery, soapy feeling
Eye Contact	Stinging, watering of eyes, swelling of eyelids, intense pain, ulceration of eyes, loss of eyes or eyesight

5.8 First Aid

Inhalation	**Remove person from source of contamination if safe to do so. Get medical attention. Keep person warm and quiet and do not leave unattended.**
Ingestion	Remove person from source of contamination if safe to do so. Get medical attention. Keep person warm and quiet and do not leave unattended.
Skin Contact	Remove person from source of contamination and take immediately to an emergency shower or source of water. Remove clothing, shoes, socks, and jeweler from affected areas as quickly as possible, cutting them off if. necessary. Be careful not to get any chemical on your skin or to inhale the vapors. Flush the affected area with water for a minimum of 15 minutes. Get medical attention.
Eye Contact	Areas as quickly as possible, cutting them off if necessary. Be careful not. to get any chemical on your skin or to inhale the vapors. Flush the affected area with water for a minimum of 15 minutes. Get medical attention.

5.9 Future aspects of Bio-Chemical Treatment plant

If we want to save and sustainable environment in future. We should make sure wastewater treatment plant or reuse process so that we can confirm a suitable peaceful place for next generation. To confirm this, require a chemical treatment plant (ETP) is most necessary & helpful away.

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[7] All the pictures have been collected from GAD Limited

[8] All the Data have been collected form GAD Limited