

Comparative Exploration of ETP water of Pharmaceutical Companies in Bangladesh

A project submitted

by

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Dhaka, Bangladesh

Date:

This work is dedicated to my parents and my sibling to whom I owe my achievements.

Certification statement

This is to certify that, this project titled “Comparative Analysis of ETP water of Pharmaceutical Companies” submitted for the partial fulfillment of the requirements for the degree of Bachelor of Pharmacy from the Department of Pharmacy, BRAC University constitutes my own work under the supervision of Shahana Sharmin, Senior lecturer, Department of Pharmacy, BRAC University and that appropriate credit is given where I have used the language, ideas or writings of another.

Signed,

Countersigned by the Supervisor

Acknowledgement

I would like to begin my gratitude to Almighty Allah for the help in the completion of this research and preparation of this paper.

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Abstract

Effluent Treatment Plant (ETP) is most cost Effective & technically proven system to remove the unwanted, hazardous chemicals from the waste water to meet the statutory pollution control requirements, especially for chemicals, pharmaceuticals, phosphating and electroplating wastewaters. In the present study different types of parameters were tested of the ETP water along with the Turag River water. Turag river is situated in Tongi, a very place where different industrialization has situated surrounding the river. Garments factory, pharmaceutical company and other industries dispose their wastes and disposal into the river water. As water is the vital element in our daily living, so it became a major concern of this study. However, the data analysis among the ETP water and Turag river water will give some of the ideas about the pollutions of the river. In the study, it was tried to find a cheap source to modify water quality. Further investigation needs to be developed to determine the safety of ETP water, future of the Turag river water and to find out a better source for water purification.

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List of abbreviation

ETP : Effluent Treatment Plant

FBR : Final Burette Rate

IBR : Initial Burette Rate

Chapter 1

Introduction

1.1 Overview

Water is one of the most important natural resources that is one of the basic requirements in human life. Water is used for a numerous of purposes, but it is used mainly for drinking. Apart from household uses, it is also used for several industrial purposes. Though water is found in abundance in nature, yet most of it is contaminated, and therefore it needs to be treated so that it can be recycled.

To portray water as the motor of life will not constitute an exaggeration. This is because of water in its different shapes, accounts for more than 70 percent of the whole soil surface and all life shapes notwithstanding of their territory depend on this plenteous asset for their continuous presence. In any case, as tremendous as this imperative resource is, as it were a little rate of its natural frame could be promptly utilized for drinking and sanitation purposes by the human. These are normally stored up in provisions and banks such as the aquifers, lakes, waterways and other surface freshwater bodies.

Due to the mounting impact of common events and anthropogenic exercises on these natural water sources, the flawless characteristics displayed by these water sources frequently fade out with time. Nowadays, the understanding of water quality has ended up conceptualized because of the various employments to which diverse sorts of water could be subjected to. More accordingly, due to the complexity of a few variables deciding water quality and the countless choice of factors utilized to supply a quantitative assessment of this term, it is difficult to adopt a single definition of water quality (Chapman, 1996). In a straightforward term, however, water quality introduces to the composition of any water body as influenced by nature and human cultural exercises, communicated in terms of both quantifiable amounts and narrative statements (Novotny, 2003).

Depending on the region of application, the criteria for establishing water quality necessities contrast in numerous perspectives. Subsequently, water which is suitable for a specific reason, for instance, rural water system might not be valuable for other purposes due to contrasts in water quality prerequisites.

Rising concerns related to water shortage are getting to be more of a critical issue over a more noteworthy. A number of locales & regions and particularly in regions helpless to drought and water deficiencies. Lessening water supply is especially troublesome to businesses that are dependent on giant quality prepare water for utilizing in manufacturing. In arrange to discharge potential water deficiency dangers and pick up more prominent water security, mechanical companies are progressively executing techniques that encourage higher water productivity.

"Raw water limitations present a very serious business risk, and many facilities are located in arid regions that are prone to disruptions in water supply," (Dr. Ram Venkatadri) "Water recycling is becoming a huge trend in this industry and others because it presents a way for plants to mitigate water shortage risks and become less dependent on raw water supplies," Venkatadri said.

1.1.1 Water quality is important

Water quality alludes to the chemical, physical, organic, and radiological features of water. It is a unit of the state of water relative to the prerequisites of one or more biotic species and or to any human requirement. It is most habitually utilized by reference to a set of measures against which compliance can be surveyed. The most common measures utilized to survey water quality relate to the wellbeing of environments, security of human contact, and drinking water.

Water Quality Goals perceive the natural values and employments for distinctive conduits that the community needs to see secured. These incorporate frivolous utilize, healthy

environments and ecosystems, and water for drinking and water system. Water quality is overseen and evaluated in terms of pointers for levels of microscopic organisms and the resources underneath are pointed to help in this respect.

1.1.2 Some common water quality testing parameters

pH: pH refers to the acidic and basic condition of solution. A pH of 7 indicates the neutral condition on a scale of acid (0) and base (14). The generally accepted range for pH in water is 6.5 to 8.5 with an upper limit of 9.5.

Hardness: Hardness of water causes excessive soap consumption and scaling. It is primarily caused by calcium and magnesium.

Iron: levels as low as 0.2 to 0.3 mg/L will ordinarily cause the staining of clothing and plumbing installations. The presence of iron microscopic organisms in water supplies will frequently cause the side effects at indeed lower levels. Iron gives water a metallic taste that may be problematic to a few at 1 to 2 mg/L. Most water contains less than 5 mg/L iron, but once in a while, levels over 30 mg/L are also found.

Alkalinity: Alkalinity is evaluated in erosion or scale testimony and may influence a few livestock when over 1,000 mg/L. It is a degree of the resistance of water to alter in pH. The alkalinity of most lowland waters is in the run of 100 to 500 mg/L, which is considered worthy.

E. coli (Escherichia coli) bacteria, coliform or others: Presence of this type of bacteria may indicate contamination of water. The presence of water borne bacteria causes different diseases like diarrhea, cholera etc. which are not acceptable.

There are other parameters like turbidity, total dissolved oxygen concentration, metal tests etc. These parameters help to define the quality of water.

1.1.3 What is ETP?

The abbreviation of ETP is Effluent Treatment plant. In the pharmaceutical companies' they have a separate region to purify the wastewater, this region is called ETP. In this sector, the pharmaceutical companies use different procedures to treat the wastewater so that those water will not harm the natural environment. It is important and used for the safe disposal of wastewater. ETP is designed to make up different procedures for treating industrial wastewater.

Simply, ETP is –

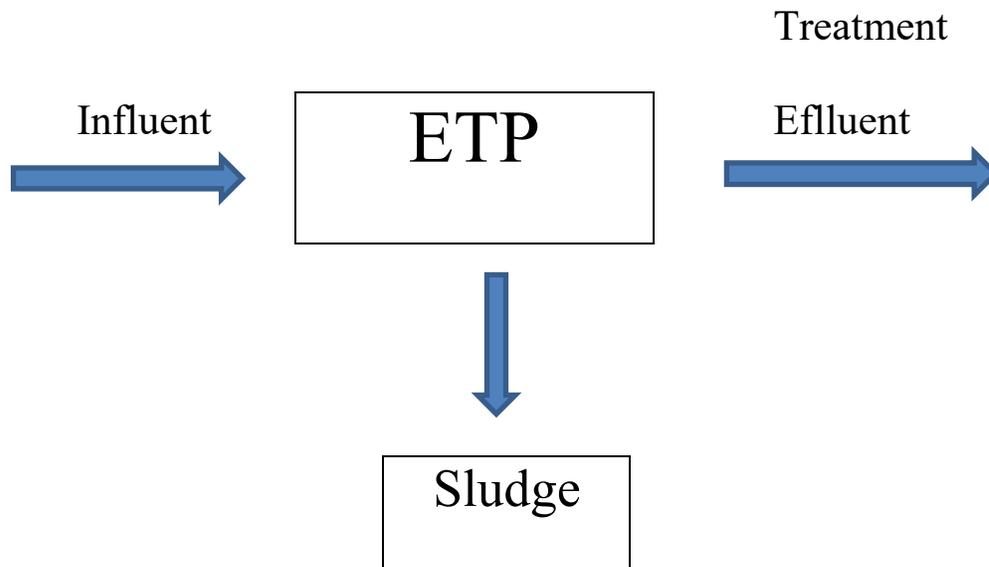


Figure 1.1.1: Basic mechanism of ETP

Influent: Untreated industrial waste water.

Effluent: Treated industrial waste water.

Sludge: Solid part separated from waste water by ETP.

1.1.4 Pharmaceutical ETP water treatment trends

Mechanical manufacturing forms in the pharmaceutical industry create wastewater that is by and large characterized as elevated quality organic effluent - waste streams that can be thought-provoking to oversee with accustomed wastewater treatment. The four primary constituents in pharmaceutical plant waste streams that supervisors are for the most part concerned with integrate oil, grease and lard, pH, suspended solids, and natural oxygen or chemical oxygen levels, dissolved oxygen concentration etc. But in expansion to these constituents, different countries and states are starting to center on the mineral substance in pharmaceutical plant effluents.

“This is something that is relatively new to the pharmaceutical industry and represents an area of potential change,” Brittan (technical director for the pharmaceuticals and microelectronics markets with Siemens Water Technologies in Britain) said.

Inorganic effluent mineral concentrations can vary, and can also be affected by raw water influent sources, depending on the pharmaceutical product manufactured. The plants need to maintain the discharge requirements for pH, mineral contents, microbial present etc.

1.1.5 Main purpose and objective of ETP

ETP reinforce the water for the safe disposal of the water from the pharmaceutical plant. In the pharmaceutical plant, water is one of the major parameter for manufacturing, processing and other requirements. The effluent from the different units of the plant contains several types of solids, toxins, antibiotics, hazards, various types of contamination etc. That water

obviously is not safe to dispose freely into the environment. So, the main purpose and objective of ETP is to prepare the effluent water in thus way so that it does not harm to the human health, marine life and ecosystem.

1.1.6 Importance of ETP

Provides clean, safe water: To clean industry deriving waste and reuse it for encourage use. Waste water can really be turned into reusable water. The treatment handle dispenses with any contagions from the water and produces clean, secure water indeed. As it were around 3% of the Earth's water is drinkable. It's a renewable asset but it takes very a long time for dissipation and rain to channel out the toxic substances. Wastewater treatment prompts the prepare up and gives clear, secure reusable water.

Saving water: To cut consumption on water procurement, ETP is very important. Actually ETP is helping to save water. If ETP was not there, a lot of water would be wasted due to the use in the industry. As ETP recycles old water, water is saved rather wasting. It ensues chemically treatment of water in the environment friendly way.

Maintaining the proper guideline: To meet the Guidelines for outflow or discharge of natural toxins from different Industries set by the Government and maintain a strategic distance from strong penalties.

A proper way to minimize waste: To protect environment against contamination and subsidize in sustainable improvement.

1.1.7 Process flow chart of effluent treatment of Effluent Treatment Plant (ETP)

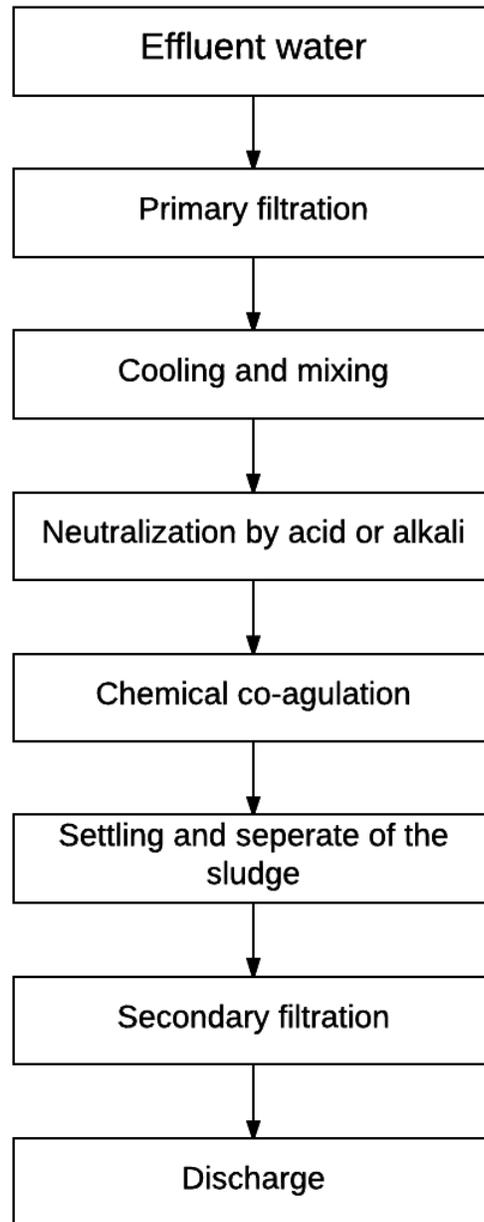


Figure 1.1.2: Basic structure of ETP

1.1.8 A small discussion about the process flow in the ETP of pharmaceutical plant

Primary filtration: It is the first stage of processing in ETP where all the effluents are passed into different units of pharmaceutical plant. By this filtration procedure, all the solid particles are removed from waste water.

Cooling and mixing: All the effluents from different source are mixed and cooled in this stage.

Neutralization by acid or alkali: In this step, acid or alkali is mixed with effluent water to neutralize them and maintain a certain pH.

Chemical co-agulation: Chemical co-agulants are added with waste water in ETP.

Settling and separation of the sludge: After different treatment, the treated water is settled and separate into another place. The residue remains the sludge.

Secondary filtration: Secondary filtration may include different treatments like carbon filtration, anti-microbial treatment, pressure filtration etc. to remove the remaining wastes from the water.

Discharge: After completion all the process, the water is discharged through certain drains to disposal river or others.

1.2 Rationale of the study

From the previous literature review, it has been found that there is a significant number of works have been done on ETP water analysis. But all the works were done in different countries but not in Bangladesh. However, the previous studies include different potential methods and test parameters. There is no comparative analysis done on ETP water in pharmaceutical company in Bangladesh. So, the main objective of my study is to do

comparative analysis between 2 different pharmaceutical ETP water and try to find out a cheaper source of water purification. In this study, microbial tests on Turag river water is also done as it is situated very close to the core of Dhaka city and it is surrounded by different industrialization. As well as, it is also source for industrial disposal of wastewater. So, it will give a general comparison between the pharmaceutical plant ETP water and a river water.

1.2.1 Targeted water

1. ETP water – before treatment in Pharmaceutical Company.
2. ETP water – After Treatment in different procedure.
3. River water where wastewater is disposed.

1.2.2 Aim of this study

The aim of the study is to do comparative analysis between two different pharmaceutical ETP water by checking different parameters.

1.2.3 Objective of this study

1. Comparative study by using 2 pharmaceutical company ETP water.
2. To do different tests on ETP Water and differentiate the water quality.
3. To study microbial tests of river water.
4. To find out a cheap source to modify the water quality.

1.3 Literature review

Extensive literature review was done to select the sample, the test parameters, the procedure and requirements, chemicals, solvents, experimental conditions along with methodology, previous work analysis and to define other new study.

Following are the list of journals to conduct the present study –

International Journal of Pharmaceutical Science and Research

Bangladesh Journal of Scientific and Industrial Research

International journal of Pharmatech Research

Article by Agriculture and Forestry

World Journal of Pharmaceutical Sciences

Chapter 2

Methodology

2.1 Working place

The overall research was performed in the Microbiology Laboratory, Physical Pharmacy Laboratory, Department of Pharmacy, BRAC University maintaining all the specifications and requirements.

2.2 Collection of the sample

The samples were collected from two different pharmaceutical company ETP water and Turag River water.

2.3 Parameters used for this study

ETP water (Before treatment)	ETP water (After Treatment)	Disposal source
pH	pH	
Alkanlinity	Alkalinity	
Microbial analysis test	Microbial analysis test	Microbial analysis test

2.4 Determination of pH

2.4.1 Theory

pH is truly a degree of the relative sum of free hydrogen and hydroxyl particles in the water. Water that has more free hydrogen is acidic, while water that has more free hydroxyl ion is

basic. Since pH can be influenced by chemicals in the water, pH is a critical marker of water that is changing chemically.

2.4.2 Apparatus required

- Beaker
- pH meter & Distilled water

2.4.3 Procedure steps

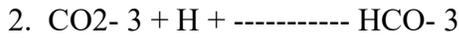
1. First of all, the pH meter is calibrated with Neutral solution of pH 4.01.
2. Then, small amount of sample water (before treatment) ETP water was taken into a beaker and by the pH meter, pH of the water was observed and recorded.
3. After that, the pH meter is washed with distilled water. Again, small amount of sample water (after treatment) ETP water was taken into another beaker. By the pH meter, pH of the water was observed and recorded.
4. Following the same process, the pH of the Turag river water was also recorded.

2.5 Determining the alkalinity of given water sample

2.5.1 Theory: Alkalinity refers to the capability of water to neutralize acid. This is really an expression of buffering capacity. In case any changes are made to the water that could raise or lower the pH esteem, alkalinity acts as a buffer, securing the water and its stability shapes from sudden alterations in pH. This capacity to neutralize corrosive or acid, or H^+ , is especially imperative in areas which are subjective by acid rain.

2.5.2 Reaction: Alkalinity of water, which is a measure of the ability of water to neutralize the acids, is due to presence of bicarbonates, carbonates & hydroxides of Ca & Mg. Determination of alkalinity due to different ions is based on the titration of the water sample against a standard acid making selective use of indicators. The indicators used are phenolphthalein & methyl orange.

The reaction taking place is as follows:



A known volume of the sample is titrated against a standard acid a sign phenolphthalein as indicator to phenolphthalein end point [P] & continuing the titration during methyl orange as indicator point [M]. The volume of acid ran down upto phenolphthalein end point [P] corresponds to the completion of the equation (1) & (2) given above, while the volume of acid ran down after [P] corresponds to the completion of equation (3). The total amount of acid used from the beginning of the experiment, i.e. [M] corresponds to the completion of the reaction (1) to (3).

2.5.3 Procedure

2.5.3.1 Preparation of 100ml 0.1N HCL solution

$$1000\text{ml } 1\text{N HCL} = 36.5\text{ml/mol}$$

$$1\text{ml } 1\text{N HCL} = \frac{36.5}{100}$$

$$\begin{aligned} \text{So, } 100\text{ml } 1\text{N HCL} &= \frac{36.5 \times 0.1 \times 100}{1000} \\ &= 0.365 \text{ ml/mol} \end{aligned}$$

As, specific gravity 1.189

Pure HCL present = 37.5%

$$\begin{aligned} \text{So, amount of HCL was required} &= \frac{0.365}{0.375 \times 1.189} \\ &= 0.818 \text{ ml} \end{aligned}$$

2.5.3.2 Process Steps

1. 10ml of before treated ETP water sample was taken in a 100ml conical flask.
2. 2-3 drops of phenolphthalein indicator was added.
3. The color of the sample solution did not become pink. If the color would change to pink, this solution would be titrated against 0.1 N HCL taken in a burette till color of the solution disappears.
4. The value 0 [P] was noted.
5. Again, 2-3 drops of Methyl orange indicator were added to the same before treated ETP water sample, the color of the sample became yellow and continued the titration against 0.1N HCL solution taken in the burette until the sharp color changed from yellow to rose red.
6. The total titre value from the beginning of the experiment as methyl orange end point [M] was noted.
7. Same procedure was followed on after treated ETP water sample. All the values were recorder properly.

2.6 Microbiological culture analysis

In this present study, identification of microbes in water sample, two mediums were used -

- Nutrient broth &
- Agar medium

2.6.1 Process of identification of microbes by nutrient broth

2.6.1.1 Chemicals required

- Nutrient broth medium
- Distill water

2.6.1.2 Apparatus required

- Conical flask (50ml)
- Sterile micro pipette
- Auto clave
- Incubator

2.6.1.3 Preparation of Nutrient broth medium

1000ml contains 13gm broth

$$\begin{aligned} 10\text{ml contains} &= \frac{13 \times 10}{1000} \\ &= 0.13 \text{ gm broth} \end{aligned}$$

So, 10ml distilled water was added into 0.13 gm broth into each conical flask.

2.6.1.4 Process steps

1. Freshly prepared 10ml nutrient broth was taken in each three conical flasks.
2. Then, the three conical flasks were transferred into the auto clave to sterilize for 45 minutes at 120degree Celsius.

3. After sterilization, by the use of sterile micro pipette, 10 ml of each three water sample (before treatment, after treatment and river water) were incorporated into the three conical flask maintaining the aseptic condition in the hood.
4. Then, they were transferred into the incubator at 37degree Celsius for 24 hours.
5. The result was noted after 24 hours.

2.6.2 Process of identification of microbes by Agar

2.6.2.1 Chemicals required

- Agar
- Distilled water
- Iso-propyl Alcohol

2.6.2.2 Apparatus required

- Conical flask (50ml)
- Sterile micro pipette
- Auto clave
- Sterile Petri dishes
- Incubator

2.6.2.3 Preparation of Agar medium

1000 ml contains = 28gm Agar

$$20 \text{ ml contains} = \frac{28 \times 20}{1000}$$

= 0.56 gm Agar; So, 20ml distilled water was added into 0.56 gm agar into each conical flask.

2.6.2.4 Process steps

1. Freshly prepared Agar medium was taken into each three conical flasks.
2. Then, the three conical flasks were transferred into the auto clave to sterilize for 45 minutes at 120degree Celsius.
3. After the sterilization is complete,10 ml of each three water sample (before treatment, after treatment and river water) were incorporated into the three conical flask maintaining the aseptic condition in the hood.
4. Then, each three mediums were transferred into three sterile petri dish.
5. After 3 plates were poured, the plates were swirled, filled agar so that it completely covers the bottom. Waited until they Agar medium will set like stiff gelatin at room temperature and placed the lid on top.
6. Then they were transferred into the incubator at 37degree Celsius for 24 hours.
7. After 24 hours, the dishes were observed and the results were noted.

2.7 Water filtration method

2.7.1 Water filtration by Aquatic plants

Freshly collected Kochuripana, also known as Water Hyacinth was washed with tap water and then distilled water. Then they were cut so small pieces like leopard and collected into a sterile beaker. Another sterile beaker and a sterile funnel was taken. Then, a filter paper was set into the funnel and the small pieces of the aquatic plants were taken into the funnel and prepared like filter. 20ml water sample (before treated ETP water) was filtered through the plants made filter. The filtered water was taken into the sterile beaker.

Following the same procedure, the other two water samples (after treated ETP water & Turag river water) were filtered. The filtrates were taken into separate beakers.

2.7.2 Microbiological analysis test of the filtrates

In this study, Agar medium was used for microbiological analysis test.

2.7.3 Chemicals required

- Agar
- Distilled water
- Iso-propyl Alcohol

2.7.4 Apparatus required

- Conical flask (50ml)
- Sterile micro pipette
- Auto clave
- Sterile Petri dishes
- Incubator

2.7.5 Preparation agar plate

1000 ml contains = 28gm Agar

$$20 \text{ ml contains} = \frac{28 \times 20}{1000}$$
$$= 0.56 \text{ gm Agar}$$

So, 20ml distilled water was added into 0.56 gm agar into each conical flask.

2.7.6 Process steps of microbiological analysis test:

1. Freshly prepared Agar medium was taken into each three conical flasks.
2. Then, the three conical flasks were transferred into the auto clave to sterilize for 45 minutes at 120degree Celsius.

3. After the sterilization is complete, 10 ml of each three filtrate sample (before treatment, after treatment and river water) were incorporated into the three conical flask maintaining the aseptic condition in the hood.
4. Then, each three mediums were transferred into three sterile petri dish.
5. After 3 plates were poured, the plates were swirled, filled agar so that it completely covers the bottom. Waited until Agar medium will set like stiff gelatin at room temperature and placed the lid on top.
6. Then they were transferred into the incubator at 37 degree Celsius for 24 hours.
7. After 24 hours, the dishes were observed and the results were noted.

Chapter 3

Result and discussion

3.1 Determining pH of the sample water

Neutral	Before treated ETP water	After treated ETP water
pH = 4.01	pH = 5.42	pH = 5.62

Table 3.1: Determination of the pH of water samples (before treated, after treated ETP sample water)

3.2 Determination the alkalinity of water sample

ALKALINITY DUE TO DIFFERENT IONS:

Titration result	OH ⁻	CO ₃ ²⁻	HCO ₃ ⁻
[P] = 0 [P] = [M]	NIL [P] or [M]	NIL NIL	[M] NIL
[P] = $\frac{1}{2}$ [M] [P] > $\frac{1}{2}$ [M] P < $\frac{1}{2}$ [M]	NIL 2 [P] - [M] NIL	2 [P] or [M] 2 { [M] - [P] }	NIL NIL [M] - 2 [P]

Table 3.2: Controlled values for Alkalinity tests

No. of obs	Volume Of water	IBR	Titration with phenolphthalein			Titration with methyle orange.		
			FBR	Volume of HCL used [P]' = FBR-IBR	[P]	FBR	[M]'=FBR-IBR	[M]
1.	10ml	20	0	0		20.6	0.6ml	
2.	10ml	20.6	0	0	0	21.2	0.6ml	0.6 ml
3.	10ml	21.2	0	0		21.8	0.6ml	

Table 3.3: Titration of before treated ETP sample water

Result for before treated ETP sample water: Comparing the result with the controlled values for alkalinity (Table 2) the following results are found-

After adding phenolphthalein indicator, the color of the sample did not change to pink.

Thus, $[P] = 0$, $[M] = 0.6$;

So, sample water contains-

Alkalinity of OH = NIL

Alkalinity of CO₃ = NIL

Alkalinity of HCO₃ = 0.6

Again, titration after adding methyle orange,

$$[P] < \frac{1}{2}[M]$$

$$0 < 0.3; \quad \dots[M] = 0.6\text{ml}$$

So, sample water contains-

Alkalinity of OH = NIL

Alkalinity of CO₃ = NIL

Alkalinity of HCO₃ = 0.6

No. of obs	Volume Of water	IBR	Titration with phenolphthalein			Titration with methyle orange.		
			FBR	Volume of HCL used [P]' = FBR-IBR	[P]	FBR	[M]'=FBR-IBR	
1.	10ml	25	0	0		26.1	1.1 ml	
2.	10ml	26.1	0	0	0	27.1	1 ml	1.03 ml
3.	10ml	27.1	0	0		28.1	1 ml	

Table 3.4: Titration of after treated ETP sample water

Result for after treated ETP sample water: Comparing the result with the controlled values for alkalinity (Table 2) the following results are found-

After adding phenolphthalein indicator, the color of the sample did not change to pink.

Thus, $[P] = 0$, $[M] = 1.03$

So, sample water contains-

Alkalinity of OH = NIL

Alkalinity of CO₃ = NIL

Alkalinity of HCO₃ = 1.03

Again, titration after adding methyle orange,

$[P] < \frac{1}{2}[M]$

$0 < 0.515$; $[M] = 1.03$ ml

So, sample water contains-

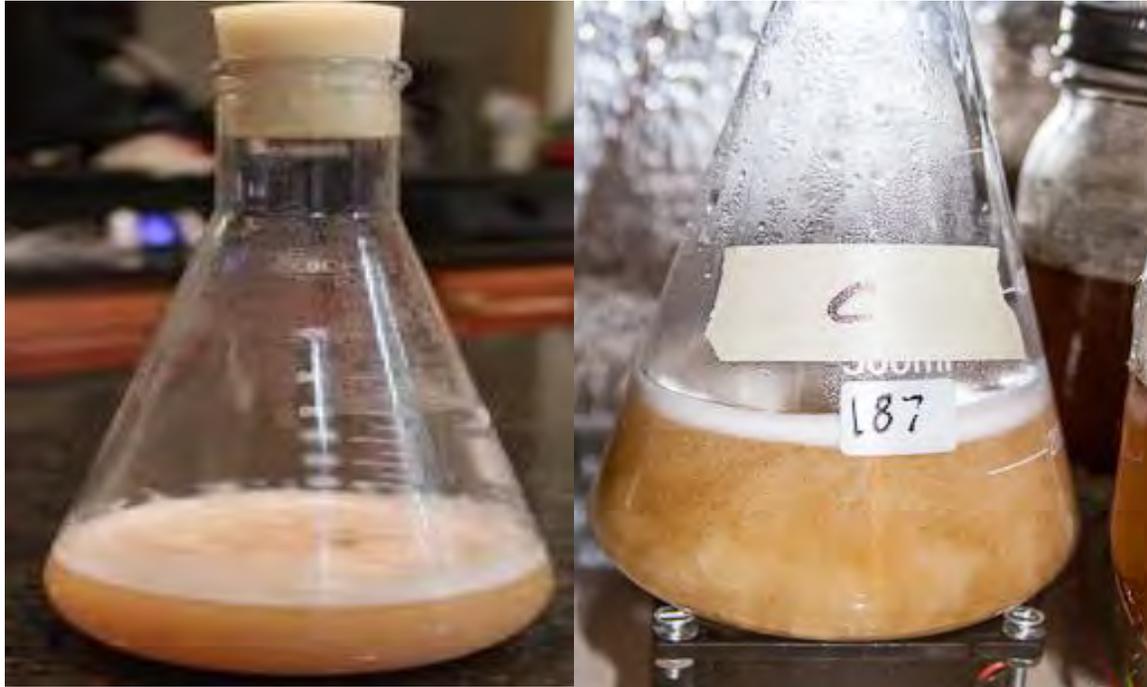
Alkalinity of OH = NIL

Alkalinity of CO₃ = NIL

Alkalinity of HCO₃ = 1.03

However, from the alkalinity test, it was observed that in this titration, when phenolphthalein was used as indicator to make the color change from light pink to colorless & when methyl orange was used as indicator to make the color change from yellow to rose red color. In this study, after adding phenolphthalein indicator, the color did not change to pink, thus, $[P] = 0$. Again when methyle orange indicator was added, the color changed to yellow. Then, the titration was done till the color changed to rose red color.

3.3 Microbiological analysis test



Before treated ETP water

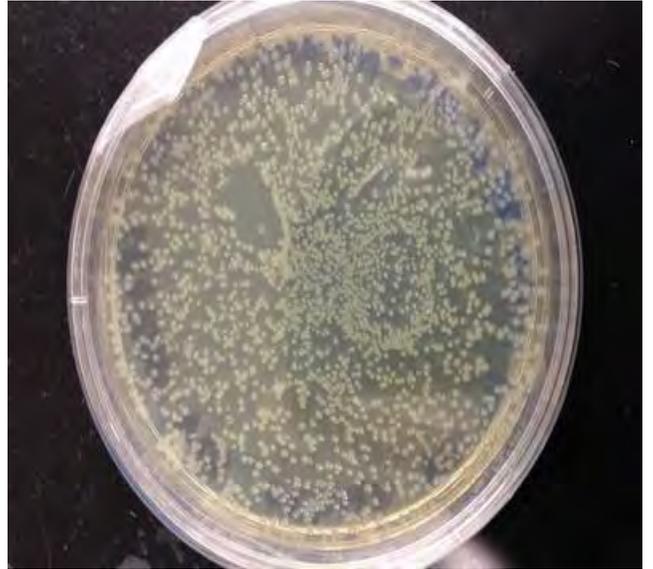
After treated ETP water

Figure 3.1: Nutrient broth culture of before treated and after treated ETP sample water

After 24 hours of incubation, the conical flasks were got out from the incubator. Microbial growth was observed in all the sample water. So, it indicated that before treated ETP water and after treated ETP water contained microbial collection.



Before treated ETP water



After treated ETP water

Figure 3.2: Agar culture plate of before treated ETP sample water and after treated ETP sample water.



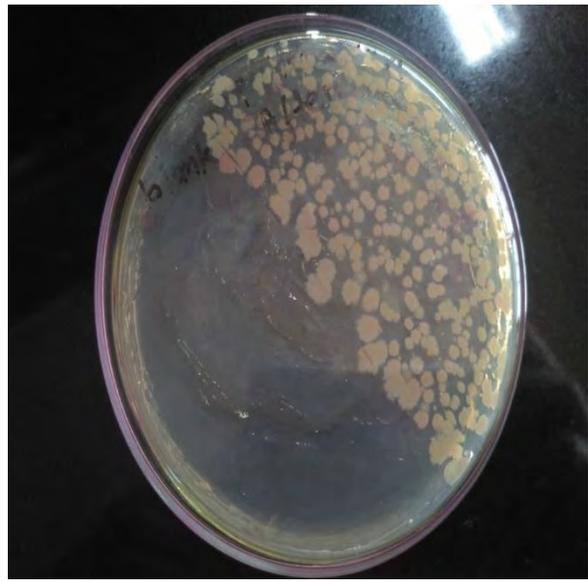
Figure 3.3: Agar culture plate of Turag river sample water

After 24 hours of incubation, the agar culture plates were observed. There was microbial growth in three agar plates (before treated ETP water, after treated ETP water and Turag river water) containing agar medium.

3.4 Microbiological analysis tests after water filtration by aquatic plant (Kochuripana)



Before treated water sample



After treated water sample

Figure 3.4: Agar culture plate of (before treated and after treated ETP water sample) after filtration by Kochuripana

After filtration by aquatic plant Kochuripana, the filtrates were incubated in agar plates for 24 hours. After 24 hours the result was, microbial growth was observed into the agar culture plates containing agar medium. That indicated that, microbes were present still after the filtration by the filter made by Kochuripana.



Figure 3.5: Agar culture plate of Turag river water sample after filtration by Kochuripana

After filtration by aquatic plant Kochuripana, the filtrate was incubated in agar plates for 24 hours. After 24 hours the result was, microbial growth was observed into the agar culture plates containing agar medium. That indicated that, microbes were present still after the filtration by the filter made by Kochuripana.

Chapter 4

Conclusion

The objective of the study was to do comparative analysis of different pharmaceutical companies using different test parameters was attained properly. The attempt to find out a cheap source to modify water quality was not fulfilled.

The conclusion of the study can be drawn by mentioning that pH of the water was not within the acceptance range and the alkalinity test was done to observe the levels of ions. The microbiology analysis tests were done maintaining all aseptic condition still there was presence of microbial growth in Before Treated ETP water sample and After Treated ETP water sample. To find out a cheap source to purify water, sterilization needed to be done to all materials and equipment's. All the data were required to maintain and record properly to avoid error and as it was a comparative analysis they were compared with one another to come into a conclusion.

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