TREATMENT OF WATER USING VARIOUS ADSORBENTS

Submitted in partial fulfilment
of the requirements
for the degree of

Bachelor of Engineering

By

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2018-2019

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This is to certify that, **Ansari Mohd SaaimMohd Shakeel (15CES10), Maste Noman Niyaz Ahmed (14CES26)** and **Mohammad Abuzar(16DCES75)** has satisfactorily completed and delivered a Project report entitled, **"Treatment Of Water Using Various Adsorbents"** in partial fulfillment for the completion of the **B.E.** in **Civil Engineering** Course conducted by the University of Mumbai in Anjuman-I-Islam's Kalsekar Technical Campus, New Panvel, Navi Mumbai, during the academic year 2018-19.

Dr.Shabiimam M.A.

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Dr. Abdul Razzak Honnutagi — Director

Project Report Approval for B. E.

This B. E. Project entitled **"Treatment Of Water Using Various Adsorbents"** by **Mr. Ansari Mohd Saaim Mohd Shakeel, Mr. Maste Noman Niyaz Ahmed,** and **Mr. Mohammad Abuzar** approved for the degree of***"Bachelor of Engineering"*** in ***"Department of Civil Engineering".***

Examiners

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Chairman (Director)

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Date:

DECLARATION

We declare that this written submission represents my ideas in our own words and where others ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Acknowledgment

It is our privilege to express our sincerest regards to our project Guide**, Dr. Shabiimam M.A.**, for their valuable inputs, able guidance, encouragement, whole-hearted cooperation and constructive criticism throughout the duration of our project.

We deeply express our sincere thanks to our Head of Department **Dr.R.B.Magar** and our Director **Dr. Abdul Razzak Honnutagi** for encouraging and allowing us to present the project on the topic "**Treatment Of Water Using Various Adsorbents**" in partial fulfillment of the requirements leading to award of Bachelor of Engineering degree.

We take this opportunity to thank all our Professors and non-teaching staff who have directly or indirectly helped our project, we pay our respects and love to our parents and all other family members for their love and encouragement throughout our career. Last but not the least we express our thanks to our friends for their cooperation and support.

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ABSTRACT

The earth contains only 3% of pure water, in this readily available fresh water content is very low. The rapid population growth creates more demand of fresh water for every day activity. To meet this demand, treatment of raw water as well as recycling of wastewater is necessary. Adsorption is one of the techniques which is used to treat the water in primary as well as tertiary condition according to treatment scheme. Nowadays portable filters available in the market mostly rely on activated carbon-based adsorption process. Conventional activated carbon is expensive , therefore introduction to new materials as naturally available can be more effective .Thereby ,while choosing the adsorbent with following criteria such as cost of the adsorbent , pH, reaction time are need to be given more emphasis . The study reviews on water treatment using various natural adsorbents like muringaolefera, tamarind seeds, and bentonite soil etc . It also discusses the various heavy metal pollutant removal like lead, arsenic and zinc etc using various natural adsorbent.

Keywords: water treatment, heavy metal, adsorption, Natural adsorbents ,tamarind seeds , Batch adsorption.

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ABBREVIATION NOTATION AND NOMENCLATURE

ATS	Activated Teff Straw
AMD	Acid Mine Drainage
OSM	Orbital shaking machine
NTU	Nephelometric Turbidity Unit
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
Cr	Chromium
Cd	Cadmium
Pb	Lead
Ni	Nickel
Cu	Copper
RPM	Rotation Per Minute
SS	Suspended Solid
TSP	Total Suspended Solid
TDS	Total Dissolve Solid

Chapter 1

Introduction

1.1 General

To make water useable various treatment are done one of which is using adsorbents. Adsorbents are the materials which attracts the impurities i.e. a thin layer is form on The surface of the adsorbents. There are two types of adsorbents artificial and natural Adsorbents. In this study natural adsorbents are used because they are low cost and easily Available.

This study is done to introduce a cheap and easy way to treat the water because in some Village areas no proper filtered water is available and they cannot even afford the expensive Treatment technique to treat the water.

Out of all the water on Earth, saline water in oceans, seas and saline groundwater make up about 97% of it. Only 2.5–2.75% is fresh water, including 1.75–2% frozen in glaciers, ice and snow, 0.5–0.75% as fresh groundwater and soil moisture, and less than 0.01% of it as surface water in lakes, swamps and rivers.

Water is a critical issue for the survival of all living organisms. Some can use salt water (like fish) but many organisms (like human, animal etc) cannot use Water requirement is increased day by day due to increase in pollution, life style and way of use. So we cannot survive or depend on 3% , we have to use some techniques, ideas to filter those 3/4th water and use it so we can avoid lack of water and provide sufficient water to the population.

There are various techniques by which we can filter the polluted water, out of which we are going to adopt "Treatment of water using various adsorbent". Adsorbent may be natural or artificial and this method is cheapest, so we can supply water at cheapest rate.

1.2 Aim

This project has been taken up to "Treatment Of Water Using Various Adsorbents" With the following objective.

1.3 Objectives

To treat the water using batch adsorption study.

To use natural adsorbent for treating water.

To check the effect of pH on adsorption.

To analyse optimum dose of adsorbent.

To continue the study with various adsorbents, like bentonite clay, tamarind seeds, Activated carbon, Sugarcane Bagasse etc.

To treat water using low cost adsorbents removing heavy metals.

To determine the turbidity of water.

1.4 Batch Adsorption Study

Adsorption is the adhesion of atoms, ions or molecules from a gas, liquid or dissolved solid to a surface. This process creates a film of the adsorbate on the surface of the adsorbent. Adsorption is present in many Natural, physical, Chemical and Biological system.

This process is different from absorption, because in absorption process, the adsorbent used is dissolved, but in adsorption process adsorbent does not dissolved but form a thin layer which helps in adhering the pollutant and may be for some other reasons.

Adsorption widely used in industrial application such as heterogeneous catalyst, activated charcoal (carbon), capturing and using waste heat to provide cold water for air conditioning and for other process requirements like synthetic resin, water purification ion exchange and chromatography.

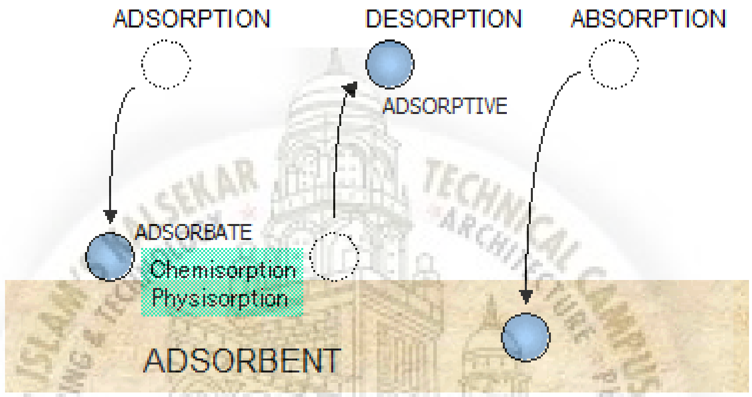

Figure 1.1: Batch Adsorption (Source:https://images.app.goo.gl/Liq7gveZMxrfyHSu9)

The Batch adsorption process being widely used by various researchers for removal of heavy metals like (Cr, Cd, Pb, Ni, and Cu) from waste stream, and activated carbon has been frequently used as an adsorbent.

Adsorption of heavy metals (Cr, Cd, Pb, Ni, and Cu) onto Activated Teff Straw (ATS) has been studied using batch-adsorption techniques. This study was carried out to examine the adsorption capacity of the low-cost adsorbent ATS for the removal of heavy metals from textile effluents.

In our project we carried out the batch adsorption to remove the turbidity and maintain the pH of waste water sample which we will can use for different purposes like clothe washing, gardening, street washing, utensils washing, bathing etc so we can decrease the crises of water, and we can brought the waste water into use.

We use different adsorbent in batch adsorption to remove the turbidity and maintain the pH like tamarind seeds, sugarcane bagasse, activated carbon and bentonite clay.in batch adsorption, in which we take10 number of beakers of size 250ml mark from 1to 10 filled with

100ml of waste water after that we put 0.1gm/100ml, 0.2gm/100ml, 0.3gm/100ml, 0.4gm/100ml, 0.5gm/100ml, 0.6gm/100ml, 0.7gm/100ml, 0.8gm/100ml, 0.9gm/100ml, 1gm/100ml, adsorbent from marking 1 to 10 respectively and after that all beakers put into mechanical agitator machine for a period of 40minuts @140rpm

Chapter 2

Literature Review

2.1 General

Following adsorbents are read and reviewed carefully and effectively to treat the waste water

2.2 Tamarind Seeds

M.Murugan and E.Subramaniam (2006)

They used batch adsorption study was done to remove synthetic fluoride using tamarind seeds by agitating 0.1 gm of sorbents with 50 ml of solution in 100 ml polythene bottle in temperature controlled water both cum shaker,by spectrophotometer supernatant was analysed for fluoride. The surface characteristic of tamarind seed makes it a good adsorbents.

B.Shoba et al (2015)

Tamarind seed powder is used as adsorbents to remove dairy industry wastewater pollutants batch test was done at concentration 2g/L, 4g/L, 6g/L, 8g/L at 6 min. The optimum dosage obtained was 4g/L . Tamarind seed is suitable in removing COD , Total solids, Turbidity and sulphate in dairy industrial wastewater .

T.D.Raju et al (2018)

in this study tamarind seeds used as natural adsorbents to process parameters like pH, turbidity, acidity, alkalinity and chloride content. Batch adsorption study was carried out 15 litre of sample was taken and varying amount of dosage i.e. 100 mg/L, 150 mg/L, 250 mg/L was addedat 100 rpm.

2.3 Activated Carbon

P.K. Malik et al (2004)

In these Study, Textile Dyeing wastewater is treated using Activated carbon. The Dyeing wastewater is collected from Textile factory located in Calcutta. Batch study was carried at 30℃. The result shows that the maximum removal of dye occurs at pH 3. It also shows that when the pH is raised above 10 then the dye colour of wastewater is precipitated.

Dines Mohan et al (2001)

In these Study, the waste sample is collected from Bhatinda, India. Activated carbon is used as an adsorbent to treat the liquid. 1g of activated carbon was stirred with 100 ml of sample of pH 6.8 for 2 hour and left for 24 hour. As a result lowering of pH was observed. Batch study was done, 50 ml test tubes were taken each contains 10 ml of sample and different amount of activated carbon for different amount of activated carbon for different contact time. The desired results were obtained at 6 to 8 hour.

2.4 Sugarcane Bagasse

Nasim Ahmad Khan et al (2004)

In these Study, the removal of heavy metal from the wastewater flow is studied, generally activated carbon is used as an adsorbent, but to replace it by cheap adsorbents these Study is done. In these Study natural materials are used. Sugarcane bagasse is the by-product from Sugar Manufacturing Industry. Sugarcane bagasse has adsorption capacities. Batch studies experiment is done to require optimum dosage and contact time. It was most effective at low pH.

Sachin M. Nanaware et al (2011)

In these Study, removal of Acid dye is Studied using Sugarcane bagasse as an adsorbent. In these, Column study was done. A column of 100 cm lenght, 2.5 cm internal diameter and 0.2 cm wall thickness was used in which sugarcane bagasse was kept as fixed bed adsorbent. As the result sugarcane bagasse was observed to be efficient in removing dye colour.

Adel Al-Gheethi et al (2018)

In these Study, Textile wastewater is treated using sugarcane bagasse as adsorbent. Zn and Fe was removed in these Study. In these 0.6g of sugarcane bagasse is taken in 100 ml of sample and rotated at 125 rpm for 30 min, 75 min, 120 min, 180 min and 1440 min. It was observed that Zn and Fe removal was increasing with increase in time. At 120 min the removal of Zn and Fe was 78% to 85%. Also the pH value ranges from 5 to 6, especially pH 5 was taken as the optimum pH for the experiment. These Study results in removal of BOD from 97 mg/L to 28 mg/L and COD removal from 146 mg/L to 45 mg/L, also Fe and Zn removal 5.42 mg/L and 1.16 mg/L to 0.62mg/L and 0.12 mg/L respectively.

2.5 Bentonite Clay

Dr.Shabiimam M.A. et al (2017)

In these Study, removal of heavy metals such as lead, cadmium, zinc by bentonite clay is done. Bentonite clay is collected from Bhavnagar, Gujarat. Lead analysis is done using Inductively Compled Plasma Atomic Emission Spectrometer (ICP - AES). Magnetic stirrer is used for shaking the mixture of bentonite and metal solution. The study was done in batch reactor. The stock solution of 100 mg/lit of lead is prepared and range of 0.1g to 1g of bentonite clay is added and kept for 2 hour at 200 rpm on magnetic stirrer. Whatman's filter paper was used as a filter media to separate clay from solution. The optimum dosage of bentonite clay for removal of lead is 6 g/L at a contact time of 5 minutes

Birte Nissen et al (1984)

In these Study, Nile river water is treated, located in Sudan. Bentonite clay was used to treat the turbidity of the water. Perfect amount of bentonite clay treats the water. If the amount of bentonite clay is more or less then the water becomes more turbid. Bentonite clay was mixed in 100 ml of water and mechanically shaken for 30 min. But no difference was found. Reliable removal was obtained when good flocculants were employed.

Bunt J.R. et al (2017)

Un these Study, Acid Mine Drainage (AMD) solution is treated using coagulation and flocculation. Jar test method is used. In flocculation the sample were stirred at 250 rpm for 2 min and allowed to settle for 1 hour and then the pH, conductivity and turbidity were measured. The water sample were collected from Western Decant in Krugersdorp. The observation confirms it's turbidity removal potential.

Chapter 3

Materials and Methodology

3.1 General

The main objective of the study is to obtain optimum dose of adsorbents & find outs which adsorbents is economical for treatment of water.

3.2 Materials

- Tamarind seeds (Fine & Coarse particles)
- Activated Carbon
- Sugarcane bagasse
- Bentonite clay

3.3 Collection of Materials

Preparation Waste tamarind seeds was obtained from a industry which has prepared product related to tamarind & its seeds comes into waste, crush into small pieces, passing into IS Sieve 2.36mm & 1.18mm then wash it & dried in sunlight for 1 day. We get fine particles & coarse particles. The coarse and fine particles used as an adsorbent. Also we have collected wastewater sample from nearby B.P marine college,panvel creek

Figure 3.1 Tamarind seeds dry form

Figure 3.2 Collection of Wastewater

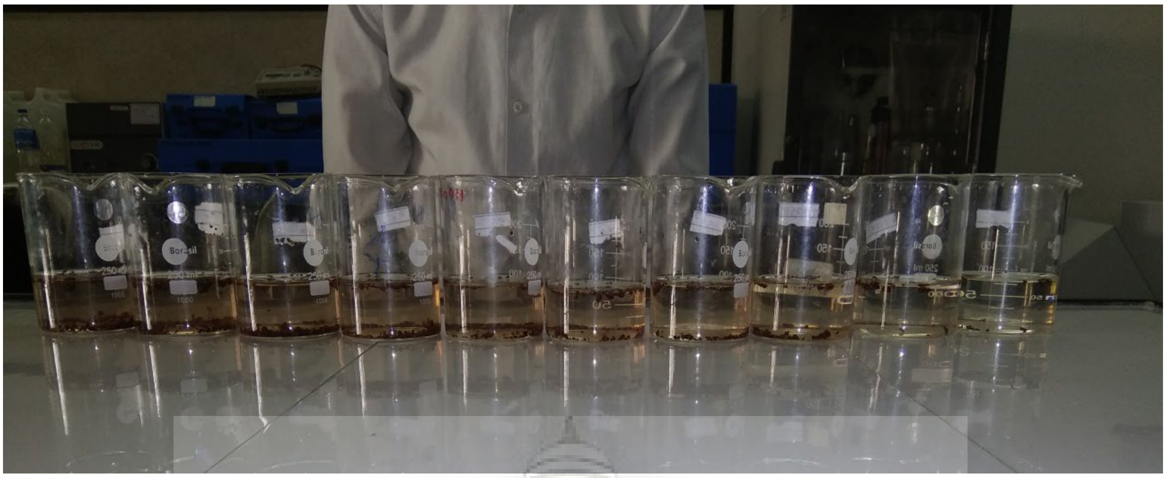

Figure 3.3 Wastewater Sample Beaker With Adsorbent

Figure 3.4 Mechanical shaker machine (Orbital shaking machine)

Figure 3.5 Treated Wastewater Checking pH

3.4 Methodology by Using Adsorbents

Taking Batch adsorption study in this taking 10 beaker of 250mL in each beaker wastewater sample amount 100mL & dosage added by i.e. 100 mg,200 mg, 300 mg 400mg ,...& so on at beaker1,2,3,... Respectively at 140 rpm in this experiment finding optimum dose and check the pH , Turbidity, acidity, alkalinity and chloride content etc.

After that shaking adsorbent in waste water of 10 beaker sample by using of mechanical/Orbital shaking machine.

Chapter 4

Results and Discussion

4.1 General

This chapter discuss about the results and discussion based on the experimental study conducted.

4.2 Tamarind Seeds Fine Particles Retained On 1.18mm Is Sieve

From the table no 4:1 and figure no 4:1 it is observed that from 1gm/l to 6gm/l turbidity decreases, but after that turbidity increases. It is also observed that pH decreases but with very less efficiency.

As the turbidity must be not more than 4NTU, and pH should be lies between 6.5-8.5, and our results for 6gm/l and pH is in between hence ok.

Table 4:1 Tamarind Seeds Fine Particles Readings

SR.NO	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
1	1	3.1	7.3	21	85.24%
2	2	3	7.1	21	85.71%
3	3	2.8	7.2	21	86.67%
4	4	0.3	6.9	21	98.57%
5	5	0.2	6.8	21	99.05%
6	6	0.1	6.5	21	99.52%
7	7	0.8	6.5	21	96.19%
8	8	1	6.4	21	95.24%
9	9	1.2	6.4	21	94.29%
10	10	1.3	6.3	21	93.81%

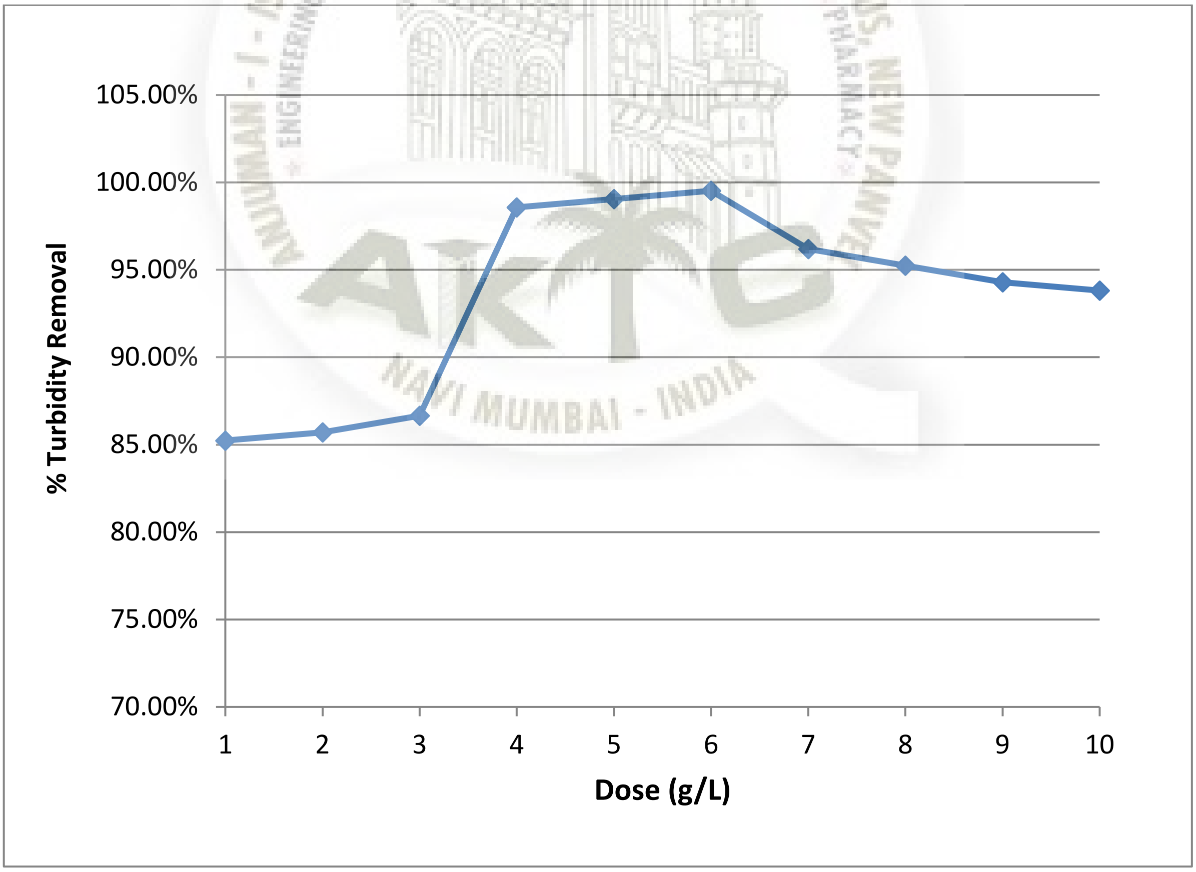

Figure 4.1 Tamarind Seeds Fine Particles

4.3 Tamarind Seeds Coarse Particles Retained On 2.36mm Is Sieve

From the table no 4:2 and figure no 4;2 it is observed that from 1gm/l to 5gm/l turbidity decreases, but after that turbidity increases. It is also observed that pH decreases but with very less efficiency.

As the turbidity must be not more than 4NTU, and pH should be lies between 6.5-8.5, and our results for 5gm/l and pH is in between hence ok.

Table 4:2 Tamarind seeds coarse particles

SR.NO	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
1	1	3.1	7.5	21	85.24%
2	2	3	7.2	21	85.71%
3	3	3	7.1	21	85.71%
4	4	2.8	7	21	86.67%
5	5	0.1	6.9	21	99.52%
6	6	2	6.9	21	90.48%
7	7	2.9	6.8	21	86.19%
8	8	3	6.7	21	85.71%
9	9	3.3	6.7	21	84.29%
10	10	3.5	6.6	21	83.33%

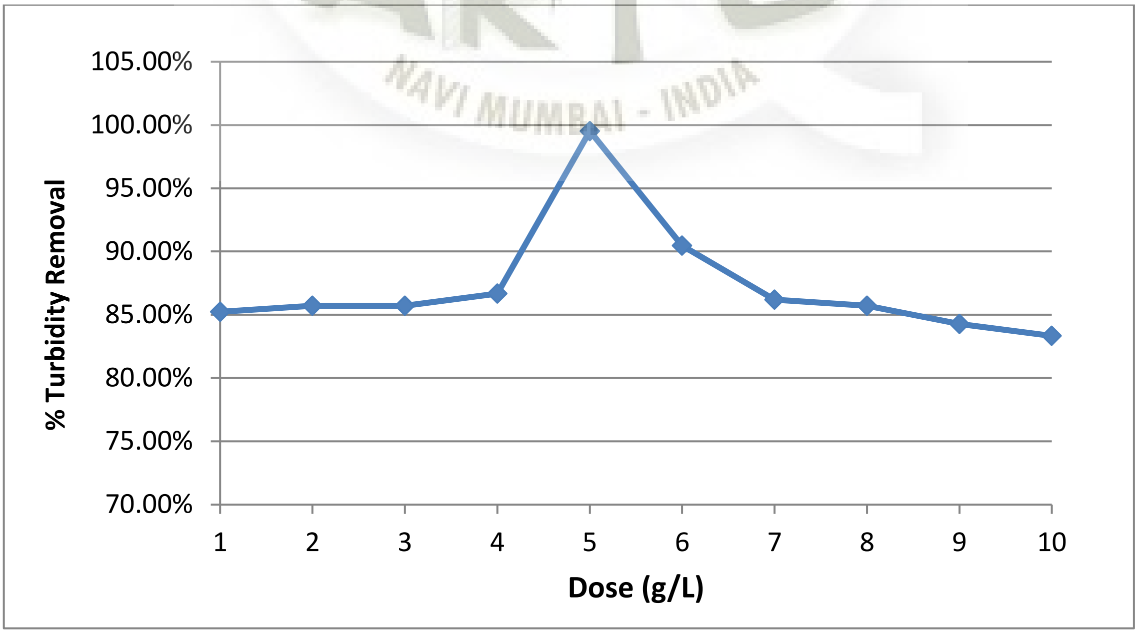

Figure 4.2 Tamarind seeds coarse particles

4.4 Bentonite Clay

From the table no 4:3 and figure no 4:3 it is observed that from 1gm/l to 6gm/l turbidity decreases, but after that turbidity increases. It is also observed that pH decreases but with very less efficiency.

As the turbidity must be not more than 4NTU, and pH should be lies between 6.5-8.5, and our results for 5gm/l and pH is in between hence ok.

Table 4:3 Bentonite Clay

SR.NO	QTY(g/l)	TURBIDITY (NTU)	Ph	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
1	1	18.7	7.7	21	10.95%
2	2	18.6	7.4	21	11.43%
3	3	18.5	7.3	21	11.90%
4	4	18.5	7.3	21	11.90%
5	5	18.5	7.2	21	11.90%
6	6	18.4	7.2	21	12.38%
7	7	18.7	7.2	21	10.95%
8	8	18.9	7.1	21	10.00%
9	9	22	7.1	21	0.00%
10	10	26	7.1	21	0.00%

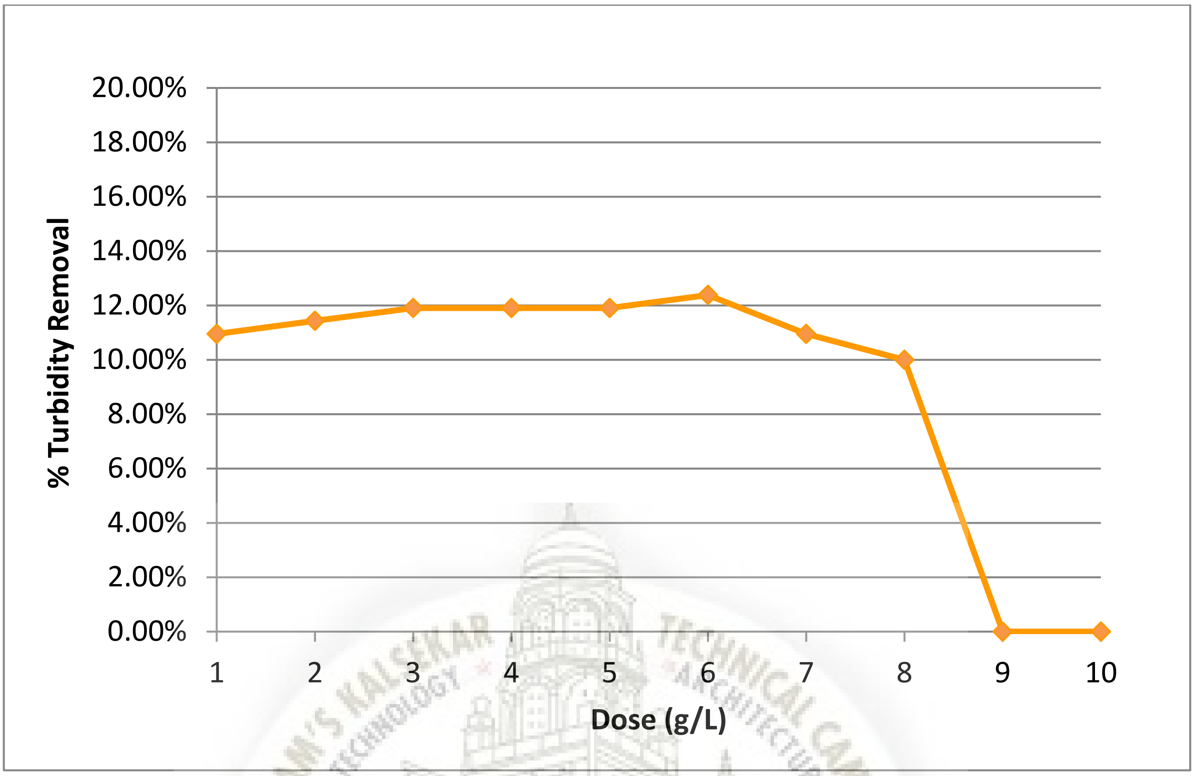

Figure 4.3 Bentonite clay

4.5 Sugarcane Bagasse

From the table no 4:4 and figure no 4:4 it is observed that from 1gm/l to 3gm/l turbidity decreases, but after that turbidity increases. It is also observed that pH decreases but with very less efficiency.

As the turbidity must be not more than 4NTU, and pH should be lies between 6.5-8.5, and our results for 5gm/l and pH is in between hence ok.

Table 4:4Sugarcane Bagasse

SR.NO	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
1	1	4	8	21	80.95%
2	2	2	7.7	21	90.48%
3	3	0.2	7.5	21	99.05%
4	4	0.9	7.2	21	95.71%
5	5	0.9	7.1	21	95.71%
6	6	0.9	7	21	95.71%
7	7	2	7	21	90.48%
8	8	2.2	7	21	89.52%
9	9	2.9	6.8	21	86.19%
10	10	3.2	6.5	21	84.76%

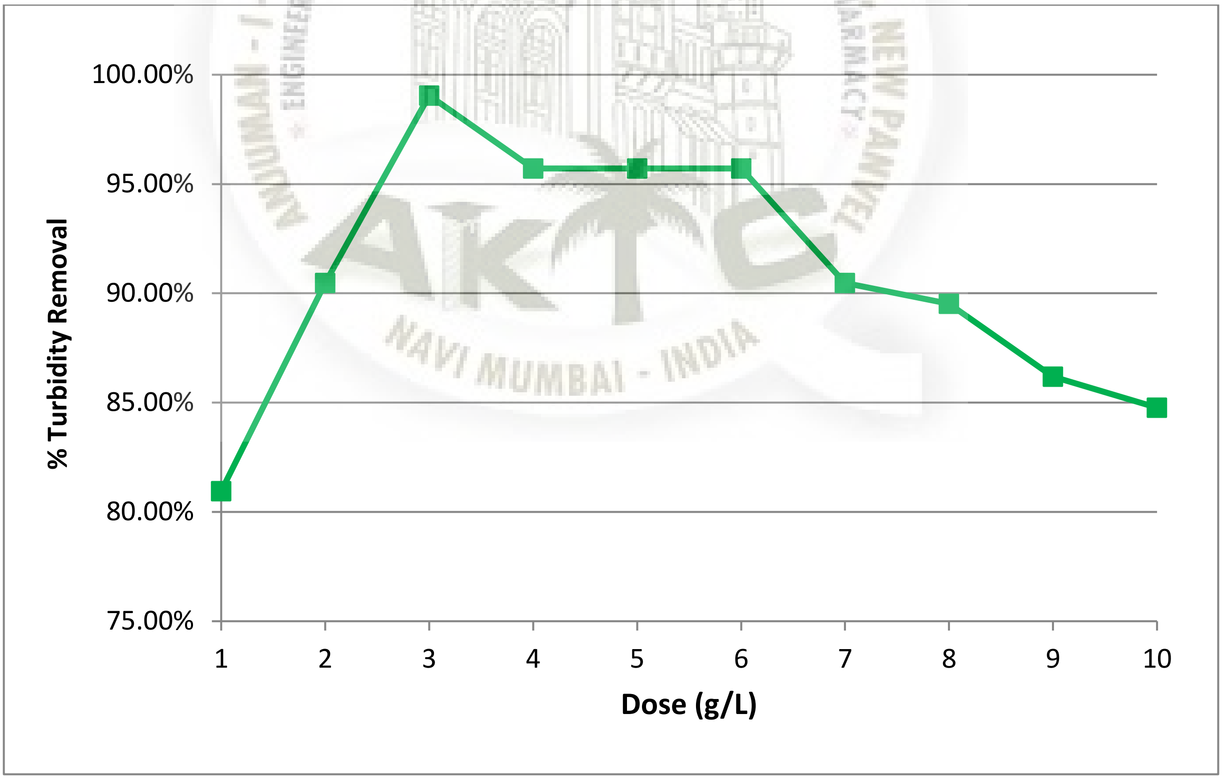

Figure 4.4 Sugarcane Bagasse

4.6 Activated carbon

From the table no 4:5 and figure no 4:5 it is observed that 1gm/l gives a good efficiency. As the turbidity must be not more than 4NTU, and pH should be lies between 6.5-8.5, and our results for 5gm/l and pH is in between hence ok.

Table 4:5Activated carbon

SR.NO	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
1	1	0.2	7.7	21	99.05%
2	2	0.2	7.4	21	99.05%
3	3	0.2	7.3	21	99.05%
4	4	0.3	7.3	21	98.57%
5	5	0.3	7.2	21	98.57%
6	6	2	7.2	21	90.48%
7	7	2	7.2	21	90.48%
8	8	3.2	7.1	21	84.76%
9	9	3.4	7.1	21	83.81%
10	10	3.8	7.1	21	81.90%

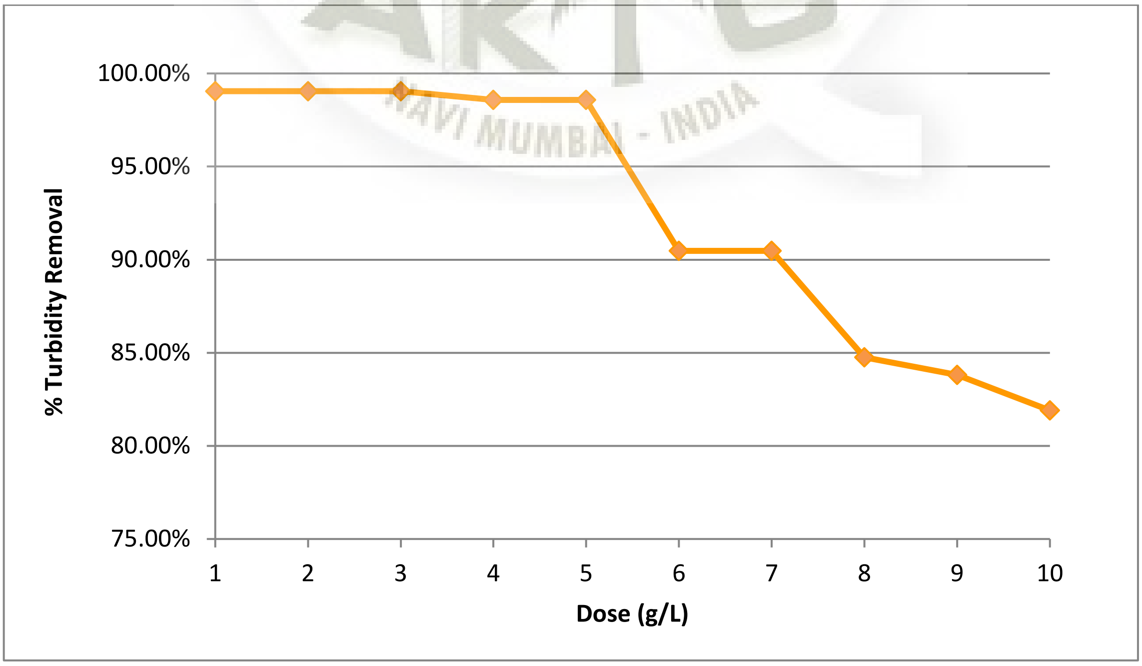

Figure 4.5 Activated carbon

4.7 Case Study Of Tamarind Seeds Variation With Time Of Coarse Particles

From the table 4:6 and figure 4:6 of variation in time it is observed that the it requires minimum40 minutes, so there should not be variation in time.

Optimum quantity of adsorbent =6gm/l from the graph and table.

Table 4:6 Case Study Of Tamarind Seeds Coarse Particles

TIME	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
10	5	10	8	21	52.38%
20	5	5	7.8	21	76.19%
30	5	2	7.2	21	90.48%
40	5	0.1	6.9	21	99.52%
50	5	3	6.8	21	85.71%
60	5	6	6.8	21	71.43%

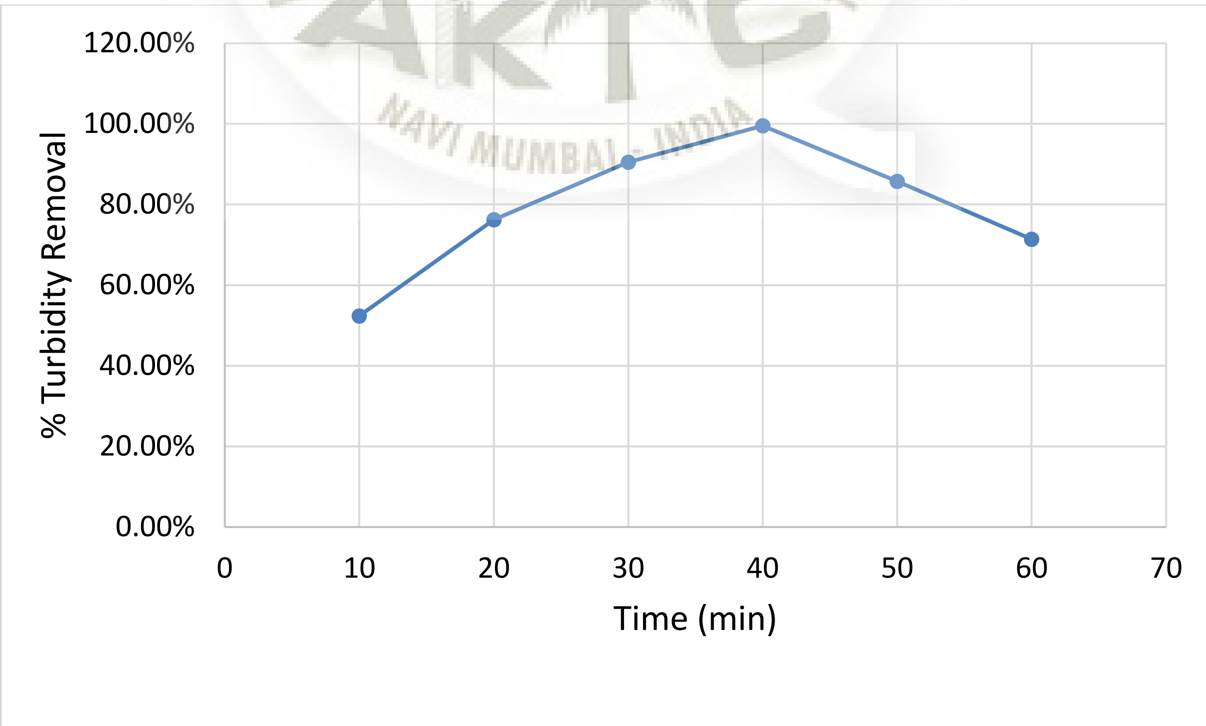

Figure 4.6 Case Study Of Tamarind Seeds Coarse Particles

4.8 Fine Particles Tamarind

From the table 4:7 and figure 4:7 of variation in time it is observed that the it requires minimum40 minutes, so there should not be variation in time. Optimum quantity of adsorbent=5gm/l from the graph and table.

Table 4:7 Case Study Of Tamarind Seeds Fine Particles

TIME	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
10	5	12	8	21	42.86%
20	5	7	7.5	21	66.67%
30	5	3	7	21	85.71%
40	5	0.1	6.5	21	99.52%
50	5	3	6.7	21	85.71%
60	5	7	6.7	21	66.67%

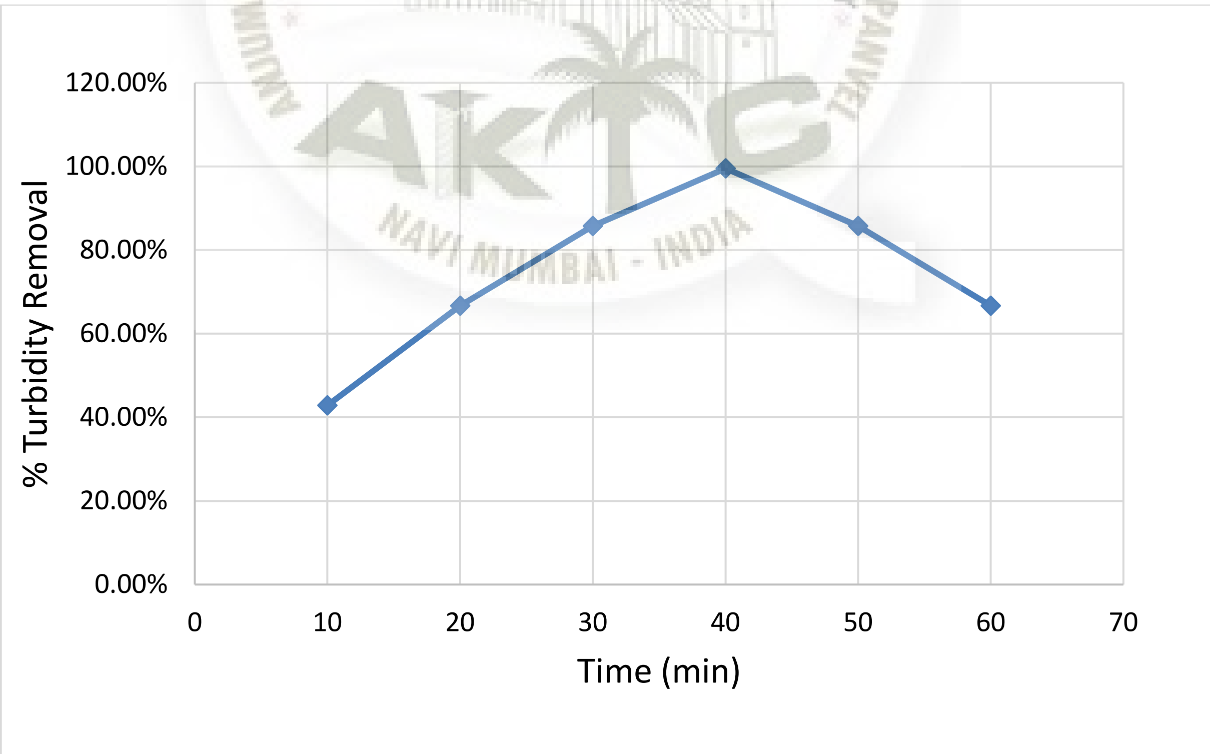

Figure 4.7 Case Study Of Tamarind Seeds Fine Particles

4.9 Sugarcane Bagasse

From the table 4:8 and figure 4:8 of variation in time it is observed that the it requires minimum40 minutes, so there should not be variation in time.

Optimum quantity of adsorbent =3gm/l from the graph and table.

Table 4:8 Case Study Of Sugarcane Bagasse

TIME	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
10	3	11	7.9	21	47.62%
20	3	4	7.6	21	80.95%
30	3	1	7.6	21	95.24%
40	3	0.2	7.5	21	99.05%
50	3	0.2	7.2	21	99.05%
60	3	0.3	7.1	21	98.57%

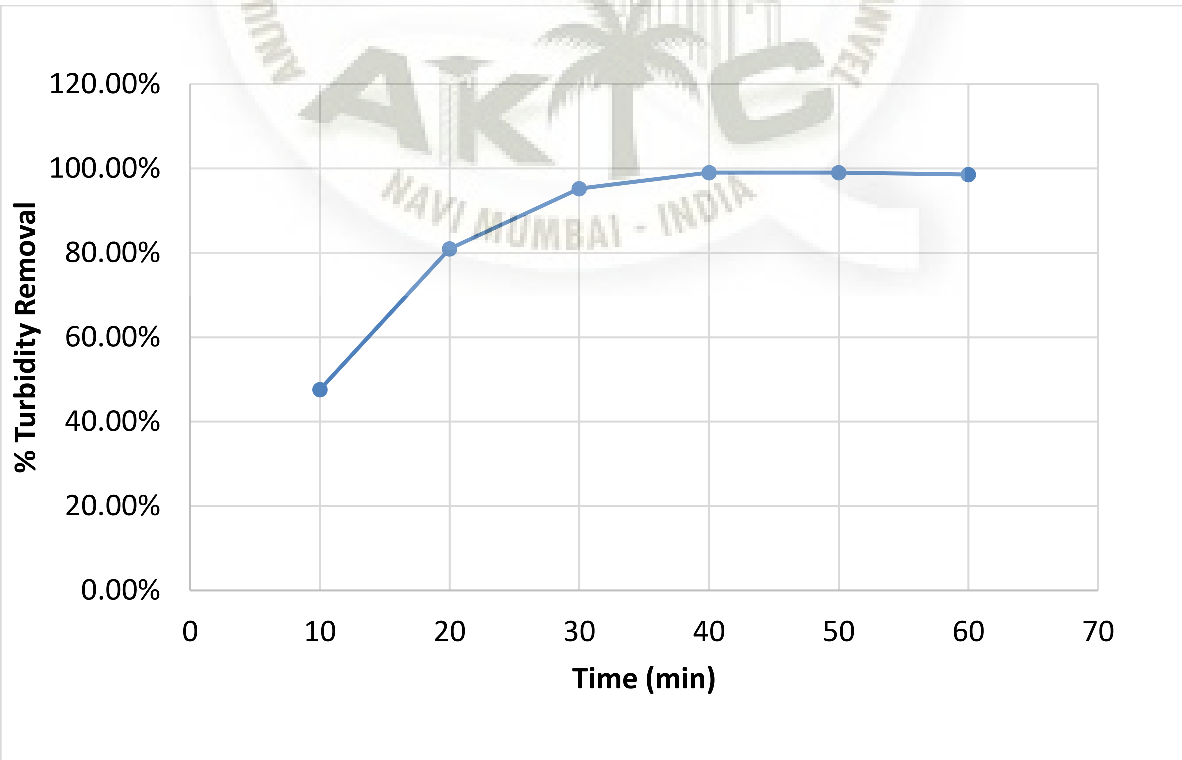

Figure 4.8 Case Study Of Sugarcane Bagasse

4.10 Bentonite Clay

From the table 4:9 and figure 4:9 of variation in time it is observed that the it requires minimum40 minutes, so there should not be variation in time. Optimum quantity of adsorbent =6gm/l from the graph and table.

Table 4:9 Case Study Of Bentonite Clay

TIME	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
10	6	20	8.5	21	4.76%
20	6	19	8.5	21	9.52%
30	6	19	8.4	21	9.52%
40	6	18.4	8.3	21	12.38%
50	6	24	8.3	21	0.00%
60	6	26	8.3	21	0.00%

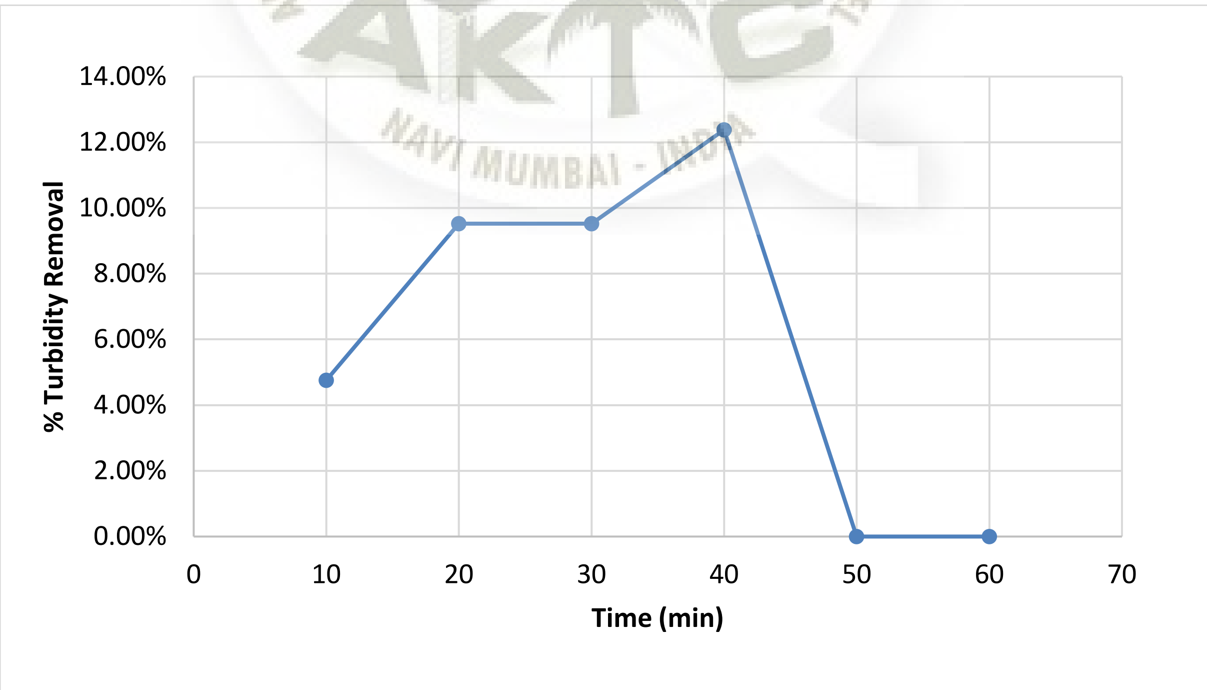

Figure 4.9 Case Study Of Bentonite Clay

4.11 Activated Carbon

From the table 4:10 and figure 4:10 of variation in time it is observed that the it requires minimum 60 minutes, so there should not be variation in time. Optimum quantity of adsorbent =1gm/l from the graph and table.

Table 4:10 Case Study Of Bentonite Clay

TIME	QTY(g/l)	TURBIDITY (NTU)	pH	INITIAL TURBIDITY (NTU)	EFFICIENCY (%)
10	1	13	8.2	21	38.10%
20	1	8	8	21	61.90%
30	1	2	8	21	90.48%
40	1	0.2	8.1	21	99.05%
50	1	0.2	7.8	21	99.05%
60	1	0.1	7.8	21	99.52%

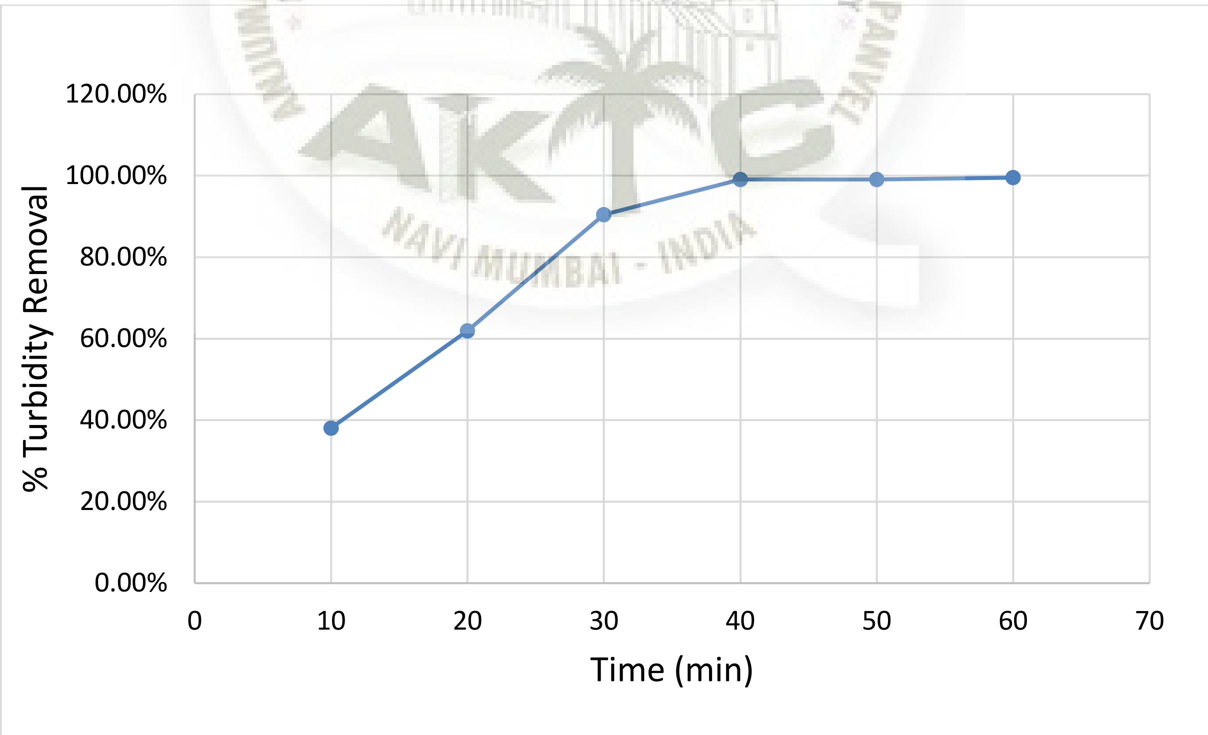

Figure 4.10 Case Study Of Bentonite Clay

Chapter 5

Conclusions

5.1 Summary

According to our results and test performed we can use the treated water into following places

- Washing clothes
- Washing utensil
- Washing street
- Cleaning homes and
- Gardening etc

According to the optimum dose and the efficiency of removing the turbidity are as follows in descending order

1) Activated Carbon

2) Sugarcane Bagasse

3) Tamarind seeds

4) Bentonite clay

From the table and graph of tamarind fine particles we found out that 6gm/l, removed turbidity with efficiency 99.52%.

From the table and graph of tamarind coarse particles we found out that 5gm/l, removed turbidity with efficiency 99.52%.

From the table and graph of bentonite clay we found out that 6gm/l, removed turbidity with efficiency 12.38%.

From the table and graph of sugarcane bagasse we found out that 3gm/l, removed turbidity with efficiency 99.05%.

From the table and graph of activated carbon we found out that 1gm/l, removed turbidity with efficiency 99.50%.

By comparing above adsorbent, we conclude that Activated carbon is more effective but it is costly as compare to other adsorbent, on the other hand bagasse is quiet good and effective in removing turbidity with minimum quantity and low cost and the most important things it is easily available in everywhere.

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LIST OF PUBLICATIONS

Project Exhibition

Participated In 5th National Level Project Exhibition Cum Poster And Paper Presentation At Universal College Of Engineering ,Vasai.