

# A Power Generation Through Double Chamber MFC Operation from Industrial Waste Water

A PROJECT REPORT

Submitted by

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**BONAFIDE CERTIFICATE**

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INTERNAL EXAMINER

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### ABSTRACT

The main view of our project has been established that voltage generated in a microbial fuel cell (MFC) decreases with respect to time. The application of MFC in generating electricity using textile waste water from local small scale industry. Our project “A Power Generation Through Double Chamber Mfc Operation From Industrial Waste Water” has paved the way for improved knowledge in the process of filtration of water.

A small scale, composting, MFC system was constructed that used cow manure, glucose and sugar as the reduced carbon energy source. The system was a double chamber, air cathode MFC with a reactor, resistance box and data multimeter unit. A moisture content of greater than 80% is suitable for generation of current in the composting MFC.

MFC can be best defined as a fuel cell where microbes act as catalyst in degrading the organic content to produce electricity. It is a device that straight away converts microbial metabolic or enzyme catalytic energy into electricity by using usual electrochemical technology. Biological treatment is applied to that waste water. The advanced biological treatment MFC (Microbial fuel cell) is adopted. The maximum current, voltage, BOD, COD and pH are generated with respect to time.

In this project we are intended to reduce colour, odour, turbidity, hardness, etc,. Detailed description of the waste analysis water and their procedures and results are also included.

**TABLE OF CONTENT**

<b>CHAPTER NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
	<b>ABSTRACT</b>	<b>626</b>
	<b>LIST OF TABLES</b>	<b>629</b>
	<b>LIST OF FIGURES</b>	<b>630</b>
	<b>LIST OF NOTATIONS</b>	<b>630</b>
<b>1.</b>	<b>INTRODUCTION</b>	<b>632</b>
	1.1 General	632
	1.2 Objectives	632
	1.3 Effect of textile effluent on environment	633
<b>2.</b>	<b>LITERATURE REVIEW</b>	<b>634</b>
	2.1 General	634
	2.2 Review of literature	634
<b>3.</b>	<b>METHODOLOGY</b>	<b>637</b>
	3.1 General	637
	3.2 Materials used	637
	3.3 Methodology	637
	3.4 MFC Set up	638
<b>4.</b>	<b>TEST PROCEDURE AND RESULT</b>	<b>639</b>
	4.1 Turbidity	639
	4.2 Alkalinity	640
	4.3 pH	642
	4.4 Total hardness	644
	4.5 Sulphates	645
	4.6 Nitrates	647
	4.7 Biochemical oxygen demand	648
	4.8 Chemical oxygen demand	649
	4.9 Potassium	650

4.10	Chromium	652
4.11	Cadmium	653
4.12	Total solids	656
4.13	Result	657
<b>5.</b>	<b>CONCLUSION</b>	<b>660</b>
	<b>REFERENCES</b>	<b>661</b>

**LIST OF TABLE**

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
4.1	Comparison for turbidity test	639
4.2	Comparison for alkalinity test	641
4.3	Comparison for pH test	643
4.4	Comparison for total hardness test	645
4.5	Comparison for sulphate test	646
4.6	Comparison for nitrates test	647
4.7	Comparison for biochemical oxygen Demand test	648
4.8	Comparison for chemical oxygen Demand test	650
4.9	Comparison for potassium test	651
4.10	Comparison for chromium test	653
4.11	Comparison for cadmium test	654
4.12	Comparison for total solids test	656
4.13	Comparison for electricity by adding cow dung	657
4.14	Comparison for electricity by adding sugar	658
4.15	Comparison for electricity by adding Glucose	659

**LIST OF FIGURE**

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
4.1	Comparison graph for turbidity test	640
4.2	Comparison graph for alkalinity test	641
4.3	Alkalinity test	642
4.4	Comparison graph for pH test	643
4.5	pH test	644
4.6	Comparison graph for total hardness test	645
4.7	Comparison graph for sulphate test	646
4.8	Comparison graph for nitrates test	647
4.9	Comparison graph for biochemical oxygen demand test	649
4.10	Comparison graph for chemical oxygen demand test	650
4.11	Comparison graph for potassium test	652
4.12	Comparison graph for chromium test	653
4.13	Comparison graph for cadmium test	655
4.14	Comparison graph for total solids test	656
4.15	Comparison graph of Electricity by adding cow dung	657
4.16	Comparison graph of Electricity by adding Sugar	658
4.17	Comparison graph of Electricity by adding Glucose	659

**LIST OF NOTATIONS**

mg/lit	-	Milligram per litre
ppm	-	Parts per million
NTU	-	Nephelometric Turbidity Units
BOD	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
TDS	-	Total Dissolved Solids
TSS	-	Total Suspended Solids
Fe	-	Iron
EDTA	-	Ethylene Diamine Tetra Acetic Acid



EBT	-	Erichrome Black T
Cd	-	Cadmium
Cu	-	Copper
Pb	-	Lead
Zn	-	Zinc
H <sub>2</sub> SO <sub>4</sub>	-	Sulphuric acid
HCL	-	Hydrochloric acid

## CHAPTER - 1

### INTRODUCTION

#### 1.1.General

The increase in urbanization results in growth of industries causing increase in pollution of environment. The waste water released from the industries are discharged directly into water sources leading to higher pollution rate. The effluent from textile industries is a big question mark which has created environmental problems around the world.

The textile industries use dyes and pigments to colour their products. These are the main source of waste water generated during dyeing and finishing stages. When these coloured effluents enter rivers or any surface water system they upset biological activity, aquatic ecosystem, agricultural growth. The waste water is of great chemical complexity and diversity which cannot be treated by conventional waste water treatment plant.

Hence the land irrigated with textile effluent acts as sink for heavy metals and other chemicals consequently reduces soil fertility. A number of technique has been put practice to get solution for textile waste water. One new promising method for treating waste water is use of MFC.

The conventional water treatment process such as coagulation, membrane separation, and electrochemical, reverse osmosis suffers from one or more limitations for complete removal of dye. Now-a-days special attention has been focused on the rise of natural adsorbents based on environmental and economic point of view.

This project aims at the generation of electricity from the textile waste water.MFC is a unique device that utilize micro-organisms as catalyst for convert it into electricity.MFC is used to treat various kinds of waste water such as domestic, sugar, paper, etc,. It is potential for reducing solid protection compared to aerobic process. MFC produces electricity from organic matter. It is a device which converts chemical energy to electric energy by catalytic reaction of micro-organisms.

#### 1.2 Objectives

- To provide the twin advantage of providing electricity and improving the water quality simultaneously.
- To remove colour, odour, turbidity from the waste water.
- To evaluate the rate of change of the generated voltage with respect to time.
- To observe whether a mixer of biowaste does actually react in higher voltage.
- To provide cost effective technique for generating electricity

### **1.3 Effects of Textile Effluent on Environment**

- The colloidal matter present along with the colours and oily scum increases the turbidity, gives foul smell.
- High levels of toxicity due to the presence of nickel, mercury, cadmium, etc.,
- These show allergic reactions.
- Increased turbidity affects the levels of photosynthesis.
- This effluent if allowed to flow in the field's clogs the pores of the soil resulting in loss of soil productivity.

## CHAPTER - 2

### LITERATURE REVIEW

#### 2.1 General

This chapter confers the review of literatures on the use of MFC for the generation of electricity. The most noteworthy of them which are relevant to current study are being reviewed.

#### 2.2 Literature Review

**Logan B.E., Selembo P. (2010) , Generation of electricity from MFC using bio waste** , An MFC is thus a bio electro chemical system that divers electricity by bacterial found in nature. The reason for using bacteria to generate electricity for new sources of energy and fuel cell technology. As parameter, it was evaluated the power density produced during MFC operation on variation of fuel volume and microbe concentration. Flux digital multimeter had been used to record the voltage and current generated within the system. The Generated electricity was used to switch on LED light.

**Pyle H., Wilks S.S., (1999), Enzymatic catalysis in anhydrous organic solvents**, Despite consider variability in a characteristics of waste water depending on their sources. The primary organic compound in waste water is particulate organic matter. In this article, it has been established that voltage generated in a microbial fuel cell decreases linearly with respect to time. In other words, the first order derivative of voltage generated with respect to time is a negative constant. Thus the rate of change of voltage generated with respect to time has been established to be independent of time. It has been found that a mixture of biowaste can actually result in higher extractable current than any single component although this is not always true in general. Further, it has been found that when a component results in higher voltage production, it ends up reducing the cell life.

**Doddamani R., Shashikant R,( 2014 ), Generating of electricity using sugar mill waste water by Microbial Fuel Cell**, It includes the application of single chamber MFC in generating electricity using sugar water. The current, voltage and power generation in the 1.28 mA and 0.304 watts respectively. Microbial fuel cells (MFCs) convert biodegradable materials into electricity, potentially contributing to an array of renewable energy production strategies tailored for specific applications. Since there are no known microorganisms that can both metabolize cellulose and transfer electrons to solid extracellular substrates, the conversion of cellulosic biomass to electricity requires a syntrophic microbial community that uses an insoluble electron donor (cellulose) and electron acceptor (anode). Electricity was generated from cellulose in an MFC using a defined coculture of the cellulolytic fermenter *Clostridium cellulolyticum* and the electrochemically active *Geobacter sulfurreducens*.

**Wang X., Feng Y., Nakamura R ,( 1996 ), Synergy of Electricity generation and waste disposal in solid state MFC of cow manure composting** , It is a small scale MFC constructed that used cow manure as reduced carbon energy source . The results of the composting MFC can be used to treat wastes while generating electric current. Microbial fuel cell (MFC) represents a new method for electricity generation. Microbial fuel cells are devices that can use bacterial metabolism to produce an electrical current from wide

range organic substrates. This research explores the application of Double chamber MFC in generating electricity using different waste water mixed with slurry from Jabalpur. In order to obtain the aim of this research, a system of MFC with microbes has been used. Based on the result of different types of waste water samples with slurry, it found that the maximum voltage generated among all the three combinations is 434mV at day five by waste water of bread factory mixed with slurry. The potential difference generated by the MFC was measured using multimeter.

**Suzuki S., Matsuoka H,( 1997 ), Comparative study on sustainable bio electricity generation from MFC using bio waste,** It has been proven that MFC could be conducted successfully in solid fermentation process of food waste. Bacteria can generally utilize a limited range of substrates to oxidize more complex organic matters. MFC can be best defined as a fuel cell where microbes act as catalyst in degrading the organic content to produce electricity. It is a device that straight away converts microbial metabolic or enzyme catalytic energy into electricity by using usual electrochemical technology. Mediator-microbial fuel cells are microbial fuel cells which use a mediator to transfer electrons produced from the microbial metabolism of small chain carbohydrates to the anode. This is necessary because most bacteria cannot transfer electrons directly to the anode. Mediators like thionine, methyl blue, methyl viologen and humic acid tap into the electron transport chain and abstract electrons (becoming reduced in the process) and carry these electrons through the lipid membrane and the outer cell membrane.

**Jenssen P.D., Heyerdahl P.H ,( 2003), Local recycling of wastewater and wet organic waste ,** Besides the collapse of the physical structure of one of the grey water systems at Torvetua, the grey water systems at both research sites have performed well and have shown to be robust . Generation of electric current can be affected by different influencing factors. Moisture content should be kept high for the practical application of composting MFC. Catalyst should be added in cathode and the value of maximum power density and output voltage may be low without catalyst. Proper concentration of PBS could promote conductivity of the system, which needs further study to get the suitable value according to different substrates and reaction conditions. Smaller electrode area was more efficient in current producing and resulted in shorter lag time. The MFC process can enhance the degradation of organic C at the same time. The microbial community change is not consistence with that electricity generation which suggested that electrogens and non-electrogens coexisted in the biofilm of MFC anode. Composting MFC could enhance solid waste degradation and generate electronic current at the same time, which will be a new development of MFC and can be applied in remote areas where water supply is insufficient but there are many organic wastes.

**Wank k. (1994), Integrated anaerobic and aerobic treatment of sewage,** The fermentation process in which organic material is degraded and biogas is produced, is referred to as anaerobic digestion. This process occurs in many places where organic material is available and red ox potential is low. A concentration of 100 mM PBS resulted in maximum power density and output voltage. The power per unit area of electrode was inversely proportional to surface area of the electrode. Quantification of carbon, hydrogen and nitrogen (CHN) content indicated enhanced degradation or organic compounds in addition to production of the electric current. The diversity of the microbial community, as determined by denaturing gradient gel electrophoresis (DGGE) was directly proportional to content of water, but inversely proportional to concentration of PBS. The results of this study demonstrated that the composting MFC can be used to treat wastes while generating electric current. A small-scale, composting, microbial fuel cell

(MFC) system was constructed that used cow manure as the reduced carbon energy source. The system was a single-chamber, air-cathode MFC with a reactor, resistance box and data processing unit.

**Xin Wang, Jingchun Tang, Jinxin Cui, (2003), Fuel Cell Systems Explained,** microbial fuel cell (MFC) technology can replace activated sludge processes for secondary wastewater treatment. We will discuss the present limitations and problems of electric current generation when a complex wastewater is treated with a diverse and undefined community of microbes in large-scale systems. These challenges include low coulombic efficiencies, slow kinetic rates, and nonlinear power density increases during scale up efforts. Finally, we developed a prediction of the main economic gain from treating wastewater with microbial fuel cells. We conclude that electricity generation will not justify MFC operation, but that BOD removal with this more sustainable technology is attractive. Researchers in the fields of Biological and Environmental Engineering have shown a real potential to apply microbial fuel cell technology to wastewater treatment.

**Miriam Rosenbaum, B.Largus, T. Angenentc, (2007), Mediating Effect of Ferric Chelate Compounds in Microbial Fuel Cells with Lactobacillus plantarum, Streptococcus lactis and Erwinia dissolvens, Bioelectrochem,** This is the principle behind generating a flow of electrons from micro-organisms. In Order to turn this into a usable supply of electricity, this process has to be accommodated in a fuel cell. To generate a useful current, it is then necessary to create a complete circuit. The mediator and the micro-organism are mixed together in a solution to which is added a suitable substrate, glucose for example. This mixture is placed in a sealed chamber to stop the entry of oxygen, forcing the micro-organism to use anaerobic respiration thereby. An electrode is placed in the solution, which would then act as the anode. In the second chamber of the MFC, there is placed another solution and an electrode. This electrode, the cathode, is positively charged and is the equivalent of the oxygen sink at the end of the electron transport chain. It is however external to the biological cell. The solution is an oxidizing agent that picks up the electrons at the cathode. Incidentally, this is not particularly practical as it would require large Volumes of circulating gas. A more convenient option is to use a solution of a solid oxidizing agent.

**Leang, Coppi. M. V, Lovely, (2007), A c-type polyheme cytochrome involved in Fe(III) reduction in Geobacter sulfurreducens,** Based on the research conducted, there are several points that can be concluded, Technology of Microbial Fuel Cell is one alternative of energy production using renewable Resource. Saccharomyces cereviceae can be used as micro organism in MFC operation using Tapioca waste water solution as fuel. The optimum power of MFC for this system is 60.64W/m<sup>2</sup>, given by microbe concentration 0.33g/ml and fuel volume 30 ml. In this condition, the voltage and current generated within the System is 0,55V and 0,12A respectively. This power density is given by microbe concentration 0.33 gram/ml and fuel volume 30 ml. In this condition, the voltage and current generated within the system are 0.55 V and 0.12 A respectively.

### CHAPTER - 3

### METHODOLOGY

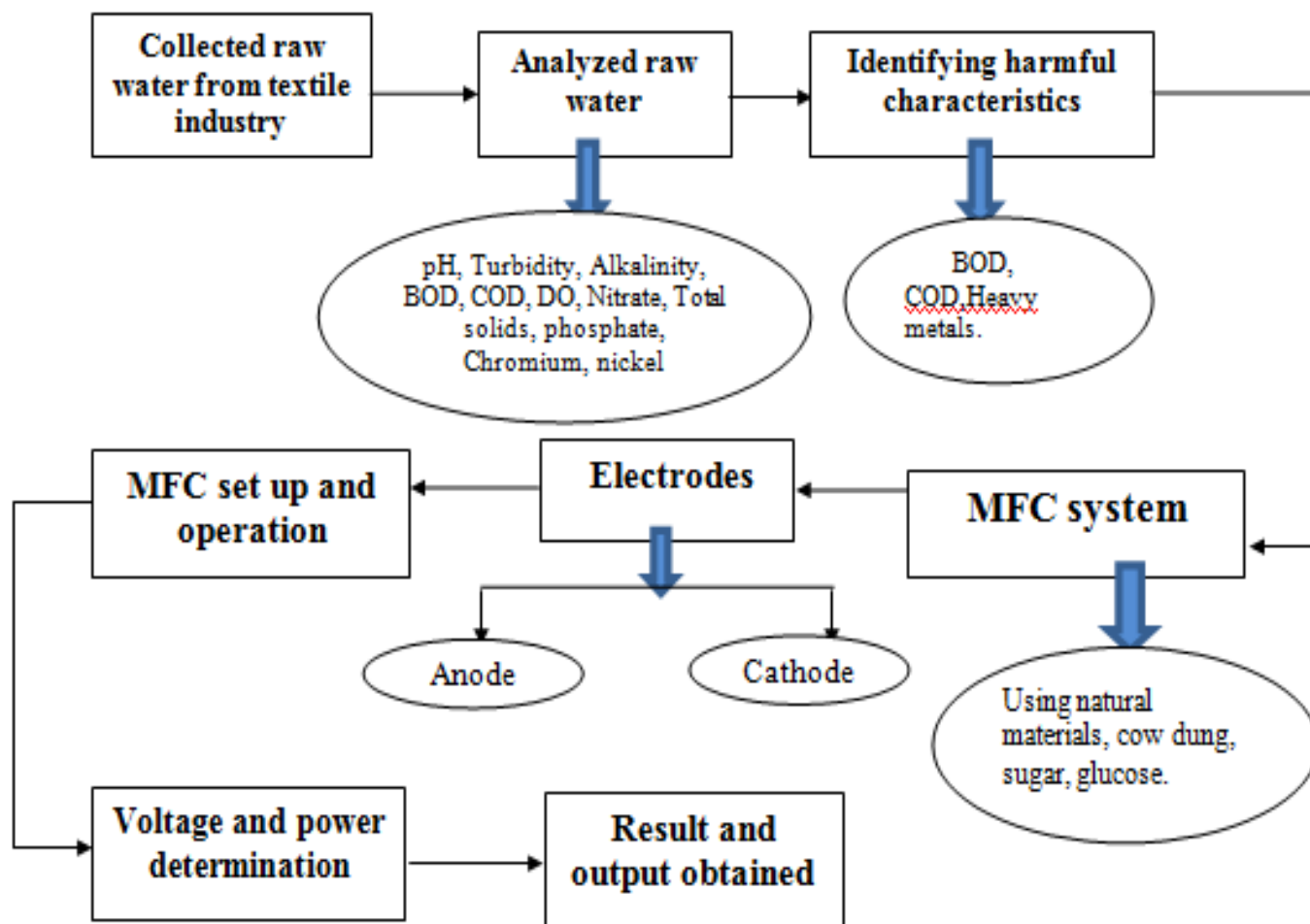
#### 3.1 General

The following are the methodologies for the generation of electricity using MFC.

#### 3.2 Materials Used

- Textile waste water
- Cow dung
- Sugar
- Glucose

#### 3.3 Methodology



### 3.4 MFC Set up





**CHAPTER - 4****TEST PROCEDURE AND RESULT****4.1 Turbidity****Definition**

Turbidity is an optical determination of water clarity. The turbidity of the sample is analysed by using Nephlo turbidity meter. Set the nephelometer to '0' to '100' reading using double distilled water '100' NTU standard. Distilled water is used and set zero by adjusting the switch before the sample is analysed. The turbidity of the sample is shown in the display of the meter.

**Equipment used**

Nephelo turbidity meter with all its accessories.

**Procedure**

- Insert the cell with distilled water into the cell holder. Cover the cell with light shield.
- Insert the 3 pin plug into 230 volts A.C main jacket.
- Switch on the instrument and give 15 to 20 minutes warm-up time.
- Select the range switch as required. Adjust needle zero on panel meter with the help of set zero control.
- Insert the cell with standard solution into cell holder. Adjust standardized control to get 100 on panel meter.

**Test result**

<b>S.no</b>	<b>Parameter</b>	<b>Textile raw water</b>	<b>Standard value</b>
1.	Turbidity (NTU)	7	8-10

Table No.4.1 Comparison for turbidity test

#### 4.1.5 Graph

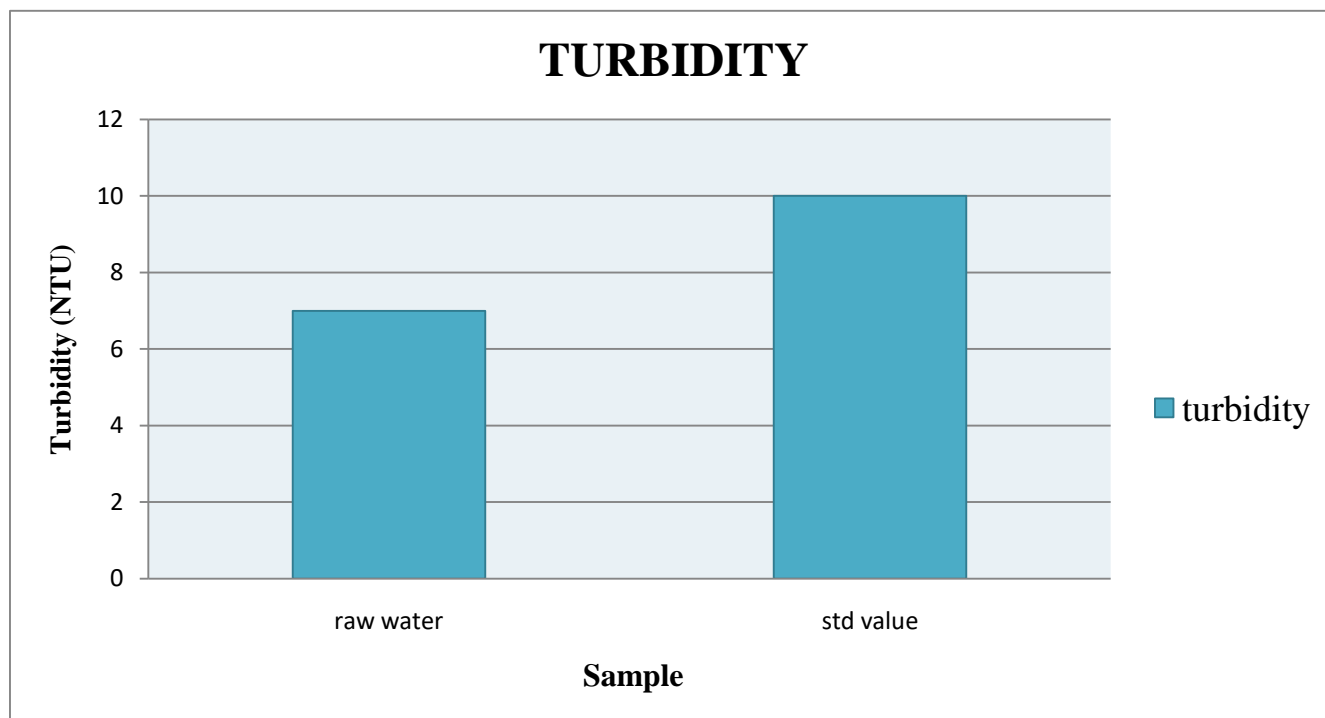


Fig.No.4.1 Comparison graph for turbidity test

#### 4.2 Alkalinity

##### Definition

Alkalinity is composed of primarily of carbonate and bicarbonate. The alkalinity of the sample is determined by titrating 20ml of water sample with dilute HCL burette. The indicator used is phenolphthalein. The first end point of the titration is pink colour disappears. After the solution is colourless, methyl orange is added the end point of the titration is yellow to pink.

##### Equipment used

1. Burette
2. Pipette
3. Conical flask
4. Methyl orange indicator
5. Phenolphthalein indicator

##### Procedure

##### Phenolphthalein alkalinity:

- Take 20ml of sample in a clean conical flask.

- Add one drop of phenolphthalein indicator and the sample turns pink in colour.
- Titrate the sample with standard H<sub>2</sub>SO<sub>4</sub> (0.02 N) taken in a burette.
- The end point is the disappearance of pink colour.

**Total alkalinity**

- Add one drop of methyl orange indicator to the solution in which phenolphthalein alkalinity has been determined.
- Titrate the above sample against standard H<sub>2</sub>SO<sub>4</sub> (0.02 N).
- The end point is the appearance of pink colour.
- Repeat the titration to get concordant values.

**Test result**

S.no	Parameter	Textile raw water	Standard value
1.	Alkalinity (ppm)	55	35-38

Table No: 4.2 Comparison for Alkalinity test

**Graph**

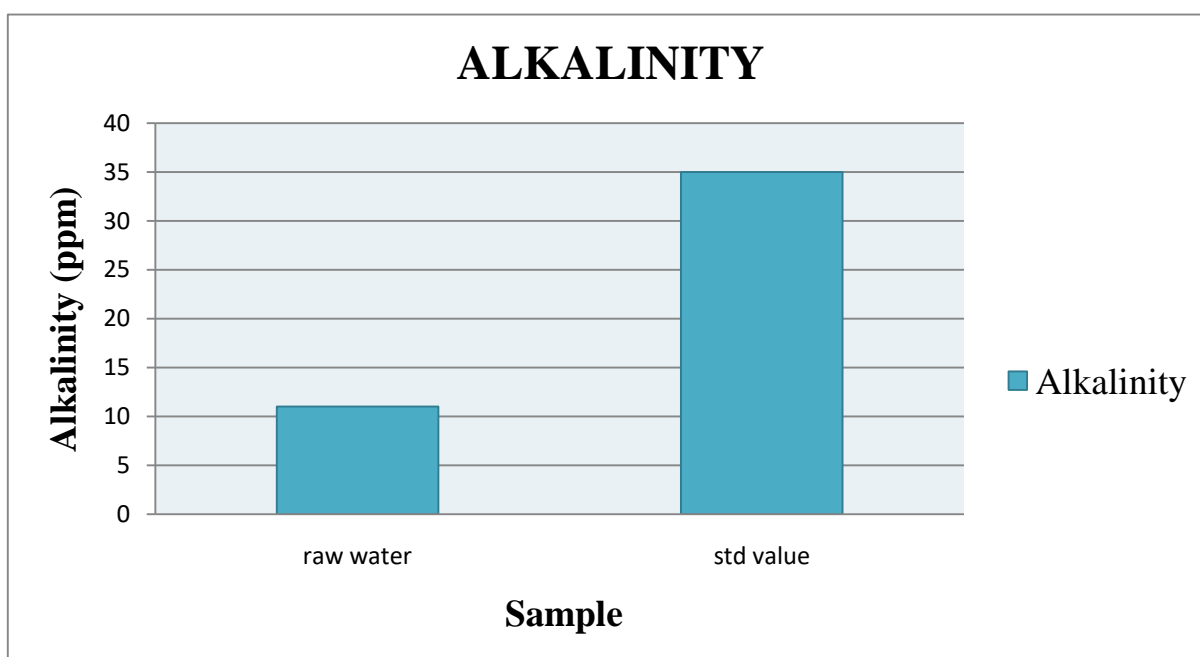


Fig.No.4.2 Comparison graph for Alkalinity test



Fig.no.4.3 Alkalinity test

### 4.3 pH

#### Definition

The pH is determined by using pH meter. The instrument must be standardized by using buffer. The platinum electrode of pH meter is immersed in the water sample for 5-10 seconds. The pH of the sample is shown in the display of the water.

#### Equipment used

pH meter with its accessories.

#### Procedure

- Clean the electrode with distilled water and wipe them with tissue paper.
- Take the unknown solution in a clean beaker, washed already with distilled water and rinsed with the unknown solution.
- Immerse the electrode into this solution.
- Measure the temperature of the solution and set temperature. Compensate knob to solution temperature.
- put the selector switch to the proper pH position and read the pH value after 30 seconds

**Test result**

S.no	Parameter	Textile raw water	Standard value
1.	pH	8.62	5.5-9

Table No.4.3 Comparison for pH Test

**Graph**

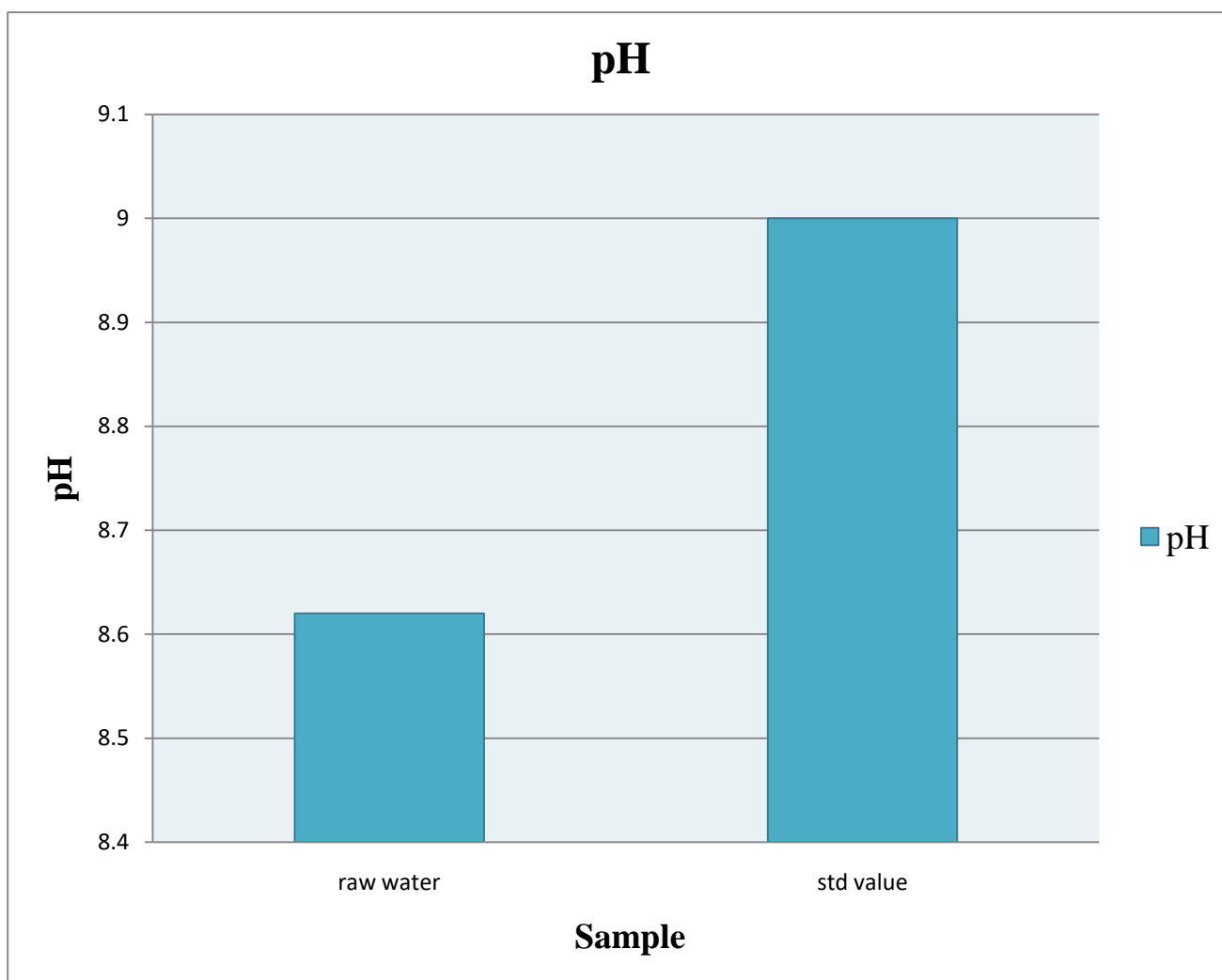


Fig.No.4.4 Comparison Graph for pH Test



Fig.No.4.5 pH test

#### 4.4 Total Hardness

##### Definition

The total hardness of sample is determined by titrating hard water with EDTA in the burette. The EBT indicator and standard buffer is added as reagents. Permanent hardness is determined by titrating the boiled water instead of hard water and the same procedure of total hardness is followed. Strength of EDTA is to be prepared with 0.01N

Temporary hardness = Total Hardness –Permanent Hardness

##### Equipment used

1. Burette
2. Two conical flasks
3. Pipette
4. White tiles
5. beaker
6. standard measuring flask
7. whatman filter paper no.44
8. glass rod etc.,

## Procedure

- Rinse and fill the burette with E.D.T.A. solution. Pipette out 25ml standard hard water in a conical flask.
- Add 10ml of burette solution and 4 to 5 drops of Erio-T indicator.
- Titrate with E.D.T.A solution till wine –red colour changes to clear blue.

## Test Result

S.NO	Parameter	Textile raw water	Standard value
1.	Total hardness	20	20-25

Table No.4.4 Comparison for Total hardness test

## Graph

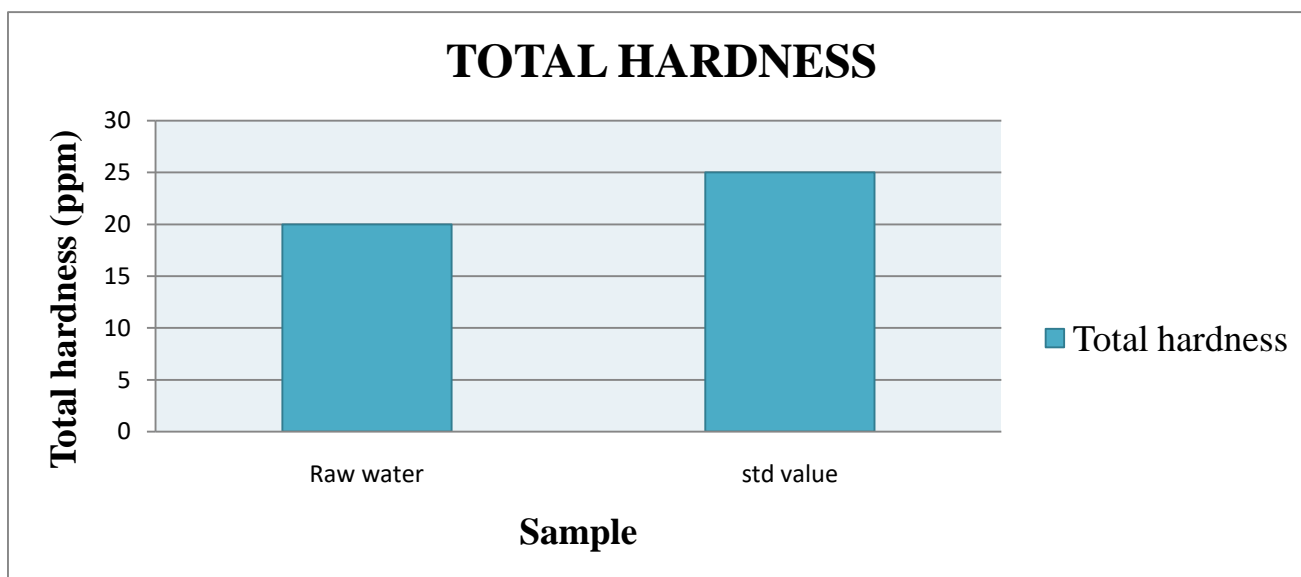


Fig.No.4.6 Comparison Graph for Total Hardness Test

## 4.5 Sulphate

### Definition

The sulphate in the water is determined by heating 20ml water, 5ml BaCl and 5 drop of HCL in china dish until precipitate is obtained. Weight of residue has to be determined.

Weight of concrete = final weight of china dish – initial weight of china dish

### Equipment used

1. Barium chloride solution:  
Dissolve 50g of hydrated  $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$  in 500 ml of water.
2. 2NHCL:  
Dissolve 166 ml of HCL in 1000ml of water.

### Procedure

- Measure 50ml of sample in a beaker.
- Add 10 ml of 2NHCL to it.
- Boil the contents while boiling add 30ml of 40%  $\text{BaCl}_2$  solution and filter precipitate is filtered through filter paper no.42.
- Wash the precipitate with distilled water.
- Burn the paper at  $800^\circ\text{C}$  after transferring to silica crucible.
- Heat the filter paper until no black particle appears.
- Silica crucible is cooled and weighed.

### Test result

S.no	Parameter	Textile raw water	Standard value
1.	Sulphate (mg/lit)	24.80	2-5

Table No.4.5 Comparison for Sulphate test

### Graph

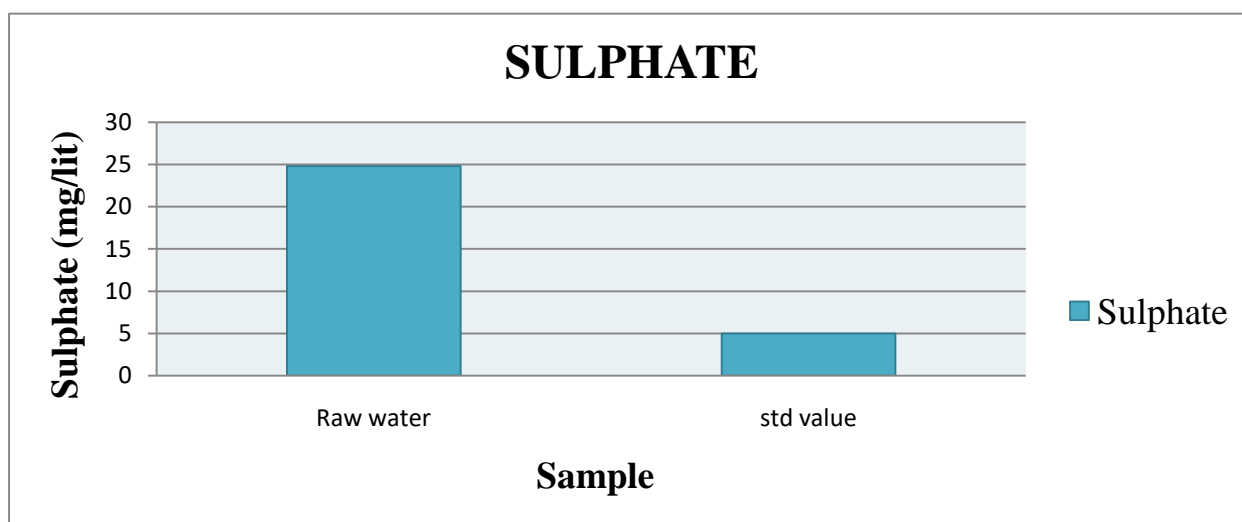


Fig.No.4.7 Comparison graph for Sulphate test



## 4.6 Nitrates

### Definition

Nitrate and nitrate ions are important indicators of pollution by organic materials as nitrogen from decomposing organic substances often ends up as nitrate or nitrite ions.

### Equipment used

1. Colorimeter
2. Hot plate
3. 100ml volumetric flask

### Procedure

1. Take 10ml sample in a tube and add 2ml sodium chloride solution, mix thoroughly.
2. Add 10ml of sample of acid solution, cool and add 0.5ml brucine sulphate reagent.
3. Swirl the tube to get the solution mixed and place it in a water bath maintaining a temperature of about 95°C.
4. After 20 minutes remove the tube and cool.
5. Read the yellow colour in the colorimeter at 410nm.
6. The calibration curve can be plotted using standards ranging from 0.1 to 1mg/l by diluting 1-10ml of the standard nitrate solution to 10ml distilled water and carrying out the estimate.
7. The distilled water blank with reagent can be run for adjustment of colorimeter to 100% transmission or zero absorbance.

### Test result

S.no	Parameter	Textile raw water	Standard value
1.	Nitrate (mg/lit)	2.64	5-8

Table No.4.6 Comparison for Nitrate test

### Graph

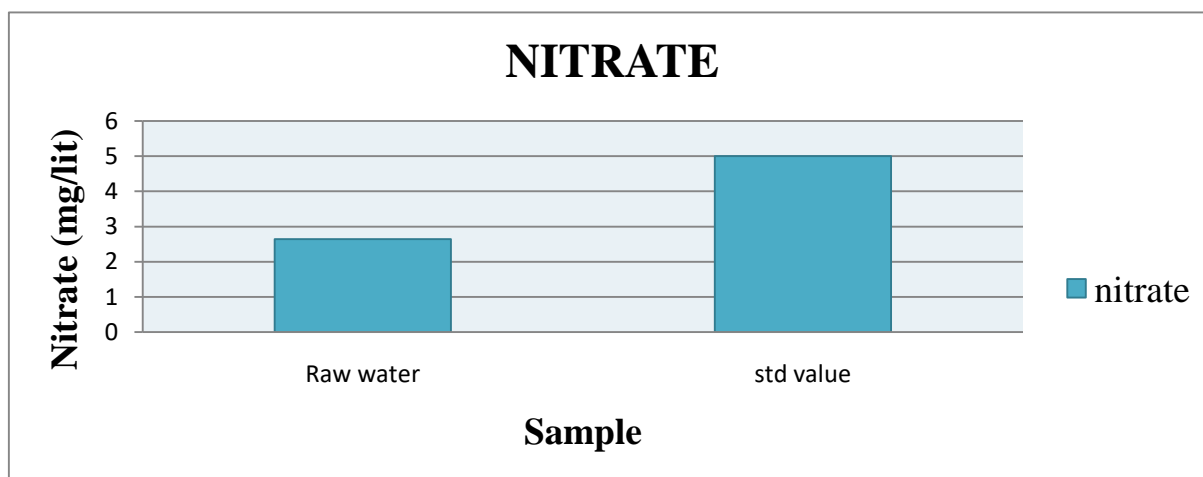


Fig.No.4.8 Comparison graph for Nitrate test

## 4.7 Biochemical Oxygen Demand

### Definition

BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compound and the oxidation of certain inorganic material (e.g., iron, sulphites). Typically the test for BOD is conducted over a five-day period. Place required volume of distilled water in a bottle and add 1ml each of phosphate buffer, magnesium sulphate, calcium chloride and ferric chloride solutions per liter of water. Prepare dilutions either in graduated cylinder or volumetric flask, mix well with a plunger type mixing rod, siphon mixed dilution into two BOD bottles without any entrapment of air and stopper the bottle. Take aerated distilled water in another two BOD bottles without entrapment of air and stopper the bottles as blank. Determine the initial dissolved oxygen on one of these two bottles for sample as well as blank. Stopper the second bottle of both sample and blank, water seal and incubate for 5 days at 20°C in BOD incubator. After 5 days incubation period, determine dissolved oxygen.

### Equipment used

1. Incubator
2. BOD bottle
3. Burette
4. Pipette
5. Conical flask

### Procedure

- Take the sample, dilute it with dilution water.
- Take the diluted sample in 2 BOD bottles.
- Fill another two BOD bottles with dilution water alone.
- Immediately find DO of the diluted waste water sample and dilution water.
- Incubate the other 2 BOD bottles at 20°C for 5 days. They are to be tightly stoppered to prevent any air entry into the bottles.
- Determine the DO content in the bottles at the end of 5 days.

### Test result

S.no	Parameter	Textile raw water	Standard value
1.	BOD (mg/lit)	186	500

Table No.4.7 Comparison for biological oxygen demand test

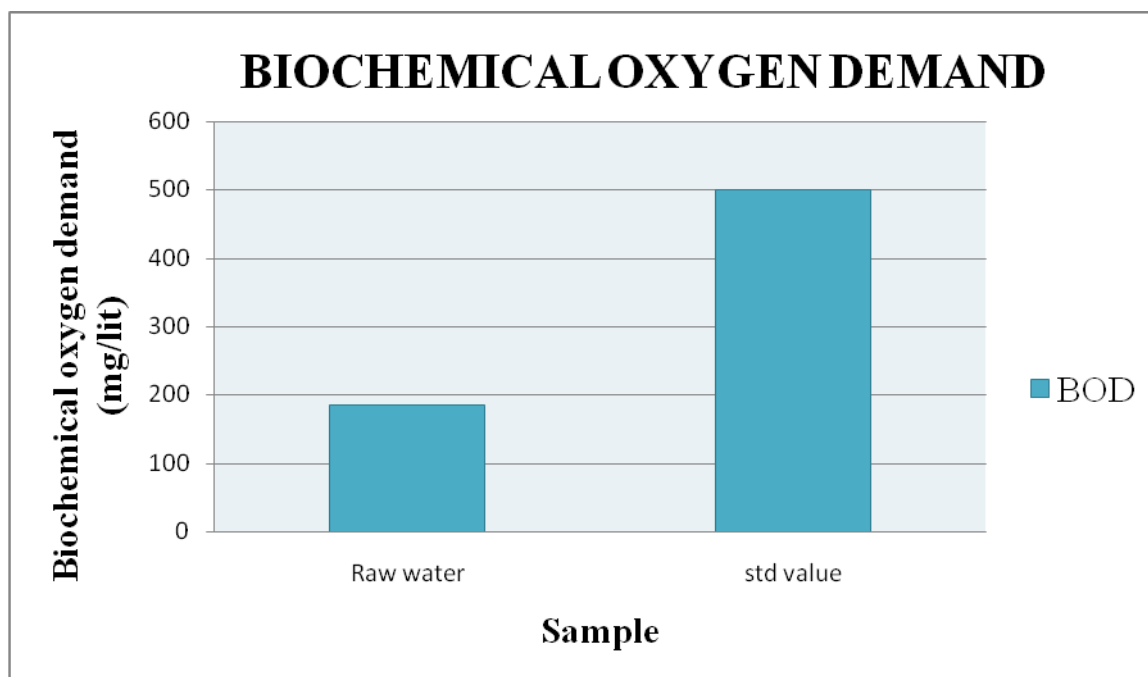
**Graph**

Fig.No.4.9 Comparison graph for biological oxygen demand test

**4.8 Chemical Oxygen Demand****Definition**

COD is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. Take 2.5ml sample, add 1.5ml digestion reagent, add 3.5ml of sulphuric acid reagent, stop the vial and digest in the COD reactor for one hour. Measure the reading using spectrophotometer.

**Equipment used**

1. Refluxing unit
2. Conical flask
3. Burette
4. Pipette

**Procedure**

- Place 10ml of a sample diluted to 100ml in the refluxing flask. Add 1gm (half spatula) mercuric sulphate crystals to the sample.
- Carefully add 5ml sulphuric acid-silver sulphate reagent and dissolve the mercuric sulphate. Cool while mixing it to avoid possible loss of volatile matter in the sample.
- Pipette out 25ml standard potassium dichromate solution into the RB flask and in cool in ice bath. While on cooling, add slowly 30 ml of sulphuric acid –silver nitrate reagent very carefully and mix thoroughly.
- Add a few anti –bumping granules and attach the condenser.
- Start the cooling water and reflux for a period of 2hours.

- Remove the heating source; allow the flask to cool for half an hour and wash the condenser with distilled water into the flask.
- Add 2-5 drops of ferroin indicator and titrate with standard ferrous ammonium sulphate solution. The end-point is the sharp colour change from yellowish green to reddish brown through green and blue green.
- Conduct blank also using 100ml distilled water instead of sample.

**Test result**

S.no	Parameter	Textile raw water	Standard value
1.	COD (mg/lit)	3.3	5

Table No.4.8 Comparison for chemical oxygen demand test

**Graph**

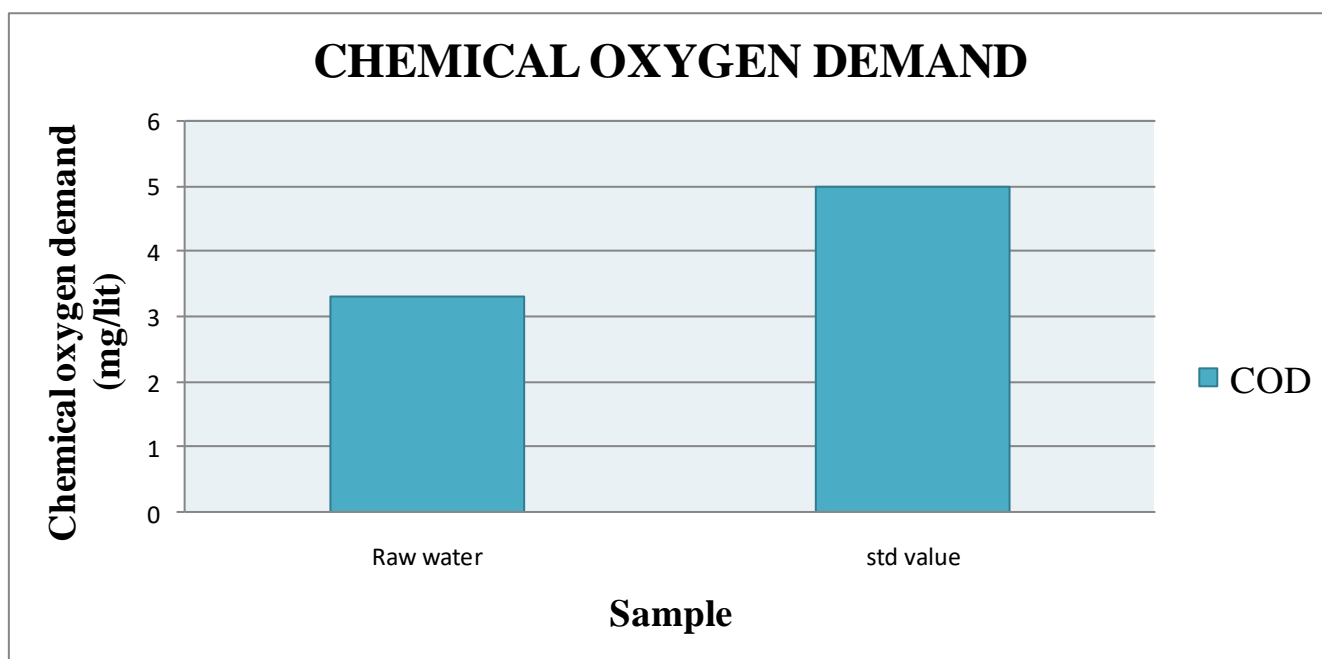


Fig.No.4.10 Comparison graph for chemical oxygen demand test

**4.9 Potassium**

**Definition**

Flame photometry or flame emission spectroscopy is based on the emission of seven radiations in visible region by a metal atom. This method is used in water analysis for determining the concentration of alkali

and alkaline earth metals such as sodium, potassium, lithium etc. A diagram showing the basic elements of flame photometer is given below:

A liquid sample to be analyzed is sprayed under controlled conditions into a flame where the water evaporates, leaving the salts behind as minute particles. The salts decompose into constituent atoms and become vaporized when they are subjected to a flame at about 1700oc. Vapors containing metal atoms are excited by thermal energy of the flame and this causes electrons of the metal atoms to be raised to higher energy levels.

### Equipment used

Flame photometer

### Procedure

- Switch on the flame photometer. Regulate the flow of gas and air supply. Send the distilled water first and start ignition.
- After the instrument is warmed up for about 10 minutes, adjust for zero reading display in the instrument. After this no further adjustment is required.
- Now the sodium chloride solution of various concentrations namely 2ppm, 4ppm, 6ppm and 8ppm are induced into the mixing chamber one by one and note the readings for each case.
- Draw the calibration graph with intensity of emitted light Vs concentration in the ppm of sodium ions.
- Then introduce the unknown NaCl solution and find the intensity value. From which the concentration of the unknown sample can be determined.

### Test result

S.no	parameter	Textile raw water	Standard value
1.	Potassium (mg/lit)	1.82	4

Table No.4.9 Comparison for Potassium test

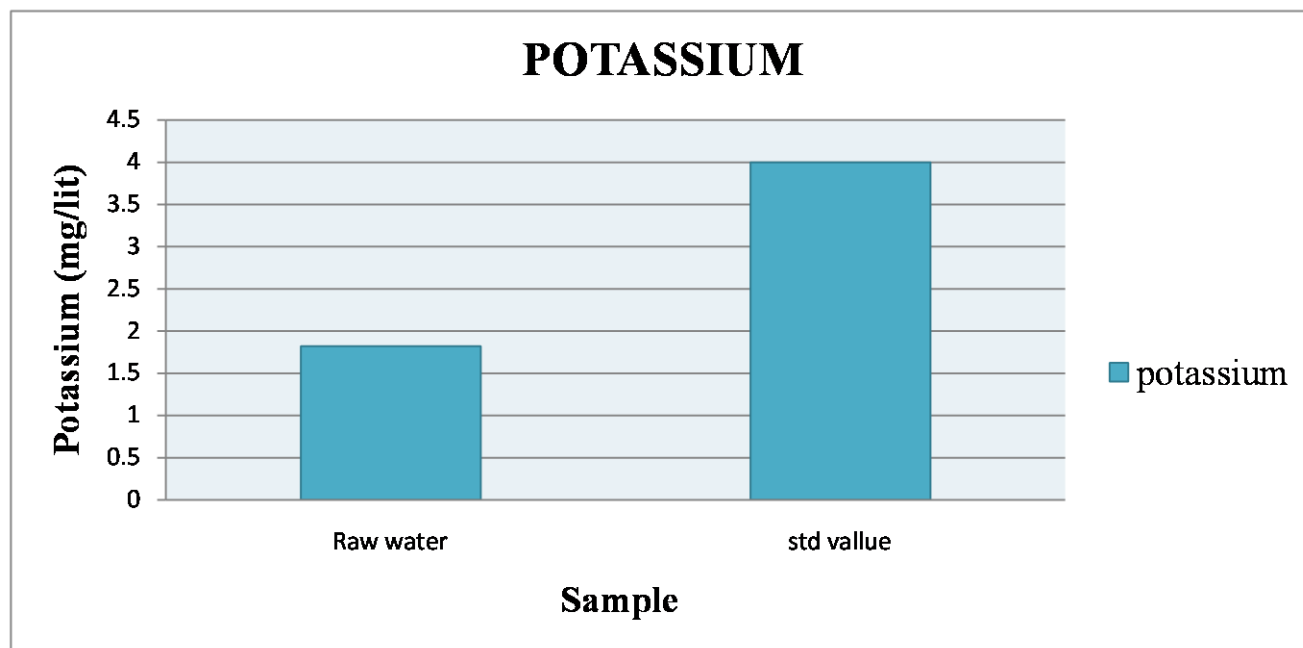
**Graph**

Fig.No.4.11 Comparison graph for Potassium test

**4.10 Chromium****Definition**

Flame photometry or flame emission spectroscopy is based on the emission of seven radiations in visible region by a metal atom. This method is used in water analysis for determining the concentration of alkali and alkaline earth metals such as sodium, potassium, lithium etc. A diagram showing the basic elements of flame photometer is given below:

A liquid sample to be analyzed is sprayed under controlled conditions into a flame where the water evaporates, leaving the salts behind as minute particles. The salts decompose into constituent atoms and become vaporized when they are subjected to a flame at about 1700oc. Vapors containing metal atoms are excited by thermal energy of the flame and this causes electrons of the metal atoms to be raised to higher energy levels.

**Equipment used**

Flame photometer

**Procedure**

- Switch on the flame photometer. Regulate the flow of gas and air supply. Send the distilled water first and start ignition.

- After the instrument is warmed up for about 10 minutes, adjust for zero reading display in the instrument. After this no further adjustment is required.
- Now the sodium chloride solution of various concentrations namely 2ppm, 4ppm, 6ppm and 8ppm are induced into the mixing chamber one by one and note the readings for each case.
- Draw the calibration graph with intensity of emitted light Vs concentration in the ppm of sodium ions.
- Then introduce the unknown NaCl solution and find the intensity value. From which the concentration of the unknown sample can be determined.

**Test result**

S.no	Parameter	Textile raw water	Standard value
1.	Chromium (mg/lit)	2.40	0.1-2

Table No.4.10 Comparison for Chromium test

**Graph**

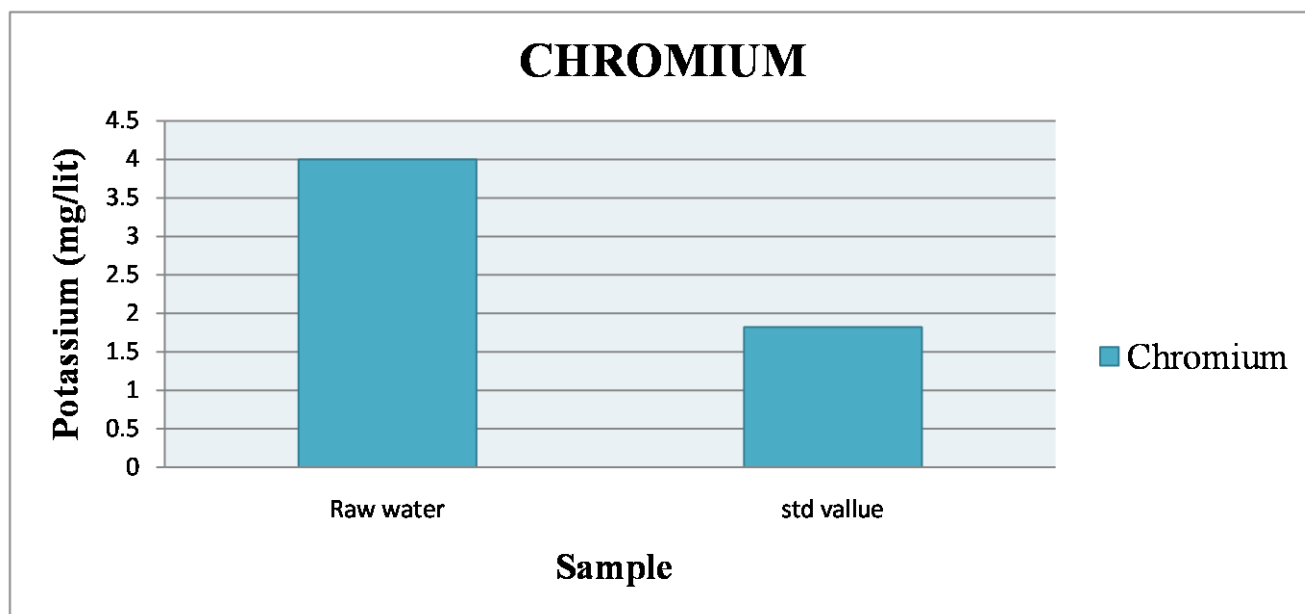


Fig.No.4.12 Comparison graph for Chromium test

**4.11 Cadmium**

**Definition**

Flame photometry or flame emission spectroscopy is based on the emission of seven radiations in visible region by a metal atom. This method is used in water analysis for determining the concentration of alkali and alkaline earth metals such as sodium, potassium, lithium etc. A diagram showing the basic elements of flame photometer is given below:

A liquid sample to be analyzed is sprayed under controlled conditions into a flame where the water evaporates, leaving the salts behind as minute particles. The salts decompose into constituent atoms and become vaporized when they are subjected to a flame at about 1700oc. Vapors containing metal atoms are excited by thermal energy of the flame and this causes electrons of the metal atoms to be raised to higher energy levels.

### Equipment used

Flame photometer

### Procedure

- Switch on the flame photometer. Regulate the flow of gas and air supply. Send the distilled water first and start ignition.
- After the instrument is warmed up for about 10 minutes, adjust for zero reading display in the instrument. After this no further adjustment is required.
- Now the sodium chloride solution of various concentrations namely 2ppm, 4ppm, 6ppm and 8ppm are induced into the mixing chamber one by one and note the readings for each case.
- Draw the calibration graph with intensity of emitted light Vs concentration in the ppm of sodium ions.
- Then introduce the unknown NaCl solution and find the intensity value. From which the concentration of the unknown sample can be determined.

### Test result

S.no	Parameter	Textile raw water	Standard value
1.	Cadmium (mg/lit)	0.32	2

Table No.4.11 Comparison for Cadmium test



## Graph

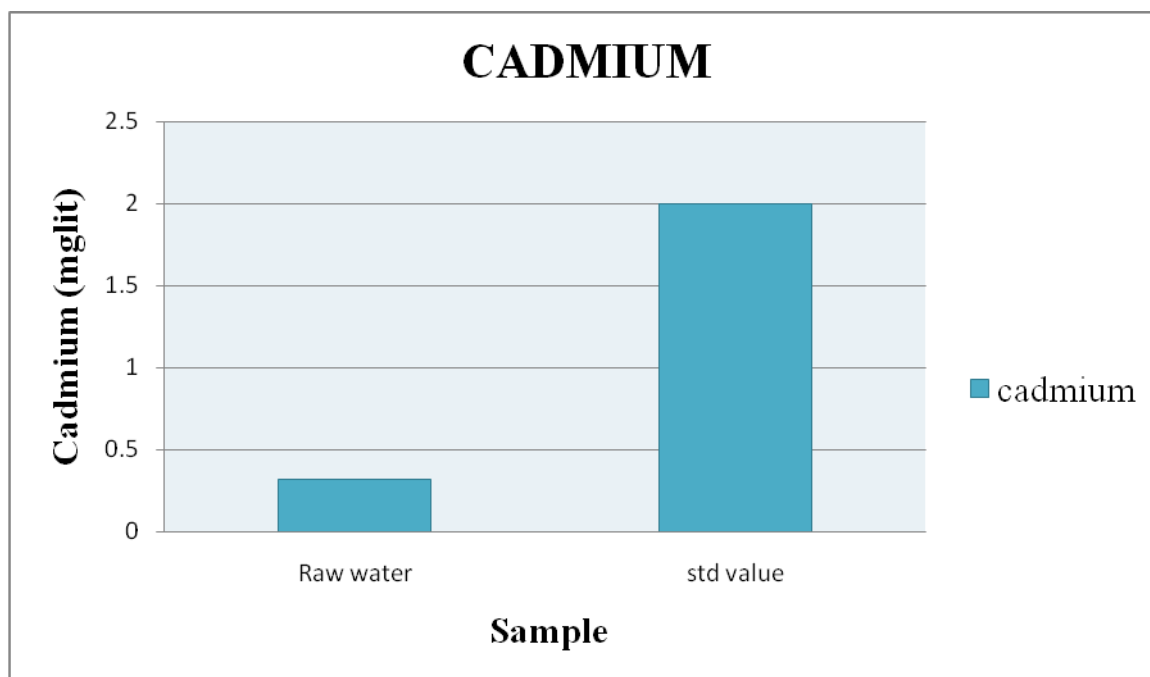


Fig.No.4.13 Comparison graph for Cadmium test

## 4.12 Total solids

### Definition

Total solids include suspended and dissolved solids. Dissolved solids are obtained when the sample filtered before evaporation. Suspended solids are obtained by drying the suspended matter obtained by filtration. The amount of total solids (total residue on evaporation) shall not exceed 500mg/l in drinkable water.

However up to a pressure of 1000mg/l may be permitted. Since the weight of the solids varies with the temperature of drying, a definite temperature must be used to get consistent results and is usually 1030C to 1050C. For rapid estimate of the dissolved solids, the method of specific conductance is preferred.

### Equipment used

1. Evaporating dishes
2. Water path
3. Desiccators
4. Weighing balance
5. Filter paper

### Procedure

- Wash and wipe the china disk and dry it in a hot air oven for dryness.
- Measure the initial weights of dishes by using electronic balance.
- Take 20 ml sample in a china dish and evaporate in a water bath at 103<sup>0</sup> C to 105<sup>0</sup>C the container to dryness in a dessicator and weigh the dishes again.
- Note the increase in weight.
- The amount of total solids present in the sample is calculated as amount of total solids present in the sample.

### Test result

S.no	Parameter	Textile raw water	Standard value
1.	Total solids (mg/lit)	300	600

Table No.4.12 Comparison for Total solids test

### Graph

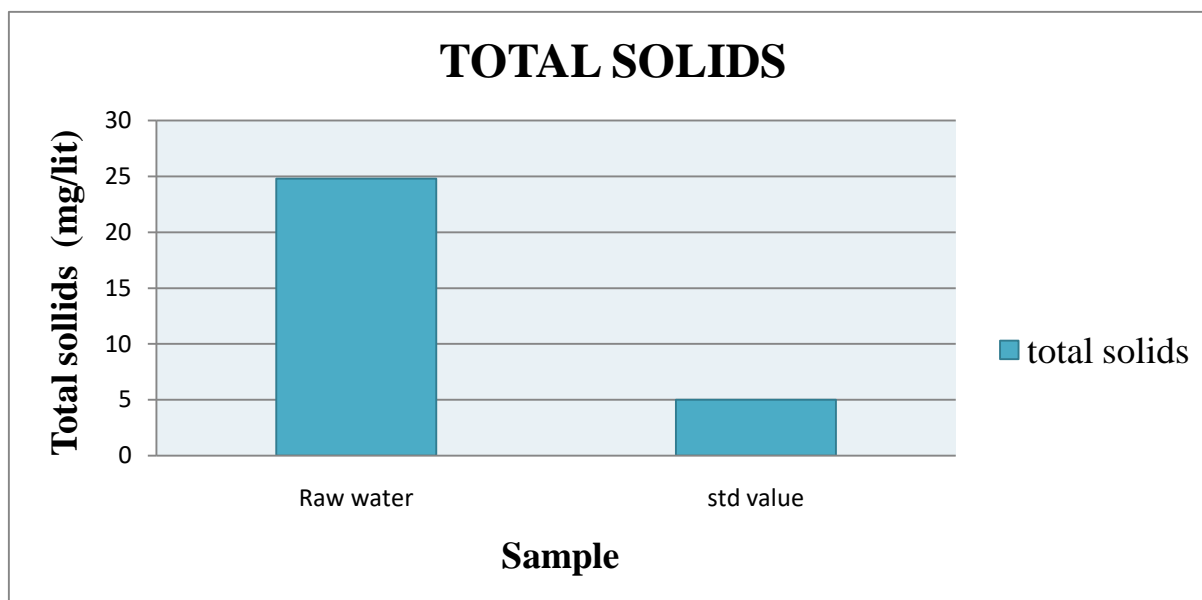


Fig.No.4.14 Comparison graph for Total solids test

**4.13 RESULT**

**Electricity value with addition of Cow Dung**

Days	Maximum voltage generated in(mV)
1	82
2	112
3	110
4	183
5	215

Table No.4.13 Comparison for Electricity by adding cow dung

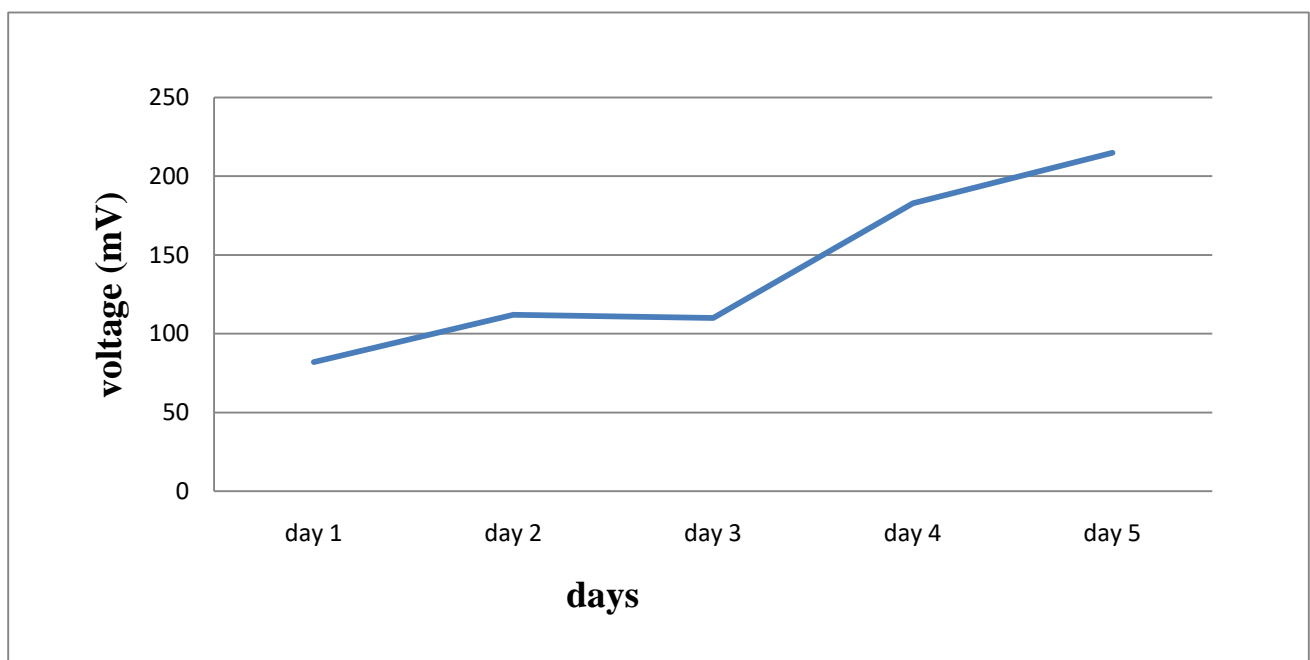


Fig.No.4.15 Comparison graph of Electricity by adding cow dung

**4.13.2 Electricity value with addition of Sugar**

Days	Maximum voltage generated in(mV)
1	55
2	98
3	76
4	99
5	113

Table No.4.14 Comparison for Electricity by adding sugar

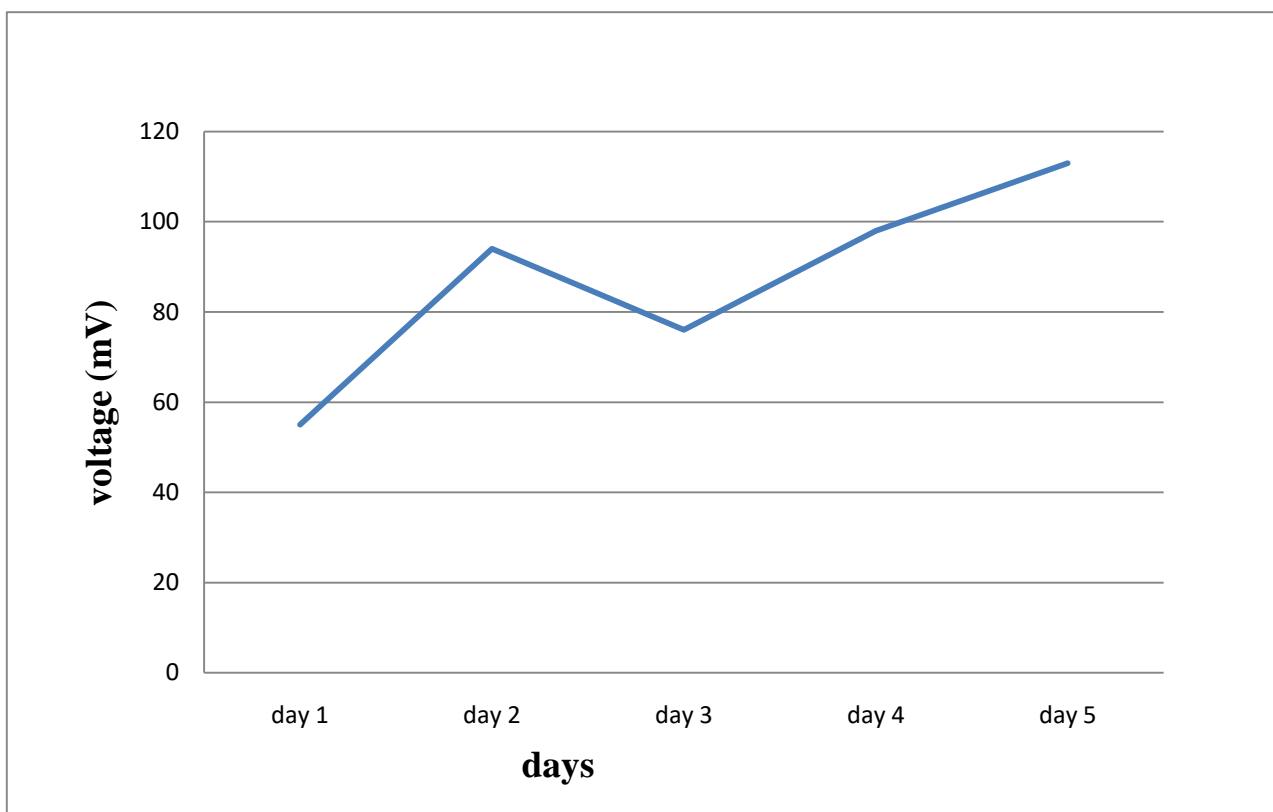


Fig.No.4.16 Comparison graph of electricity by adding Sugar

**4.13.3 Electricity value with addition of Glucose**

Days	Maximum voltage generated in(mV)
1	122
2	186
3	157
4	198
5	256

Table No.4.15 Comparison for Electricity by adding Glucose

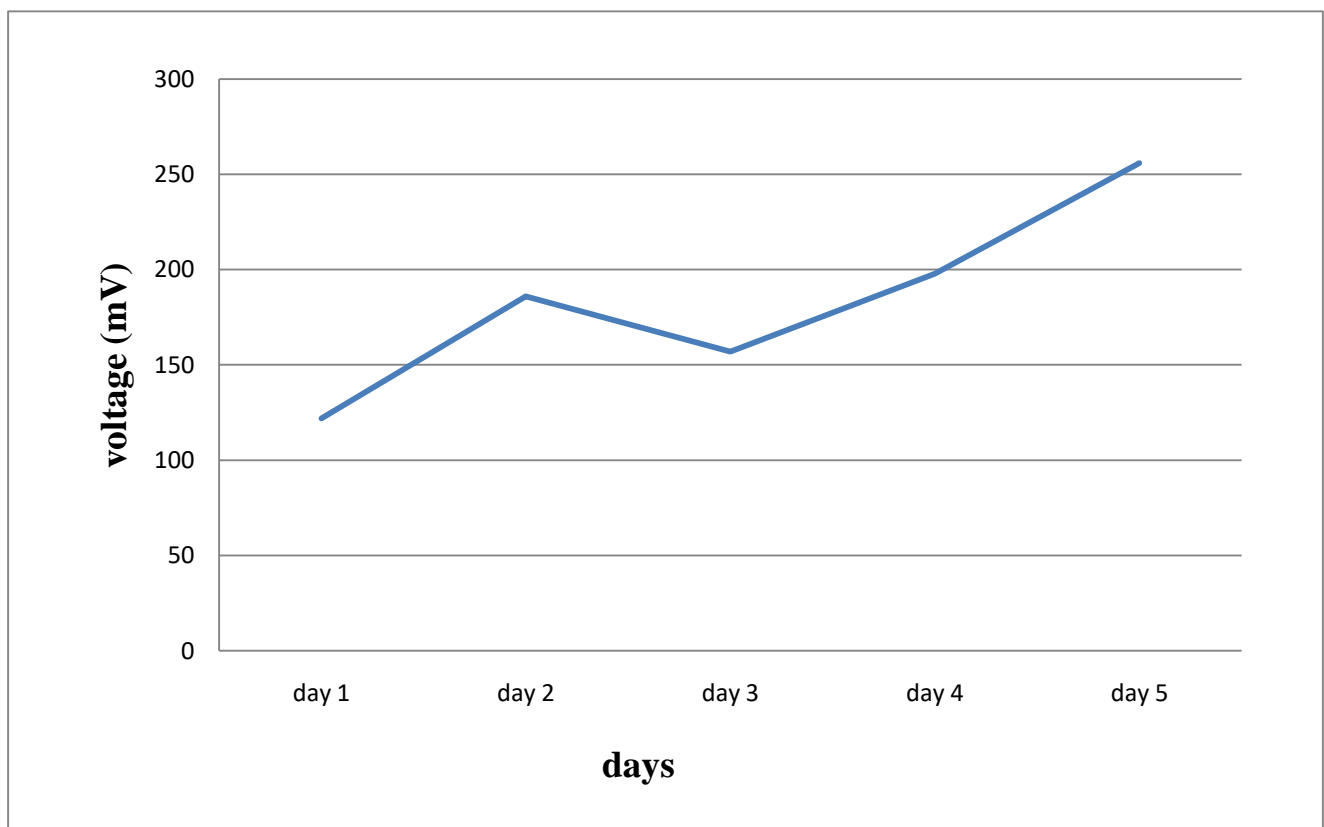


Fig.No.4.17 Comparison graph of electricity by adding Glucose

## **CHAPTER - 5**

### **CONCLUSION**

Due to the increase in urbanization around the natural water sources it leads to contamination of water. In future there will be increasing requirements of water for purposes such as domestic, agricultural practices and so on. It has shown considerable reduction of turbidity, pH, alkalinity, chromium, potassium etc. These parameters are also compared with the standards for discharge of industrial effluent. So far, MFC systems have been applied in several fields, including for the treatment of waste water and producing electricity, biosensors, and the production of secondary fuels. MFC technology is attractive for waste treatment because it allows the system to extract energy from waste for electricity production. MFC substrate contains a growth promoter that can increase the microbial growth during the waste processing. MFC can be used for produce secondary fuels like hydrogen as an alternative electricity power.

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