

COMPARISON BETWEEN TAP WATER AND KITCHEN WASTE WATER OF SELECTED SITES OF NIT ROURKELA

**A REPORT SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF**

Bachelor of Technology

In

Civil Engineering

By

SUSANTA KUMAR SETHY



**DEPARTMENT OF CIVIL ENGINEERING
NIT ROURKELA
2010**

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DEPARTMENT OF CIVIL ENGINEERING

**NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA
2010**

**NATIONAL INSTITUTE OF TECHNOLOGY
ROURKELA
CERTIFICATE**

This is to certify that the thesis entitled “ **Comparison between tap water and kitchen wastewater of selected sites of NIT Rourkela**” being submitted by **Sri Susanta Kumar Sethy** to the **National Institute of Technology, Rourkela** (India) , for the partial fulfilment of requirement of the degree of **Bachelor in Technology** in **Civil Engineering** , is an authentic record of research work carried out by him under my supervision and guidance and the work incorporated in this thesis has not been, to the best of my knowledge, submitted to any other University or Institute for the award of a degree or diploma.

Place : Rourkela

Date : 13th May 2010

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ABSTRACT

Because of growing concern that constituents of drinking water may have adverse health effect, consumption of tap water has decreased. The main objective of this work is to determine acidity, alkalinity, pH, turbidity, Total Solids, Chloride concentration, Do, BOD, Ca, Mg, Cu, Fe etc. values. IS codes are provided for determining these values. The average values of pH, Turbidity, Dissolved oxygen, BOD, Total Hardness, Alkalinity, Acidity, Total solids, Chloride, Concentration of Ca, Mg, Fe, Cu are ranges between 5 to 6.62, 1 to 3 NTU, 1.19 to 8.16 mg/l, 2 to 63.5 mg/l, 26 to 472 mg/l, 10.77 to 11.22 p.p.m, 21 to 430 p.p.m, 13.6 to 162.5 mg/l, 8.7 to 15.84 mg/l, 6.38 to 8.87 mg/l, 0.8 to 2.03 mg/l, 0.263 to 0.29 mg/l respectively.

KEYWORDS

Tap water, Kitchen wastewater, AAS (Atomic absorption spectrometry).

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1.0 INTRODUCTION

Water fit for human consumption is called drinking water or potable water. Wastewater is liquid waste discharged by domestic residences, commercial properties, industry, and agriculture. In the most common usage, it refers to the municipal wastewater that contains a broad spectrum of contaminants resulting from the mixing of wastewaters from different sources (Wikipedia). In the present work, the kitchen waste water and tap water have been collected from different locations of NIT Rourkela to compare different physical and chemical characteristics.

2.0 STUDY AREA

For comparison of tap water and kitchen waste water sampling points are 1,2,3,4 as shown in figure 1.

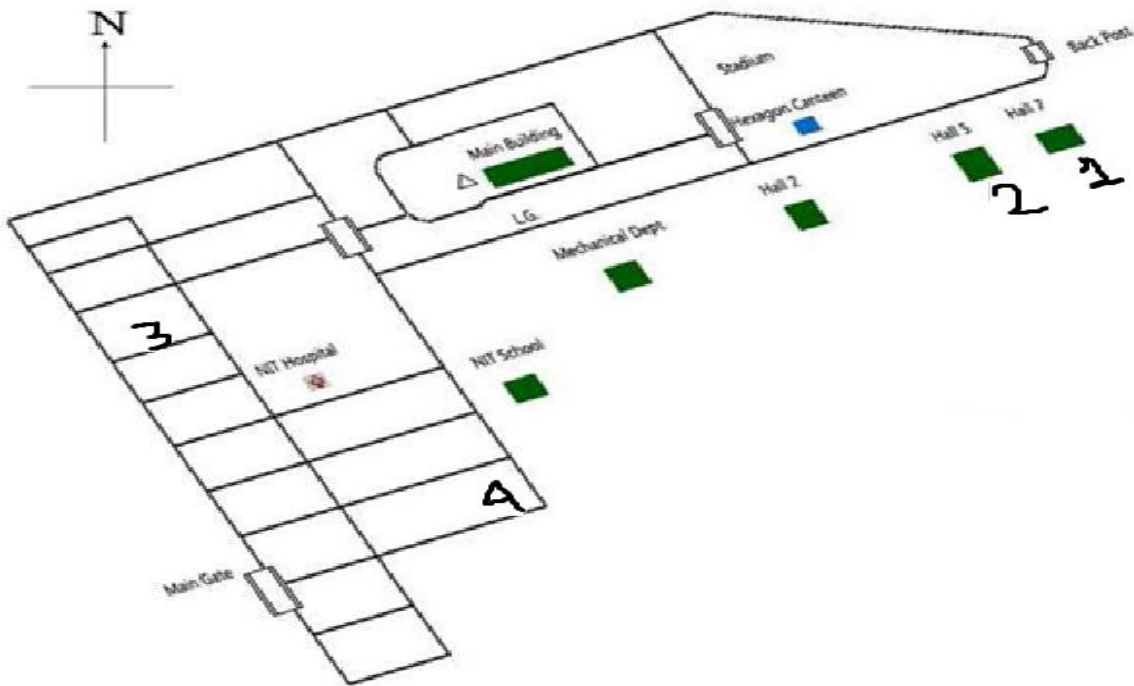


Figure 1. Map of Study area

- 1 – HBH hall of NIT Rourkela
- 2 – MSS hall of NIT Rourkela
- 3 – A type quarter of NIT Rourkela
- 4 – E type quarter of NIT Rourkela

3.0 EXPERIMENTAL METHODS:

3.1.0 TAP WATER AND KITCHEN WASTE WATER SAMPLING PROCEDURE

The tap water sample of the kitchen has been collected into a normal air tight bottle of capacity of 2 liters. A mug has been used to take the kitchen waste water into the same type of bottle. Similarly 8 samples of water and kitchen waste water from different locations of NIT Rourkela has been collected and experimented. The same procedure has been repeated 4 times to get the average value of the required parameters of duration December 2009 to may 2010.

FOR COMPARISION OF WATER AND KITCHEN WASTE WATER ANALYSIS SAMPLING POINTS ARE:-

- HBH- Homi Bhaba hall of NIT Rourkela
- MSS- M.S.Swaminathan hall of NIT Rourkela
- Faculty residence of NIT Rourkela (A type) (A5)
- E type quarter (E 31)

3.2.0 METHODOLOGY FOR MEASUREMENT OF pH VALUE (ELECTROMERIC METHOD)

3.2.1. PRINCIPLE

The pH of the sample is determined electrometrically using either a glass electrode in combination with a reference potential or a combination electrode.

3.2.2. APPARATUS USED

- pH meter – With glass and reference electrode
- Thermometer

3.2.3. PROCEDURE

Standardize the instrument with a buffer solution of pH near that of the sample and check electrode against at least one additional buffer of different pH value. Measure the temperature of the water and if temperature compensation is available in the instruments adjust it accordingly. After the standardization place the sample in the beaker and immerse the electrode, then take the reading in the pH meter and the temperature (SW-846).

3.3.0 METHODOLOGY FOR MEASUREMENT OF TURBIDITY

3.3.1. PRINCIPLE

It is based on comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions.

3.3.2. APPARATUS USED

- Sample tubes - The sample tubes should be of clear and colorless glass.
- Turbidity meter – Systronics digital nephelo-turbidity meter 132

3.3.3. PROCEDURE

- Insert three pin plug into appropriate 230V AC mains socket.
- Switch the instrument on and allow 10-15 minutes to warm up.
- Select the appropriate range.
- Set the CALIB control to maximum, clockwise position.
- Insert the test tube with distilled water into cell holder and cover with light shield.
- Adjust SET ZERO controls to get zero on the display.
- Remove the test tube and replace the test tube containing standard solution.
- Adjust CALIB control for display the result.
- The instrument is now ready for test samples. Insert test tube containing unknown sample in cell holder.
The display directly gives the turbidity in NTU (Laboratory manual, NIT Rourkela).

3.4.0 METHODOLOGY FOR MEASUREMENT OF DISSOLVED OXYGEN

3.4.1 PRINCIPLE

Oxygen saturation or dissolved oxygen (DO) is a relative measure of the amount of oxygen that is dissolved or carried in a given medium. It can be measured with dissolved oxygen meter.

3.4.2 APPARATUS USED

- Dissolved oxygen meter
- Incubation bottle

3.4.3 PROCEDURE

First take the unknown sample in the incubation bottle. Then with the help of DO meter 3 readings have been noted, first reading has been taken at the bottom, second at mid point and third at top of the bottle. Now the average of the readings will give the dissolved oxygen present in the water sample (Laboratory manual, NIT Rourkela).

3.5.0 METHODOLOGY FOR MEASUREMENT OF BIOCHEMICAL OXYGEN DEMAN (BOD)

3.5.1 PRINCIPLE

Biological Oxygen Demand (BOD) is a measure of the oxygen used by microorganisms to decompose this waste. If there is a large quantity of organic waste in the water supply, there will also be a lot of bacteria present working to decompose this waste. In this case, the demand for oxygen will be high (due to all the bacteria) so the BOD level will be high. As the waste is consumed or dispersed through the water, BOD levels will begin to decline (Field book).

3.5.2 APPARATUS USED

- Incubation bottles- 300 ml capacity
- Magnetic stirrer

3.5.3 PROCEDURE

Place the unknown sample in the incubation bottle, and 4 capsules (4 gm) of NaOH has been kept at the neck of the bottle. A magnetic stirrer continuously rotates inside the bottle. Then it is kept air tight by the special caps attached with an electronic meter, which directly records BOD reading at every 24 hour. Now the bottles are preserved in the Refrigerator for days as per requirement of study. The same procedure follows for BOD 3 days and BOD 5 days (Laboratory manual, NIT Rourkela).

3.6.0 METHODOLOGY FOR MEASUREMENT OF HARDNESS

3.6.1 PRINCIPLE

Total hardness is a measurement of calcium and magnesium, and is expressed as calcium carbonate; our body needs both Ca and Mg to remain healthy. If water is too hard it will also decrease the washing ability of many soaps and detergents as well as affect the taste of the water (SDWF).

3.6.2 APPARATUS USED

- A pipette –(Minimum 50 ml capacity)
- 4 – 8 oz. glass bottle

3.6.3 PROCEDURE

- Pipette 50 ml. of the sample into 4 – 8 oz. glass bottle.
- Add the standard soap solution, in small portions at first (0.5 ml.), shaking vigorously after each addition.
- As the end point is approached, the quantity added should be reduced to 0.1 ml. for each addition.
- After a permanent lather is produced which is last for 5 minutes with the bottle on its side, record the ml. of soap solution used.
- Continue the addition of small quantities of soap solution. If the lather again disappears, the first point was false owing to the presence of magnesium salts. (The ml. of soap used to obtain this false end point may be used for calculation of the approximate magnesium hardness by substituting in the formula used for calculation.)
- Continue the addition of the soap solution until the true end point is reached and record the ml. used. If the quantity of soap solution used is greater than about 14 ml, repeat the procedure using a smaller sample diluted to 50 ml. with freshly boiled and cooled distilled water (Laboratory manual, NIT Rourkela).

3.7.0 METHODOLOGY FOR MEASUREMENT OF ALKALINITY

3.7.1 APPARATUS USED

- Pipette – Minimum 100 ml. capacity
- Erlenmeyer flask
- A burette

3.7.2 REAGENTS USED

- Phenolphthalein indicator
- 0.02N sulfuric acid
- Methyl orange indicator

3.7.3 PROCEDURE

- Pipette 100 ml. of the sample into the Erlenmeyer flask and the same quantity of distilled water into another.
- Add 3 drops of phenolphthalein indicator to each.
- If the sample becomes pink, add 0.02N sulfuric acid from a burette until the pink color just disappears and record the no. of ml. of acid used.
- Add 3 drops of methyl orange indicator to each flask.
- If the sample becomes yellow, add 0.02N sulfuric acid until the first difference in color is noted when compared with the distilled water. The end point is orange. Record the no. of ml. of acid used (Laboratory manual, NIT Rourkela).

3.8.0 METHODOLOGY FOR MEASUREMENT OF ACIDITY

3.8.1. APPARATUS USED

- Pipette – Minimum 100 ml. capacity
- Erlenmeyer flask
- A burette

3.8.2 REAGENTS USED

- Phenolphthalein indicator
- 0.02N sodium hydroxide

3.8.3. PROCEDURE

- Pipette 100 ml. of the sample into a Erlenmeyer flask.
- Add 3 drops of phenolphthalein indicator.
- Add 0.02N sodium hydroxide from burette until the first permanent pink color appears and record the no. of ml. of sodium hydroxide used (Laboratory manual, NIT Rourkela).

3.8.4. CALCULATION

Ml. of 0.02N sodium hydroxide \times 10 = p.p.m. total acidity expressed in terms of CaCO_3

3.9.0 METHODOLOGY FOR MEASUREMENT OF TOTAL SOLIDS

3.9.1 APPARATUS USED

- Pit crucible
- A desiccator
- Flask or pipette

3.9.2. PROCEDURE

- Clean the pit crucible and place it in a 103°C oven for 1 hr.
- Place the crucible in a desiccator until cools, then weigh.
- Thoroughly mix the sample and measure 100 ml. by means of a volumetric flask or pipette.
- Transfer the sample to the dish, rinse the flask or pipette several times with small portions of distilled water and add the rinsing to the dish. Be sure that all suspended matter is transferred to the crucible.
- After the sample is evaporated, dry the crucible and residue in the 103°C oven for 1 hr., cool in the desiccator and weigh (Laboratory manual, NIT Rourkela).

3.9.3. CALCULATION

$[\text{Increase in weight (cm)} \times 1000] \div \text{Ml. of sample} = \text{p.p.m. total solids}$

3.10.0 METHODOLOGY FOR MEASUREMENT OF CHLORIDE PRESENT

3.10.1 APPARATUS USED

- Porcelain evaporating dish
- A burette
- A pipette

3.10.2. REAGENTS USED

- Potassium chromate indicator
- Standard silver nitrate solution

3.10.3. PROCEDURE

- Pipette 50 ml. of the sample in the porcelain evaporating dish.
- Place about same quantity of distilled water into second dish for color comparison.
- Add 1 ml. of potassium chromate indicator to each.
- Add standard silver nitrate solution to the sample from a burette, a few drops at a time, with constant alternating until the first permanent reddish coloration appears. This can be determined by comparison with the distilled water. Record the ml. of the silver nitrate solution used.
- If more than 7 or 8 ml. of silver nitrate solution are required, the entire procedure should be repeated using a smaller sample diluted to 50 ml. with distilled water (Laboratory manual, NIT Rourkela).

3.10.4. CALCULATION

$[(\text{Ml. of silver nitrate used} - 0.2) \times 500] \div \text{Ml. of sample} = \text{p.p.m. chloride}$

3.11.0 METHODOLOGY FOR MEASUREMENT OF METALS LIKE Fe, Cu, Ca, Mg BY ATOMIC ABSORPTION SPECTROMETRY (AAS)

3.11.1. PRINCIPLE

Atomic absorption spectrometry (**AAS**) resembles emission flame photometry in that a sample is aspirated into a flame and atomized. The major difference is that in photometry the amount of light emitted is measured, where as in **AAS** a light beam is directed through the flame, into a monochromator, and on to a detector that measures the amount of light absorbed by the atomized element in the flame. The amount of energy of the characteristic wavelength absorbed in the flame is proportional to the concentration of the element in the sample.

3.11.2. APPARATUS USED

- Atomic absorption spectrometer



Figure 2. Atomic Absorption spectrometer

- Burner
- Recorder
- Lamps
- Pressure reducing valves
- Vent

3.11.3. REAGENTS USED

- Air
- Acetylene
- Metal free water
- Standard metal solution – A series of standard metal solutions of respective metals in optimum concentration range by appropriate dilution of the stock metal solution.

3.11.4. PROCEDURE

- In general proceed according to the manufacturer's operating manual.
- Install a hollow cathode lamp for desired metal in the instrument and roughly set the wavelength. Set slit width according to the manufacturer's suggested setting for element being measured. Turn on the instrument, apply to the hollow cathode lamp the current suggested by the manufacturer, and let instrument warm up until energy source stabilizes, generally about 10 to 20 minutes.
- Optimize wavelength by adjusting wavelength dial until optimum energy gain is obtained. Align lamp in accordance with manufacturer's instructions.
- Install suitable burner head and adjust burner head position. Turn on air and adjust flow rate to that specific by manufacturer to give maximum sensitivity for the metal being measured.
- Turn on acetylene, adjust flow rate to value specified, and ignite flame. Aspirate a standard solution and adjust aspiration rate of the nebulizer to obtain maximum sensitivity. Atomize a standard and adjust burner both up and down and sideways to obtain maximum response. Record absorbance of this standard when freshly prepared with a new hollow cathode lamp.
- The instrument is now ready to operate. First put the standard solutions and stock solutions to obtain a graph of the respective metal concentration, put the unknown sample to get the value of the metal present with respect to the respective graph (APHA).

4.0 RESULTS AND DISCUSSION:

4.1 COMPARISON BETWEEN TAP WATER AND KITCHEN WASTE WATER AT SELECTED SITES OF NIT ROURKELA

Average value of the respective parameters of 4 samples are:-

Sampling points	HBH Water	HBH Waste water	MSS Water	MSS Waste water	Faculty Quarter (A type) Water	Faculty Quarter (A type) Waste water	Staff Quarter (E type) Water	Staff Quarter (E type) Waste Water
pH	6.455	4.9125	6.3475	5.09	6.6275	5.1325	6.3425	5.06
BOD	2	>50	2	>50	2	>50	2	>50
DO	7.8625 mg/L	1.25 mg/L	8.015 mg/L	1.19 mg/L	7.9375 mg/L	1.3025 mg/L	8.165 mg/L	1.285 mg/L
Turbidity	1 NTU	2.5 NTU	1 NTU	2.75 NTU	1 NTU	2.25 NTU	1 NTU	3 NTU
Chloride	13.5 ppm	99.5 ppm	17.5 ppm	110 ppm	14.5 ppm	106 ppm	15.5 ppm	103 ppm
Hardness	29.25 mg/L	425 mg/L	26 mg/L	419 mg/L	29.5 mg/L	472 mg/L	29 mg/L	424 mg/L
Acidity	21 ppm	425 ppm	23.25 ppm	425 ppm	22.5 ppm	430 ppm	21 ppm	420 ppm
Alkalinity	11.225	-	11.075	-	10.925	-	10.775	-
Total solids	14.05 mg/L	156 mg/L	14 mg/L	161.5 mg/L	13.6 mg/L	162.5 mg/L	15.15 mg/L	163 mg/L
Ca	11.34775 Mg/l	8.9935 Mg/l	15.84325 Mg/l	10.161 Mg/l	9.25775 Mg/l	8.7005 Mg/l	9.77775 Mg/l	9.53225 Mg/l
Mg	7.66425 Mg/l	6.44075 Mg/l	8.1445 Mg/l	6.638 Mg/l	8.87225 Mg/l	6.69525 Mg/l	8.063 Mg/l	6.38 Mg/l
Cu	0.272 Mg/l	0.27 Mg/l	0.263 Mg/l	0.263 Mg/l	0.29425 Mg/l	0.29525 Mg/l	0.28645 Mg/l	0.27475 Mg/l
Fe	1.51225 Mg/l	0.802 Mg/l	2.0395 Mg/l	0.81875 Mg/l	1.21 Mg/l	0.808 Mg/l	1.298 Mg/l	0.8238 Mg/l

Table 1.Comparision between water and kitchen waste water

HBH- Homi Bhaba Hall of NIT Rourkela

MSS- M.S.Swamintahan Hall of NIT Rourkela

4.1.1 VARIATION OF pH VALUE ON WATER AND KITCHEN WASTE WATER

The pH value is the logarithm of reciprocal of hydrogen ion activity in moles per liter. In water solution, variations in pH value from 7 are mainly due to hydrolysis of salts of strong bases and weak acids or vice versa. Dissolved gases such as carbon dioxide, hydrogen sulphide and ammonia also affect pH value of water. In this study the average of 4 sample's pH range for tap water varies from 6.34 to 6.62 and for waste water it varies from 4.91 to 5.13. It explains that kitchen waste water is more acidic than tap water.

sampling points	sample1	sample2	sample3	sample4	average
HBH Water	6.32	6.53	6.54	6.43	6.455
HBH Waste water	4.91	5.1	4.72	4.92	4.9125
MSS Water	6.21	6.32	6.52	6.34	6.3475
MSS Waste water	5.05	5.12	5.21	4.98	5.09
Faculty Quarter (A type) Water					
	6.7	6.62	6.52	6.67	6.6275
Faculty Quarter (A type) Waste water					
	5.1	5.12	5.15	5.16	5.1325
Staff Quarter (E type) Water					
	6.26	6.32	6.56	6.23	6.3425
Staff Quarter (E type) Waste Water					
	4.93	5.21	4.98	5.12	5.06

Table 2.pH values of water and kitchen wastewater on sampling locations

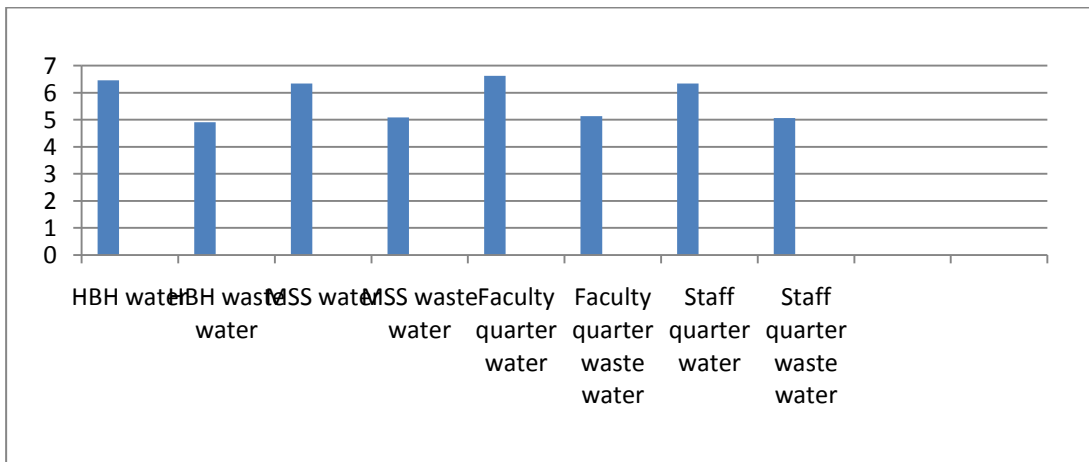


Figure 3.Average pH values of water and kitchen wastewater on sampling locations

4.1.2 VARIATION OF BOD VALUE ON WATER AND KITCHEN WASTE WATER

BOD of a sample is defined as the amount of oxygen required by the micro-organisms to oxidise the organic matter by aerobic microbial decomposition to stable inorganic forms at some standard time and temperature. BOD gives a quantitative index of the degradable organic substances in water and is used as a measure of waste strength. The low BOD value in all samples showed good sanitary condition of the water. In this study the average BOD value for tap water is 2 mg/l in all areas and for kitchen wastewater it varies between 62.5 to 63.5 mg/l. In case of wastewater, oxygen required for micro-organisms to oxydise the organic matter is more than the tap water.

sampling points	sample1	sample2	sample3	sample4	average
HBH Water	2	2	2	2	2
HBH Waste water	62	64	64	62	63
MSS Water	2	2	2	2	2
MSS Waste water	62	62	64	62	62.5
Faculty Quarter (A type) Water	2	2	2	2	2
Faculty Quarter (A type) Waste water	66	62	62	62	63
Staff Quarter (E type) Water	2	2	2	2	2
Staff Quarter (E type) Waste Water	64	64	64	62	63.5

Table3.BOD of water and kitchen wastewater on sampling locations

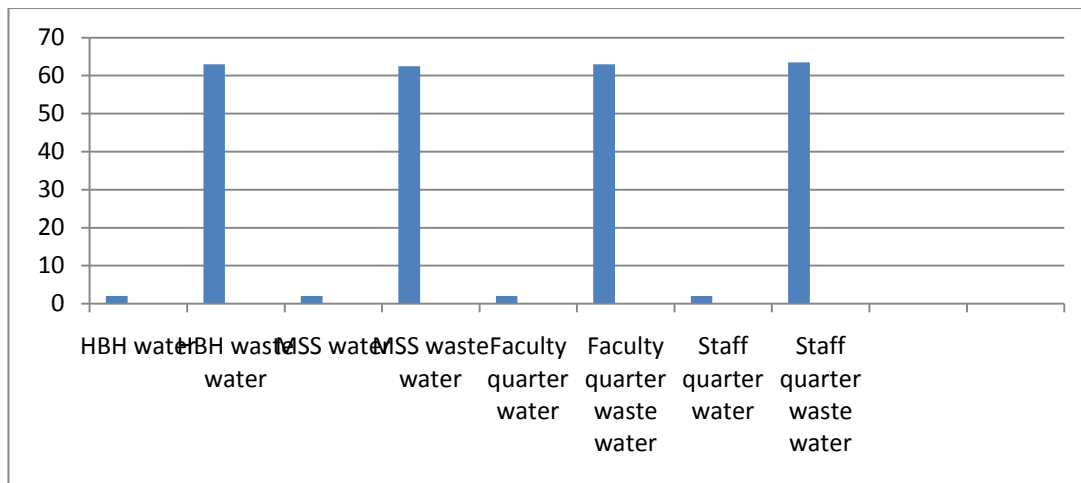


Figure 4. Average BOD of water and kitchen wastewater on sampling locations

4.1.3 VARIATION OF DO VALUE ON WATER AND KITCHEN WASTE WATER

Dissolved oxygen content in water reflects the physical and biological processes prevailing in water and is influenced by aquatic vegetation. Low oxygen content in water is usually associated with organic pollution. Average DO value is ranged from 1.19 to 1.3025 mg/l for wastewater and 7.8625 to 8.165 mg/l for tap water. It concludes that oxygen content in tap water is much more than kitchen wastewater.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	7.85	7.82	7.86	7.92	7.8625
HBH Waste water	1.31	1.2	1.23	1.26	1.25
MSS Water	7.72	8.1	8.12	8.12	8.015
MSS Waste water	1.1	1.3	1.21	1.15	1.19
Faculty Quarter (A type) Water	8.1	7.86	7.85	7.94	7.9375
Faculty Quarter (A type) Waste water	1.3	1.25	1.31	1.35	1.3025
Staff Quarter (E type) Water	8.1	8.23	8.21	8.12	8.165
Staff Quarter (E type) Waste Water	1.28	1.32	1.31	1.23	1.285

Table 4. DO of water and kitchen waste water on sampling locations

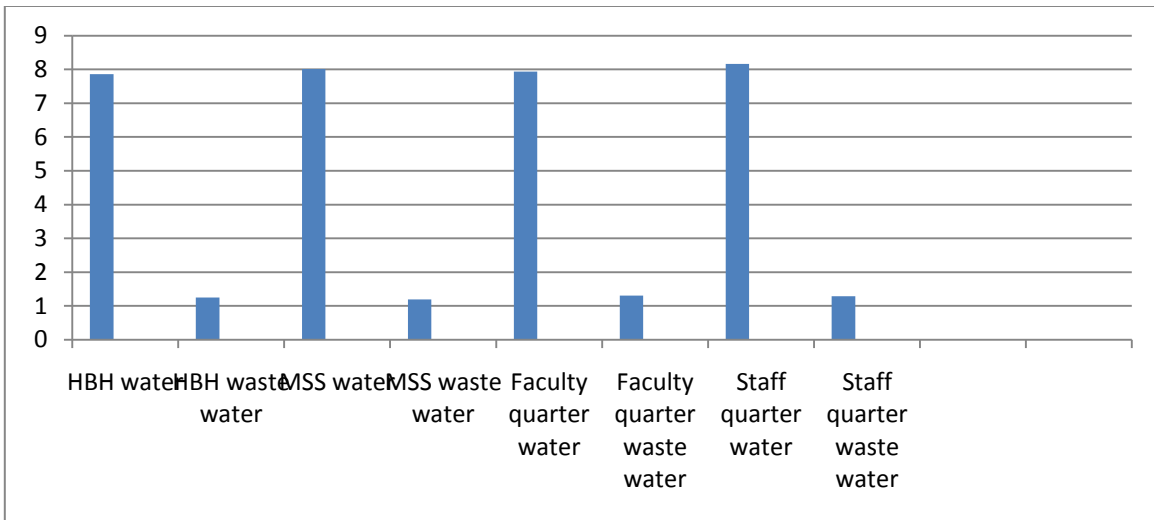


Figure 5. Average DO of water and kitchen wastewater on sampling locations

4.1.4 VARIATION OF TURBIDITY ON WATER AND KITCHEN WASTE WATER

Measurement of Turbidity reflects the transparency in water. It is caused by the substances present in water in suspension. In natural water, it is caused by clay, silt, organic matter and other microscopic organisms. Average value of turbidity for tap water is 1 NTU and for wastewater it varies between 2.5 to 3 NTU. So there are more impurities in wastewater than tap water.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	1	1	1	1	1
HBH Waste water	2	3	3	2	2.5
MSS Water	1	1	1	1	1
MSS Waste water	3	2	3	3	2.75
Faculty Quarter (A type) Water	1	1	1	1	1
Faculty Quarter (A type) Waste water	2	2	3	2	2.25
Staff Quarter (E type) Water	1	1	1	1	1
Staff Quarter (E type) Waste Water	3	3	3	3	3

Table 5. Turbidity of water and kitchen waste water on sampling location

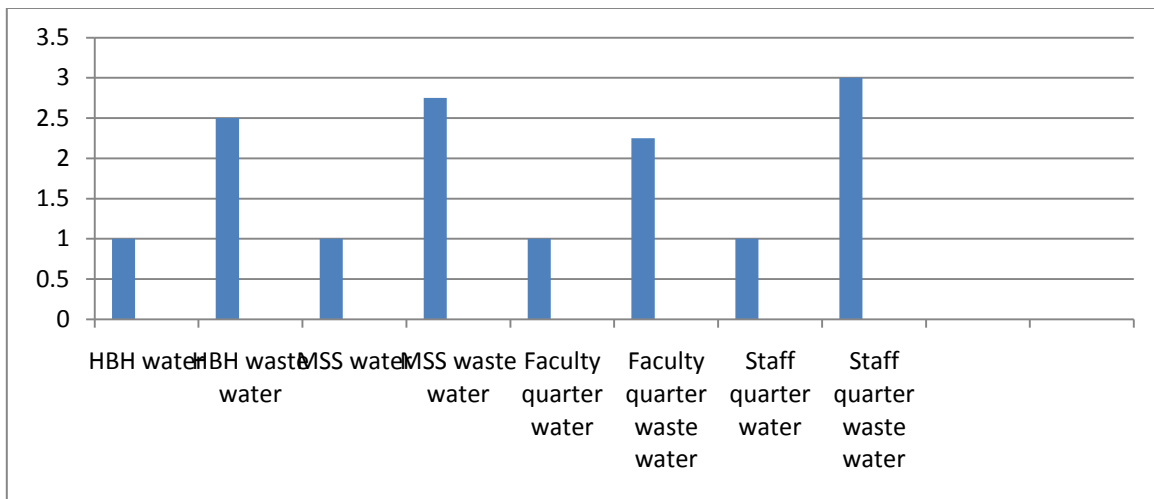


Figure 6. Average Turbidity of water and kitchen wastewater on sampling location

4.1.5 VARIATION OF CHLORIDE PRESENT ON WATER AND KITCHEN WASTE WATER

Chloride is one of the major inorganic anion in water and wastewater. In potable water, the salty taste produced by chloride concentrations is variable and dependent on the chemical composition. Chloride concentration is higher in wastewater than in raw water. High chloride content may harm metallic pipes and structures as well as growing plants. In the study area average chloride concentration is in between 13.5 to 17.5 mg/l for tap water and 99.5 to 110 mg/l for wastewater. It shows more chloride concentration in wastewater samples.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	12	14	12	16	13.5
HBH Waste water	92	112	96	98	99.5
MSS Water	18	16	18	18	17.5
MSS Waste water	116	114	112	98	110
Faculty Quarter (A type) Water	14	14	16	14	14.5
Faculty Quarter (A type) Waste water	100	102	120	102	106
Staff Quarter (E type) Water	14	16	16	16	15.5
Staff Quarter (E type) Waste Water	100	98	102	112	103

Table 6. Chloride present in water and kitchen waste water on sampling location

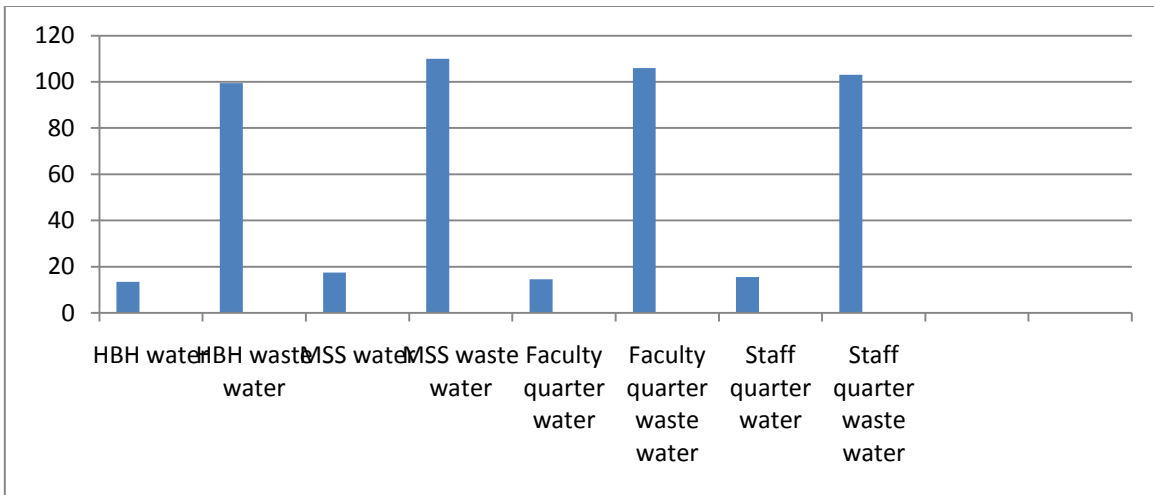


Figure 7. Chloride present in water and kitchen waste water on sampling location

4.1.6 VARIATION OF HARDNESS ON WATER AND KITCHEN WASTE WATER

Total hardness of water is the sum of the concentrations of all the metallic cations other than cations of alkali metals, expressed as equivalent calcium carbonate concentration. In most natural water, hardness is mainly due to calcium and magnesium ions. In some waters, measurable concentration of iron, aluminum, manganese, barium, zinc and other metals may be present. When the hardness is numerically greater than the sum of carbonate alkalinity and bicarbonate alkalinity, the amount of hardness which is equivalent to total alkalinity is called 'carbonate hardness, and the amount of hardness in excess of this is called 'non-carbonate hardness'. Some Water containing high concentrations of borates, phosphates, silicates, may contribute to total alkalinity (IS 3025: part 21). Based on present investigation, average hardness varied from 26 to 29.25mg/l for tap water and 419 to 472 mg/l for wastewater. So there are more metallic cations are present in kitchen wastewater samples.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	27	30	28	32	29.25
HBH Waste water	420	440	428	412	425
MSS Water	25	28	25	26	26
MSS Waste water	412	432	420	412	419
Faculty Quarter (A type) Water	32	26	28	32	29.5
Faculty Quarter (A type) Waste water	482	462	462	482	472
Staff Quarter (E type) Water	28	28	28	32	29
Staff Quarter (E type) Waste Water	420	462	422	412	429

Table 7. Hardness present in water and kitchen waste water on sampling locations

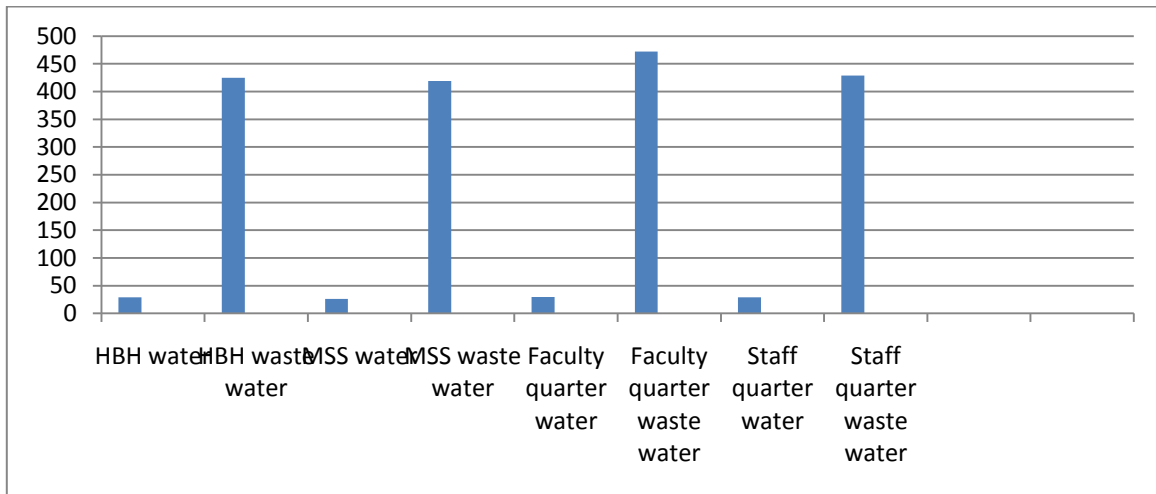


Figure 8. Average Hardness present in water and kitchen wastewater on sampling locations

4.1.7 VARIATION OF ACIDITY ON WATER AND KITCHEN WASTE WATER

Acidity of water or waste water is its quantitative capacity to react with a strong base to a designated pH. Strong mineral acids, weak acids like acetic and carbonic and hydrolysable salts like ferrous or aluminum sulphates may contribute to the measured acidity. Acids contribute towards corrosiveness, influence chemical reactions and biological processes. The measurement also reflects a change in the quality of the source water. In this study area the tap water has total 21 to 24 p.p.m. of CaCO₃, where the kitchen waste water has 420 to 440 p.p.m. of CaCO₃. So wastewater sample is more acidic in nature.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	21	21	21	21	21
HBH Waste water	420	440	420	420	425
MSS Water	21	24	24	24	23.25
MSS Waste water	420	440	420	420	425
Faculty Quarter (A type) Water	24	21	24	21	22.5
Faculty Quarter (A type) Waste water	440	420	440	420	430
Staff Quarter (E type) Water	21	21	21	21	21
Staff Quarter (E type) Waste Water	420	420	420	420	420

Table8. Acidity of water and kitchen waste water on sampling locations

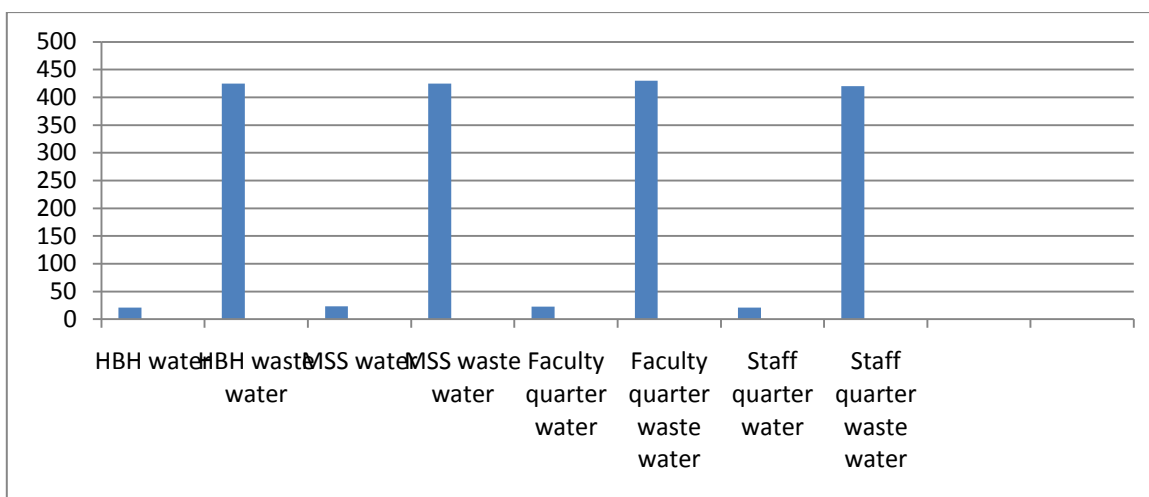


Figure 9. Average Acidity of water and kitchen wastewater on sampling locations

4.1.8 VARIATION OF ALKALINITY ON WATER AND KITCHEN WASTE WATER

Alkalinity of water or wastewater is its quantitative capacity to react with a strong acid to a designated pH. Alkalinity is significant in many uses and treatments of natural and wastewaters. Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes. In the present study Alkalinity was ranged from 10.775 mg/l to 11.225 mg/l. Here the tap water has alkalinity value where kitchen waste water does not show any value means they are purely acidic.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	11.3	11.1	11.2	11.3	11.225
HBH Waste water					
MSS Water	11.2	10.8	10.9	11.4	11.075
MSS Waste water					
Faculty Quarter (A type) Water					
	10.4	11.2	11.3	10.8	10.925
Faculty Quarter (A type) Waste water					
Staff Quarter (E type) Water					
	10.7	10.7	10.8	10.9	10.775
Staff Quarter (E type) Waste Water					

Table 9. Alkalinity of water and kitchen waste water on sampling locations

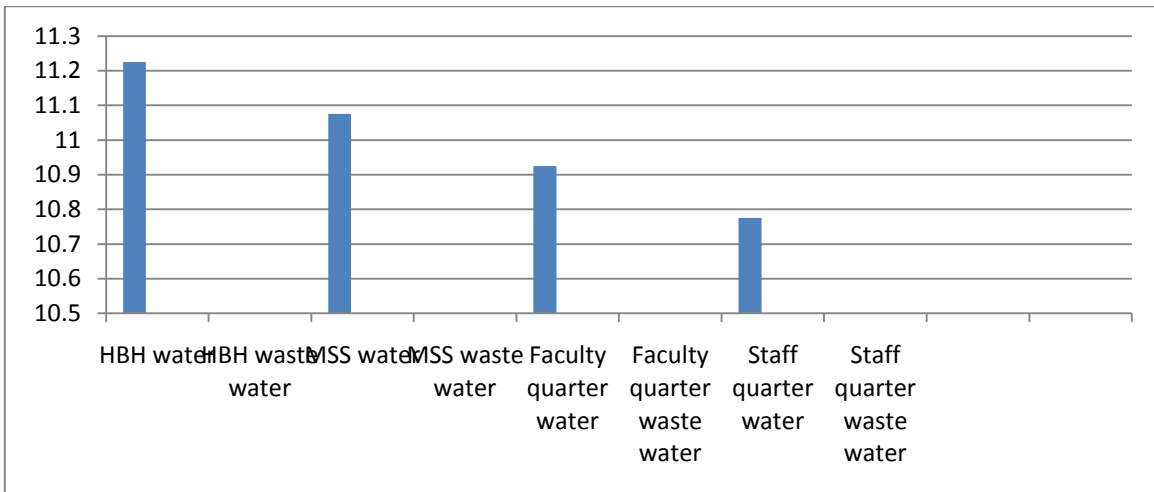


Figure 10. Average Alkalinity of water and kitchen wastewater on sampling locations

4.1.9 VARIATION OF TOTAL SOLIDS ON WATER AND KITCHEN WASTE WATER

Total residue is the term applied to the material left in the vessel after evaporation of a sample of water and its subsequent drying in an oven at a definite temperature. Total residue includes Non-filterable residue (the portion of the total residue retained by a filter), and filterable residue (the portion of the total residue which passes through the filter). In the study area average TDS varied from 13.6 to 15.15 mg/l for tap water and 156 to 163 mg/l for waste water. So there are more solids dissolved in the waste water samples than tap water, as a result tap water can use for domestic purpose.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	14.2	14	14	14	14.05
HBH Waste water	152	162	154	156	156
MSS Water	14	14	14	14	14
MSS Waste water	164	158	160	164	161.5
Faculty Quarter (A type) Water					
	13.2	14	13.6	13.6	13.6
(A type) Waste water					
	162	164	162	162	162.5
Staff Quarter (E type) Water					
	15.2	14.8	15.6	15	15.15
Staff Quarter (E type) Waste Water					
	164	162	164	162	163

Table 10.Total solids present in water and kitchen waste water on sampling locations

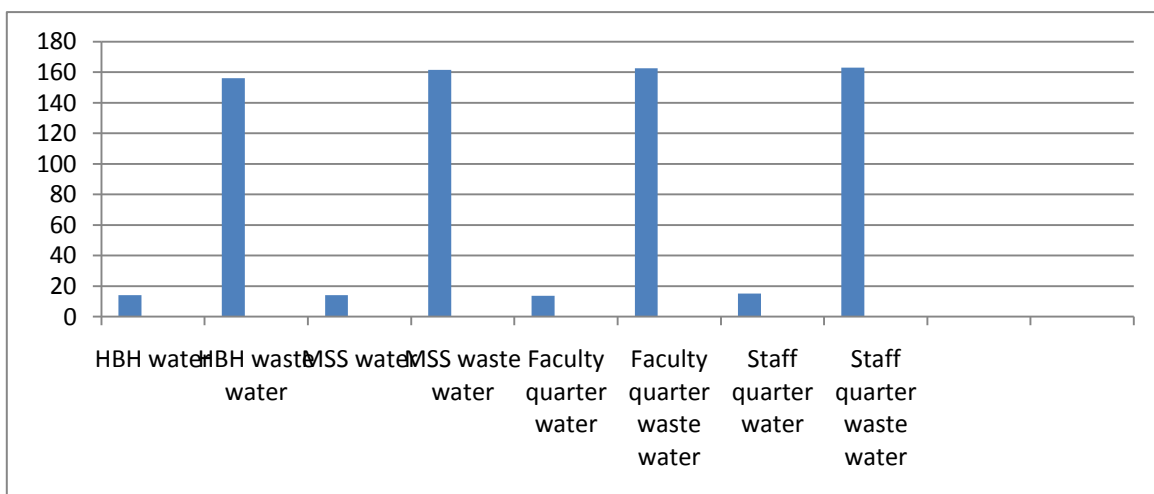


Figure 11.Average Total solids present in water and kitchen wastewater on sampling locations

4.1.10 VARIATION OF Ca VALUE ON WATER AND KITCHEN WASTE WATER

Calcium is essential for living organisms, particularly in cell physiology. As a major material used in mineralization of bones and shells, calcium is the most abundant metal by mass in many animals (Wikipedia). In the study area average Calcium (Ca) concentration varies between 8.7 to 10.161 mg/l for wastewater and 9.25 to 15.84 mg/l for tap water. It results that Ca concentration decreases in water after used for kitchen purpose because formation of bond is easy for Mg ion after excited by boiling of water for cooking purpose.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	11.641	10.882	11.236	11.632	11.34775
HBH Waste water	9.448	8.872	8.672	8.982	8.9935
MSS Water	23.098	18.671	10.932	10.672	15.84325
MSS Waste water	10.331	10.23	9.852	10.231	10.161
Faculty Quarter (A type) Water					
	8.971	9.872	9.236	8.952	9.25775
Faculty Quarter (A type) Waste water					
	8.812	8.862	8.634	8.526	8.7085
Staff Quarter (E type) Water					
	9.359	9.654	9.862	10.236	9.77775
Staff Quarter (E type) Waste Water					
	9.73	9.325	9.456	9.63	9.53525

Table 11. Ca present in water and kitchen waste water on sampling location

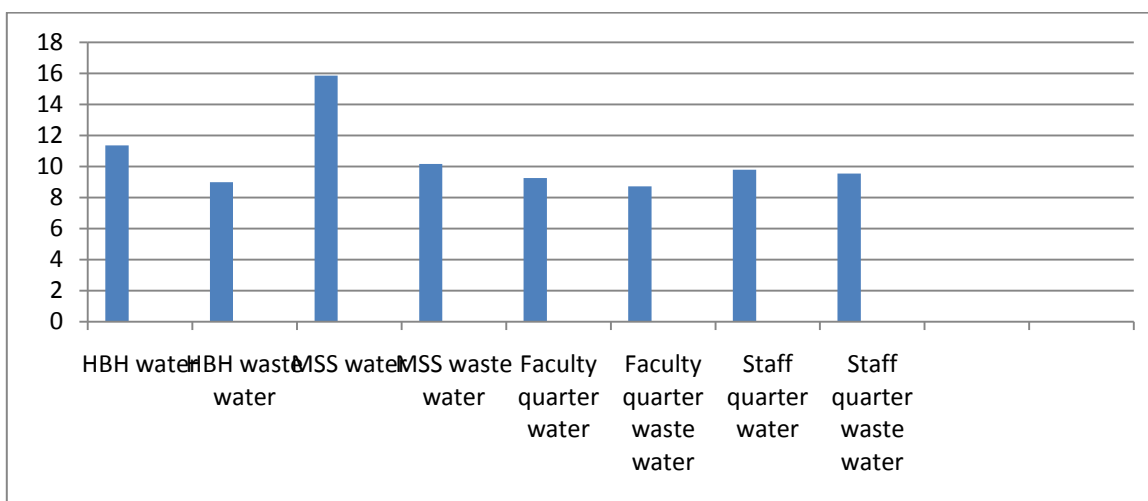


Figure 12. Average Ca present in water and kitchen waste water on sampling location

4.1.11 VARIATION OF Mg VALUE ON WATER AND KITCHEN WASTE WATER

Magnesium ranks eighth among the elements in order of abundance and is a common constituent of natural water. Magnesium salts are important contributors to the hardness of water which break down when heated, forming scale in boilers from zero to several hundred milligrams. The magnesium concentration may vary chemical softening, reverse osmosis, electro dialysis, or ion exchange reduces the magnesium and associated hardness to acceptable levels. In the study area average Mg concentration varies between 6.39 to 6.68 mg/l for kitchen wastewater and 7.66 to 8.87 mg/l for tap water. So it results decrease in concentration of Mg in water after used for kitchen purpose because formation of bond is easy for Mg ion after excited by boiling of water for cooking purpose.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	7.943	7.642	7.446	7.628	7.66475
HBH Waste water	6.447	6.446	6.442	6.428	6.44075
MSS Water	8.874	7.446	8.812	7.446	8.1445
MSS Waste water	6.675	6.628	6.624	6.625	6.638
Faculty Quarter (A type) Water	7.429	9.872	9.236	8.952	8.87225
Faculty Quarter (A type) Waste water	6.404	6.325	6.426	6.426	6.39525
Staff Quarter (E type) Water	7.498	7.446	9.862	7.446	8.063
Staff Quarter (E type) Waste Water	6.448	6.424	6.242	6.446	6.39

Table 12.Mg present in water and kitchen wastewater on sampling locations

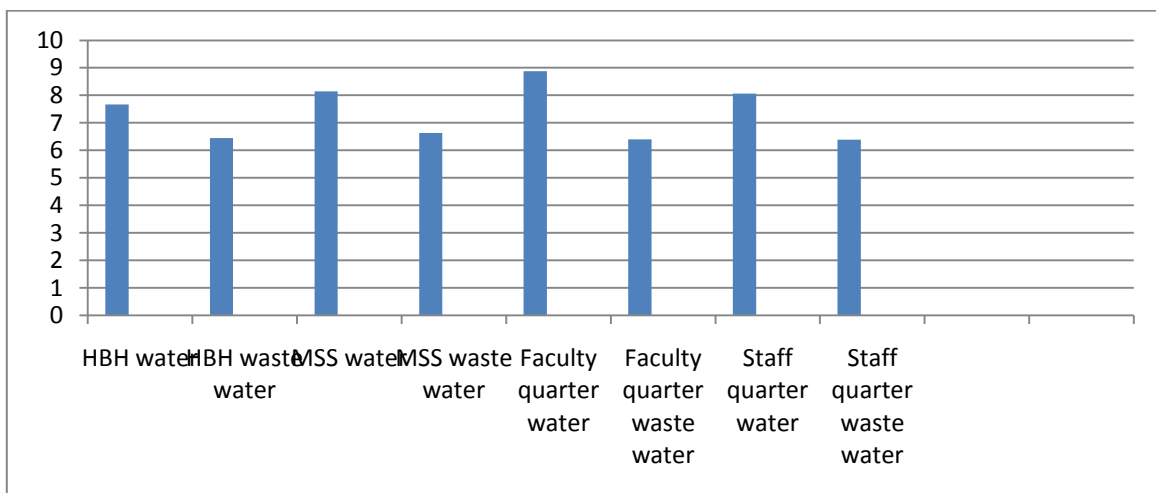


Figure 13.Average Mg present in water and kitchen wastewater on sampling locations

4.1.12 VARIATION OF Cu VALUE ON WATER AND KITCHEN WASTE WATER

Copper is found mainly as a sulphide, oxide or carbonate in the minerals. Copper enters the water system through mineral dissolution, industrial effluents, because of its use as algacide and insecticide and through corrosion of copper alloy water distribution pipes. It may occur in simple ionic form or in one of many complexes with groups, such as cyanides, chlorides, ammonia or organic ligands. The test for copper is essential because dissolved copper salts even in low concentrations are poisonous to some biota. In the study area average Cu concentration varies between 0.263 to 0.29525 mg/l for tap water and 0.263 to 0.29425 mg/l for waste water for wastewater samples. So there is no change in concentrations after used as kitchen purpose because copper ion cannot react with any other ion so the concentration remains same.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	0.268	0.272	0.267	0.281	0.272
HBH Waste water	0.27	0.268	0.272	0.27	0.27
MSS Water	0.242	0.26	0.286	0.264	0.263
MSS Waste water	0.261	0.261	0.268	0.262	0.263
Faculty Quarter (A type) Water	0.295	0.292	0.296	0.294	0.29425
Faculty Quarter (A type) Waste water	0.295	0.295	0.295	0.296	0.29525
Staff Quarter (E type) Water	0.281	0.298	0.286	0.282	0.28675
Staff Quarter (E type) Waste Water	0.269	0.262	0.282	0.286	0.27475

Table 13.Cu present in water and kitchen wastewater on sampling locations

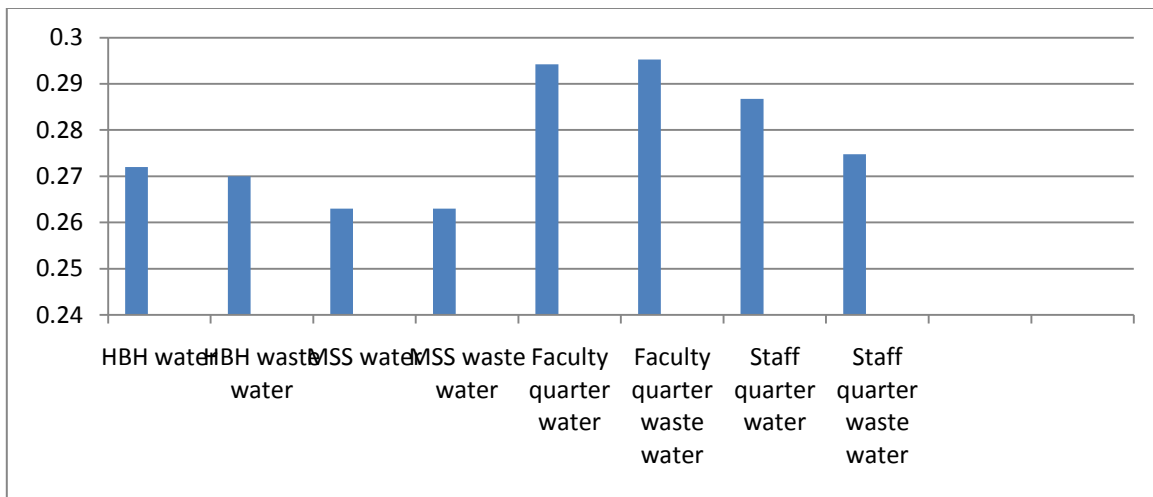


Figure14. Average Cu present in water and kitchen wastewater on sampling locations

4.1.13 VARIATION OF Fe VALUE ON WATER AND KITCHEN WASTE WATER

Iron (Fe) is naturally abundant in earth's crust. Amount of iron available in soluble form depends upon the concentration of the complex forming ions, pH and oxidation conditions. In the absence of the complex forming ions, ferric iron is not significantly soluble unless the pH is very low. Oxygenated surface waters seldom contain more than 1 mg/l of iron. Ground waters and the surface waters which are acidic, may, on the other hand, contain considerably more iron. In water samples, iron may be present, as free hydrated ions, in the form of organic/inorganic complex ions, in a colloidal state or as relatively coarse suspended particles. Iron in water can cause staining of laundry and porcelain. A bitter sweet astringent taste is imparted to the drinking water at levels above 1 mg/l of iron. Iron appears to be an essential element for all organisms — both plant and animals. In animals iron is found in many important proteins, major functions of these proteins are in oxygen storage and transport and electron transport. In the study area average Fe concentration varies between 0.802 to 0.8235 mg/l for wastewater and 1.21 to 2.0395 mg/l for tap water samples. It shows water samples contain more Iron concentration than wastewater samples because after boiling the water for kitchen use iron may be oxidized to form iron oxide so the concentration decreases.

sampling points	sammple1	sample2	sample3	sample4	average
HBH Water	1.499	1.468	1.486	1.632	1.52125
HBH Waste water	0.796	0.794	0.786	0.832	0.802
MSS Water	2.376	1.836	1.826	2.12	2.0395
MSS Waste water	0.832	0.821	0.824	0.798	0.81875
Faculty Quarter (A type) Water	1.2	1.322	1.236	1.082	1.21
(A type) Waste water	0.784	0.798	0.824	0.826	0.808
Staff Quarter (E type) Water	1.168	1.164	1.168	1.692	1.298
Staff Quarter (E type) Waste Water	0.805	0.806	0.821	0.862	0.8235

Table 14.Fe present in water and kitchen waste water on sampling locations

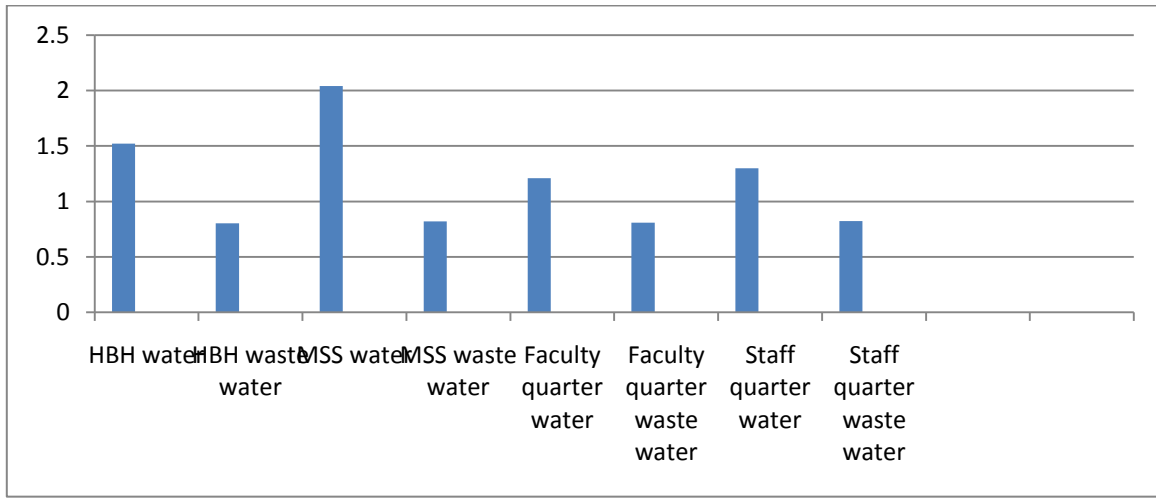


Figure 15.Average Fe present in water and kitchen wastewater on sampling locations

5.0 CONCLUSIONS

For tap water in NIT Rourkela, the pH ranges from 6.34 to 6.62 whereas for kitchen waste water it varies from 4.91 to 5.13. It shows wastewater sample is more acidic than tap water sample. The Turbidity 1NTU for tap water and 2-3 NTU for kitchen waste water. As a result there is more impurity present in wastewater sample than water sample explain the reason. Hardness, ranged from 25 to 28 mg/l for tap water and around 420 mg/l for kitchen waste water. Hence, it can be concluded that the water supplied to the campus area is soft. The DO and BOD were in the range of 7.72 to 8.10 mg/l and 2.00 mg/l for tap water but for waste water it is 1.19 to 1.3 mg/l and 62.5 mg/l, respectively. As the DO value of the wastewater sample is less so the BOD value is more. The Chloride and Alkalinity were in the ranges from 12 to 18 mg/l and 11.3 to 10.7 mg/l respectively for tap water but for kitchen waste water their concentration ranges from 92 to 116 mg/l. But the calcium and magnesium content is very low in both water and waste water, it ranges between 8.7 to 15.84 mg/l and 6.38 to 8.87 mg/l, respectively. Iron content in water is 0.8 to 0.82 mg/l, whereas in wastewater it ranges from 1.21 to 2.03 mg/l. Copper concentration does not change after using for kitchen activities. In the present study, copper concentration is around 0.27 mg/l.

REFERENCES

- **APHA**, American Public health Association Book on treatment of water and wastewater, 303 Metals by Atomic Absorption Spectrometry, 151-173.
- **Field book**, www.ciese.org/curriculum/dipproj2/en/fieldbook/bod.shtml
- **Laboratory manual**, Public health engineering laboratory, Department of Civil Engineering, NIT Rourkela
- **IS 10500:1991** Drinking water-specification.
- **IS 3025 : Part 10** : 1984 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water - Part 10 : Turbidity
- **IS 3025 : Part 11** : 1983 Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater - Part 11 : pH Value
- **S 3025 : Part 15** : 1984 Methods of Sampling and Test (physical and chemical) for Water and Waste Water - Part 15 : Total Residue (total solids – dissolved and suspended)
- **IS 3025 : Part 21** : 1983 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water - Part 21 : Total Hardness
- **IS 3025 : Part 22** : 1986 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water - Part 22 : Acidity
- **IS 3025 : Part 23** : 1986 Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater - Part 23 : Alkalinity
- **IS 3025 : Part 40** : 1991 Water and Wastewater - Methods of Sampling and Test (physical and chemical) - Part 40 : Calcium
- **IS 3025 : Part 42** : 1992 Methods of Sampling and Test (physical and chemical) for Water and Wastewater - Part 42 : Copper
- **IS 3025 : Part 46** : 1994 Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater - Part 46 : Magnesium
- **IS 3025 : Part 53** : 2003 Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater - Part 53 : Iron
- **IS 3025 : 1964** Methods of Sampling and Test (Physical and Chemical) for Water Used in Industry
- **SDWF**, Safe Drinking Water Foundation, Total Hardness Analysis (Elementary School) Revised October 6, 2006.
- **SW-846**, Method 9040C: pH Electrometric Measurement (Revision 3, November 2004)

- **Wikipedia**, <http://en.wikipedia.org/wiki/Wastewater>
- **Wikipedia**, <http://en.wikipedia.org/wiki/Calcium>