Rajshahi University of Engineering & Technology

Department of Civil Engineering

Course Name: Environmental Engineering Sessional-I

Course No: CE 3142

Submitted by:

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Session : 2017-18

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Heaven's Light Is Our Guide

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department Of Civil Engineering

Expt No. 01

Name of Expt. Determination of pH of water

	SUBMITED BY :
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COURSE NO. : CE 3142	**GROUP :**
DATE OF EXPT. : 26-01-2021	**ROLL NO:** 1700082
DATE OF SUB. : 22-03-2021	**SESSION :** 2017-18

Experiment No: 01

Experiment Name: Determination of pH of water.

Date of Experiment: 26-01-2021

1.1 Introduction:

pH is a measure of the acidic or alkaline condition of water. It is a way of expressing the hydrogen ion concentration or more preciously, the hydrogen ion activity. pH is define as follows:

$$pH = -\log[H^+] \text{ ——— } (1)$$

where $[H^+]$ is the concentration (or activity) of hydrogen ion (or photon) in moles per liter (M).

Water dissociate to form hydrogen ion (H^+) and hydroxyl ion (OH^-) according to the following equation:

$$H_2O = H^+ + OH^- \text{ ——— } (2)$$

At equilibrium, we can write:

$$K_w = [H^+][OH^-]/[H_2O] \text{ ——— } (3)$$

But since concentration of water is extremely large (approximately 55.5 mole/L) and is diminished very little by the slight degree of ionization, it may be considered as a constant and its activity is taken as 1.0

Thus equation (3) may be written as:

$K_w = [H^+][OH^-]$

where, K_w = Equilibrium Constant.

For pure water at 25°C, $K_w = 10^{-7} \times 10^{-7} = 10^{-14}$. This is known as the ion product of water or ionization constant for water. In other words, water (de-ionized or distilled water) at 25°C dissociates to yield 10^{-7} mol/L of hydroxyl ion (OH^-). Hence, according to equation (1) pH of deionized water is equal to 7.0.

The pH is usually represented by scale ranging from 0 to 14 with 7 being neutral. Groundwater is often found to be slightly acidic due to the presence of excess carbon di-oxide. Aeration removes carbon di-oxide and hence causes a rise in pH value. Some natural waters are sometimes found to be slightly alkaline due to the presence of bi-carbonate and less often carbonate. Water with outside the desirable neutral range may exhibit sour taste and accelerate the corrosion of metallic plumbing fittings and hot water services.

1.2 Environmental Significance:

a. A controlled value of pH is desired in water supplies, sewage treatment and chemical process plants.

b. In water supply pH is important for coagulation, disinfection, water softening and corrosion control.

c. In biological treatment of waste water, pH is an important parameter. Since organisms involved in treatment plants are operative within a certain pH range. According to Bangladesh Environment Conservation Rules (1997), drinking water standard for pH is 6.5 – 8.5.

1.3 Theory:

Measurement of pH is carried out either colorimetrical or by electrometrical method (i.e. using an H^+ sensitive probe). The electro-chemical method (using a pH probe / meter) is more expensive but accurate, whereas colorimetric method is cheap but serious errors may result from presence of color, turbidity high saline content, collodial matter, free chlorine, various oxidants and reductions

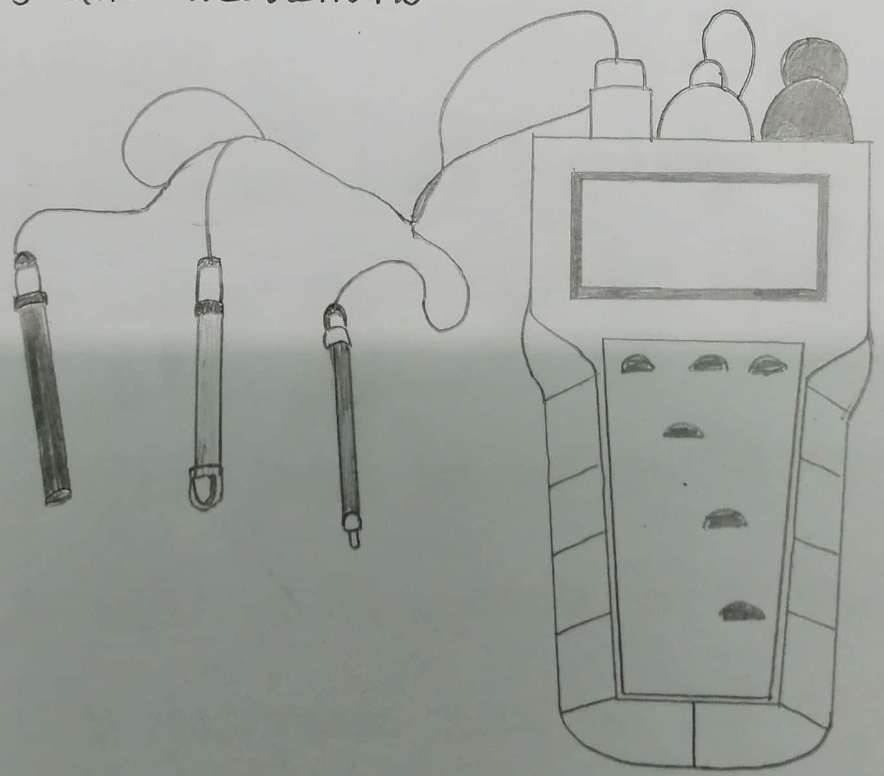

Fig 1.1: Multi- parameter Analyzer.

For colorimetric determination, a wide variety of indicators are used to determine pH. Standard pH solution for calibration of pH meter is used.

1.4 Reagent:

Standard pH solutions for calibration of pH meter.

1.5 Apparatus:

1. pH meter
2. Sample water

1.6 Procedure:

1. A pH meter was taken to perform the experiment.
2. The calibration of the pH meter using standard pH solutions was performed. The calibration procedure was done on the pH range of interest.

3. About 100ml of the sample in a beaker was taken. It was made sure not agiate the sample in order to avoid exchange of gasses between sample and atmosphere.

4. pH meter was inserted in the sample. Sometime for attainment of equilibrium was allowed. The pH meter was turned on ~~th~~and reading was taken.

5. pH meter displayed the value of pH of water sample.

1.7 Result:

1. pH of the pond water sample is 8.12
2. pH of the tap water sample is 7.86
3. pH of the distilled water sample is 7.

1.8 Discussion:

The sample of water is drinkable with respect to pH parameter if other parameters are limited.

1.9 Assignment:

a. Explain the relationship between temperature change and pH.

Answer:

The formation of hydrogen ions and hydroxide ions from water is an endothermic process. Water dissociate to form hydrogen ion (H^+) and hydroxyl ion (OH^-) according to the following equation:

$$H_2O = H^+ + OH^-$$

At equilibrium, we can write:

$$K_w = [H^+][OH^-]/[H_2O]$$

Where K_w = Equilibrium Constant.

According to Le Chatelier Principle, if we make change to the conditions of a reaction in dynamic equilibrium, the position of equilibrium moves to counter the change we have made. Hence, if you increase the temperature of the water, the equilibrium will move to lower temperature again. That means that the forward reaction will be favored and more hydrogen ions and hydroxide ions will be formed. The effect of that is to increase the value of K_w i.e. this increases $[H^+]$ and decreases the pH as temperature increases. So it can be said that the pH of water decreases as the temperature increases.

b. What is the pH of a solution of 4.1 g of sodium ethanoate in 1 l of 0.01 mol/dm³ ethanoic acid?

Answer:

Sodium ethanoate $\longrightarrow$ CH_3COONa

The reaction;

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

$W = 4.1 g$

$V = 1 L = 1000 mL$

$M = 82$

$$\therefore\ S = \frac{1000\,W}{MV}$$

$$\Rightarrow S = \frac{1000 \times 4.1}{82 \times 1000}$$

$$\therefore\ S = 0.05\,M$$

Here,
$ka = 1.8 \times 10^{-5}\ mol\,L^{-1}$

$$[CH_3COONa] = 0.05\ M$$

$$pH = p^{ka} + \log \frac{[Salt]}{[Acid]}$$

$$\Rightarrow pH = -\log[ka] + \log \frac{0.05}{0.01}$$

$$\Rightarrow pH = -\log[1.8 \times 10^{-5}] + \log\left(\frac{0.05}{0.01}\right)$$

$$\therefore pH = 5.44$$

Ans

c. What is the pH of the blood stream?

Answer: The pH of blood stream normally ranges from 7.35 to 7.45. So, blood stream is naturally slightly alkaline or base.

d. How many times more acidic is a solution with a pH of 4 than a solution with a pH of 7?

Answer:

$$pH = -\log[H^+]$$

$$\Rightarrow 4 = -\log[H^+]$$

$$\Rightarrow [H^+]_1 = 1 \times 10^{-4}$$

again,

$$pH = -\log[H^+]_2$$

$$\Rightarrow 7 = -\log[H^+]_2$$

$$\Rightarrow [H^+]_2 = 1 \times 10^{-7}$$

$$\frac{[H^+]_1}{[H^+]_2} = \frac{1 \times 10^{-4}}{1 \times 10^{-7}}$$

$$\therefore [H^+]_1 = 1000[H^+]_2$$

$\therefore$ 1000 times more acidic.

e. Can an acid have a negative pH value?

Answer: At 25°C, solutions with a pH less than 7 are acidic. The pH is the negative logarithm of the concentration of hydronium ions in an aqueous solution.

When disolve an acid in water, the acid transfer a hydrogen ion to water, forming hydronium ions.

A strong acid is one that ionizes completely that is every molecule of acid in solution. For a strong acid that has only one hydrogen to give, the concentration of ~~d hydrogen~~ hydronium ions at equilibrium is equal to the concentration of acid molecules.

For example, nitric acid (HNO_3) is a strong acid. If I disolve enough nitric acid into water to create a solution that is 0.1 Molar, then the concentration of hydronium ions at equilibrium will also be 0.1 Molar.

pH is the negative logarithm (base 10) of the concentration of hydronium ions. So, let's say that a solution has a hydronium ion concentration of 0.1 Molar. Therefore, it's pH would be equal to - $-\log(0.1M) = 1.0$

The pH of a solution where hydronium ion concentration is 1.0 Molar would be 0.00

And if a solution has a hydronium ion concentration greater than 1.0 Molar, the pH will be less than zero; i.e. negative.

So, an acid can have a negative pH value.

f. Which pH is ideal for the growth of bacteria in food?

Answer: Bacteria needs a suitable place and pH for the survival and this pH is near 7.0. They prefer the pH near 7.0 but are capable of growing in pH range of 4.6 - 7.0. pH less than 4.6 doesn't support growth of ~~desees~~ diseases causing bacteria.

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Department Of Civil Engineering

Expt No. 02

Name of Expt. Determination of the conductivity of water.

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DATE OF EXPT. : 26-01-21	**ROLL NO:** 1700082
DATE OF SUB. : 22-03-21	**SESSION :** 2017-18

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Experiment No: 02

Experiment Name: Determination of the conductivity of water.

Date of Experiment: 26-01-2021

2.1 Introduction:

Conductivity of a substance is defined as the ability or power to conduct or transmit heat, electricity or sound. When an electrical potential difference is placed across a conductor, its movable charges flow, giving rise to an electric current. This property is called conductivity. Since the charges on ions in solution facilitates the conductance of the electrical current, the conductivity of a solution is proportional to its ion concentration.

The electrical conductivity can be expressed as mhos (Reciprocal of ohms) or as Siemens. The conductivity of water is a measure of the ability of water to carry an electric current.

In most water the conductivity is very low. so milisiemens or microsiemens are used as units for water conductivity. The conductivity of water is directly linked to the concentration of ions and their mobility. The ions in water acts as electrolytes and conduct the electricity.

The conductivity of water depends on the value of pH, on the temperature of the measurement and on the amount of CO_2 which has been dissolved in the water to form ions. The conductivity is also affected by the concentration of ions already present in the water such as chloride, sodium and ammonium. Chemical composition of water determines its conductivity. Hence, this becomes the most widely used measure of the purity of water.

2.2 Environmental Significance :

1. Electrical conductivity measurements are often employed to monitor desalination plants.

2. It is useful to ~~ae~~ assess the source of pollution.

3. In coastal regions, conductivity data can be used to decide the extent of intrusion of sea water into ground water.

4. Conductivity data is useful in determining the suitability of water and wastewater for disposal on land. Irrigation water up to 2 milisiemens/cm conductance have been found to be suitable for irrigation depending on the soils and climatic characteristics.

5. It is also used indirectly to find out inorganic dissolved solids.

2.3 Theory:

Conductivity is measured with a probe and a meter. A voltage is applied between the two electrodes in the probe immersed in the sample water. The drop in voltage caused by the resistance of the water is used to calculate the conductivity per centimeter.

Conductivity (G), the inverse of resistivity (R) is determined from the voltage and current values according to Ohm's law. i.e $R = \frac{V}{I}$, then,

$$G = \frac{1}{R} = \frac{I}{V}$$

The meter converts the probe measurement to micro mhos per centimeter and displays the result for the user.

2.4 Reagent:

1. Potassium chloride
2. Distilled water.

2.5 Apparatus:

1. Conductivity meter
2. Magnetic stirrer with stirrer bead
3. Flask
4. Beaker
5. Sample water.

2.6 Procedure:

1. Conductivity meter was switched on at least 30 min before the test.
2. 0.1 N potassium chloride (KCL) was prepared.
3. The conductivity meter was calibrated to 14.12. It was done by using the standard solution of 0.1 KCL by adjusting the calibration knob.
4. Then the conductivity meter was read by inserting tap same water, distilled sample water and pond sample water.

2.7 Results:

1. The conductivity of tap sample water = 1400 micromho
2. The conductivity of distilled sample water = 600 micromho.
3. The conductivity of pond sample water = 1000 micromho.

2.8 Discussion:

1. The conductivity meter was switched on at least 30 min before starting the experiment so that the instrument could get stabilized.
2. The electrode was always dipped in the sample water and it was not exposed to air.

2.9 Assignment :

a. What is electric conductivity of water?

Answer: Electric conductivity of water is it's ability to conduct an electric current. The electric conductivity of water depends on the concentration of ions of the solution/water.

b. What is the standard conductivity of water?

Answer: The conductivity of water is a measure of capability of water to pass electric flow.

The standard conductivity of drinking water is 200 to 800 µs/cm

The standard conductivity of sea water is 50 µs/cm.

The standard conductivity of rain or snow water is 2 to 100 µs/cm.

c. Why conductivity of water is important?

Answer: The conductivity of water is important because it can tell how much dissolved substances, chemicals and minerals are present in the water. Higher amounts of these impurities will lead to a higher conductivity.

d. What can affect the conductivity of water?

Answer: The conductivity of water is affected by the presence of ~~ignor~~ inorganic dissolved solids such as chloride, nitrate, sulfate and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron and aluminum cations (ions that carry a positive charge).

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Department Of Civil Engineering

Expt No. 03

Name of Expt. Determination of color of water

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DATE OF EXPT. : 14-03-2021	**ROLL NO:** 1700082
DATE OF SUB. : 22-03-2021	**SESSION :** 2017-18

Experiment No: 03

Experiment Name: Determination of color of water.

Date of experiment: 14-03-2021

3.1 Introduction:

Pure water should not possess any color. Most water available to us are colored to some extent due to the presence of various impurities (i.e. iron and manganese in association with organic matter from decaying vegetation.). Impurities may be in the colloidal from in water or it may be in suspended state color caused by dissolved and colloidal from of impurities is called true color and that caused by suspended matters. In addition to dissolve and colloidal matters is called apparent color. Ground water may show color due to the presence of iron compounds. Color intensity generally increases with an increase in pH. For this reason recording pH with color is advised.

3.2 Environmental Significance:

1. Colored water is not always harmful to man but in most cases it is. Even if the water is not harmful, people aesthetic reasons do not prefer it.

2. Also disinfection by chlorination of water containing natural organics (which produce colors) results in the formation of chloroform, other halothanes and a range of other chlorinated organics, leading problems which is a major concern in water treatment.

3. So it is important to limit the color of water for domestic supplies. According to Bangladesh Environment conservation rules (1997) drinking water standard for color is 15 units.

3.3 Theory:

Color is usually expressed in platinum - cobalt units (Pt.-Co units) which is based on the intensity of color produced by a solution of Platinum and cobalt which approximate the yellow-brown color of natural water.

3.4 Apparatus:

Visual Comparator (LOVIBOND 2000)

3.5 Procedure:

1. There were two small transparent pots in the instrument. One was filled up with distilled water which is neutral in color. And the other pot was filled with the water to be determined.

2. There was a color palette in the instrument which was seems like a round plate having a series of number with various colors.

3. Then the color of the specimen was tested with the color of the palatte. The number of color of palatte was taken which was matched with the color of the specimen.

3.6 Result:

Amount of color in the specimen = 05 unit = 05 mg/L

Concentration of platinum in the form of K_2PtCl_6.

3.7 Discussions: The palette was matched carefully.

3.8 Assignments:

1. Discuss the environmental significance of "color".

Answer: Though the presence of color in water is not always harmful to human but in most cases it is. Even if water is not harmful aesthetically people do not prefer to use water with color. Moreover disinfection by chlorination of water containing natural organics (which produces color) results in the formation of tri-halomenthanes including chloroform and a range of other chlorinated organics leading to problems which is a major concern in water treatment. So it is important to limit the color of water for domestic supplies. According to BECR (1997) drinking water standard for color is 15 TCU.

2. Discuss briefly the causes of color in water.

Answer: Accurate documentation of water color is important as it indicates source of water and pollutants. Pure water is colorless. Water color is reffered as apparant color and true color based on the type of solid material present in it. Apparant color is the color of whole water sample, and consists of color due to both dissolved and suspended components. True color is measured by filtering the water sample to remore all suspended material and measuring the color of filtered water, which represents color due to dissolved components. Industrial wastes from textile, food processing, chemical processing and mixing, refining and strengthen houses may add sub material coloration to water in receiving streams.

3. Write the methods are commonly used for remoring color form water and waste water.

Answer: The methods are given bellow -

a) Coagulation followed by filtration.
b) Pre chlorination.
c) super chlorination followed by dichlorination.
d) Use of chlorine - dioxide.

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Department Of Civil Engineering

Expt No. ....04........

Name of Expt. ....Determination of turbidity of water........

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	SUBMITED BY :
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COURSE NO. : CE 3142	**GROUP :**........................
DATE OF EXPT. : 14-03-2021	**ROLL NO:** 1700082
DATE OF SUB. : 22-03-2021	**SESSION :** 2017-18

Experiment No: 04

Experiment Name: Determination of turbidity of water.

Date of experiment: 14-03-2021

4.1 Introduction:

The term "turbid" is applied to water containing suspended matter that interferes with passage of light through the water or in which visual depth is restricted. Turbidity may be caused by a wide variety of suspended substances of various sizes ranging in size from colloidal to coarse particles, depending on the degree of turbulence. In rivers under flood conditions, most of the turbidity will be due to relatively coarse particles. Whereas in lakes and other waters existing under relatively quiescent conditions, most of the turbidity will be due to colloidal and extremly fine particles.

4.2 Environmental Significance:

1. Turbidity is important for water supply engineers as turbid water is not aesthetically acceptable to people. There is always a fear among the people that turbid water may cause diseases.

2. For filtration, turbid water is not suitable as it causes quick clogging of filter bed which necessitates the use of pre-treatment plant.

3. Turbidity is also an important parameter in disinfection process. Disinfections is usually accomplished by means of chlorine, ozone or chlorine dioxide. To be effective, there must be contact between the agents and organisms to be killed. However, in cases in which turbidity is caused by municipal wastewater solids, many of the pathogenic organisms may be encased in the particles and protected from the disinfectant. Hence USEPA has placed a maximum level of 0.5 to 1.0 units of turbidity, depending on the disinfection process used, as the maximum amount allowable in public

water supplies.

4. According to Bangladesh Environmental Conservation Rules (1997), drinking water standard for turbidity is 10 NTU (Nephelometric turbidity unit).

4.3 Standard Unit of Turbidity:

Because of the wide variety of materials that cause turbidity in natural waters, it has been necessary to use an arbitrary standard. The original standard chosen was

$1 mg\ SiO_2/L = 1$ unit of turbidity

And the silica used has to meet certain specifications as to particle size.

Standard suspensions of pure silica are not now used for measuring turbidity. They were used originally to calibrate the Jackson candle turbidimeter, the former standard instrument for turbidity measurement [results expressed as

JTU (Jackson Turbidity Unit)]. This was a rather crude instrument in which the turbidity of suspension was measured by the depth of suspension through which the outline of a flame from a standard candle disappeared. The Jackson candle turbidimeter was removed as a standard.

procedure from the 17th edition of "Standard Methods", as it has generally been replaced in practice by more reliable, sensitive and easier to use instrument that depend upon the principle of nephelometry. Also silica as a standard reference material has been replaced by standardized preparations of formazin polymer. The formazin suspensions were first calibrated against the Jackson candle Turbidimeter and thus there is some relationship between turbidity measurements by the Jackson candle turbidimeter and nephelometry. However, the Jackson candle turbidimeter measures the interference of light passage in a straight line while nephelometry measures the scattering of light from particles. Because of this basic difference in phenomenon measured, results from the two different procedures on different suspensions can vary widely. In order to avoid any confusion this may cause, turbidity measurement by the standard nephelometry procedure are now reported in Nephelometric Turbidity Units (NTU). In additions to formazin standards, commercially available standards such as styrene divinylbenzene beads are also available.

4.4 Theory:

The current standard method for measurement of turbidity depends upon instruments that employ the principle of nephelometry. In this instrument, a light source illuminates the sample and one or more photoelectric detectors are used with a readout device to indicate the intensity of scattered light at right angle to the path of incident light. It is customary to use a particular formazin polymer suspension as a standard or commercially available preparations may also be used. When using formazin standard, 40 NTU are about equivalent to 40 Jackson candle turbidity unit (JTU). Turbidity as low as 0.02 NTU can be determined by this procedure, provided that the water with sufficiently low turbidity can be obtained for use in instrument calibration. Samples with turbidity greater than 40 NTU are diluted with turbidity free water until values within the range of 30 to 40 NTU are obtained. The turbidity is then determined by multiplying the measured by dilution factor.

4.5 Apparatus:

De Lange Turbidimeter.

4.6 Procedure:

1. It was ensured that the turbidimeter was standardized.
2. The clean sample cell was filled with water sample and it was placed in the sample cell holder. The sample cell was covered with light shield. The switch was turned on and was recorded directly from the monitor.

4.7 Results:

Turbidity found in the experiment : 12.25 NTU.

4.8 Discussions:

Turbidity of drinking water is 10 NTU. Turbidity of the sample is 12.25 NTU. So, the sample water is undrinkable.

4.9 Assignments:

1. Discuss environmental significance of turbidity.

Answer: Turbidity is an important indication of the amount of suspended sediment in water which can have many negative effects on aquatic life. The suspended sediment can block light to aquatic plants and may carry contaminants and pathogens. High turbidity can significantly reduce the aesthetic quality of lakes and streams, having a harmful effects on reaction and tourism. It can harm fish and other aquatic life by reducing food supplies, degrading spawning beds and affecting gill function.

2. Why turbidity is important in filtration and disinfection process?

Answer: Turbidity is an important indicator of filtration efficiency for remored of pathogens and treatability of water by disinfection.

Turbidity can be used as a basis for choosing between alternative sources of waters and assessing the performance of a number of control measures including coagulation, filtration, and disinfection and management of distribution system. At turbidities of >1 NTU, higher disinfection doses or contact times will be required to ensure the adequate ct- (i.e. product of disinfection concentration and contact time).

3. Write down the methods that are commonly used for removing turbidity from water.

Answer:

a) Raw water screening
b) Pre-sedimentation.
c) Coagulation
d) Flocculation
e) Sedimentation
f) Filtration.

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Department Of Civil Engineering

Expt No. 05

Name of Expt. Determination of Total Solids, Total Dissolved Solids and Total Suspended Solids

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DATE OF EXPT. : 14-03-21	**ROLL NO:** 1700082
DATE OF SUB. : 22-03-21	**SESSION :** 2017-18

Experiment No: 05

Experiment Name: Determination of Total Solids, Total Dissolved Solids and Total Suspended Solids.

Date of experiment: 14-03-2021

5.1 Introduction:

Total solids (TS) refer to the matter that remains as residue upon evaporation and dying at 103° to 105°C. Total solids (TS) include total suspended solids (TSS) - the portion of total solids retained by a filter, and total dissolved solids (TDS) - the portion that passes through the filter. Solids are incorporated in water from its source (e.g. minerals with which) it has been contact). In potable water, most of the solids remain in dissolved from and consists of inorganic salts, small amounts of organic matter and dissolved gases. The total dissolved solids content of portable water usually ranges from 20 to 1000 mg/L. Groundwater usually has higher dissolved solids.

5.2 Environmental significance:

a) Dissolved minerals, gases and organic constituents may produce aesthetically displeasing color, taste and odor.

b) Some dissolved organic chemicals may deplete the dissolved oxygen in the receiving waters and some may be inert to biological oxidation, yet others have been identified as carcinogens.

c) Water with higher solids content often has a laxative and sometime the reverse effect upon people whose bodies are not adjusted to them.

d) High concentration of dissolved solids about 300mg/L may also produce distress in livestock in industries the use of water with high amount of dissolved solids may lead to scaling in boilers, corrosion and degraded quality of product.

e) Estimation of total dissolved solids is useful to determine whether the water is suitable for drinking purpose, agriculture and industrial purpose.

f) suspended material is aesthetically displeasing and provides absorption sites for chemical and biological agents.

g) suspended organic solids which are degraded anaerobically may release abnoxious odors.

h) Biologically active suspended solids may include disease causing organisms such as toxic producing stairs of algae.

i) The suspended parameter is used to measure the quality of waste water influent and effluent.

j) suspended solids determination is extremely valuable in the analysis of polluted waters.

k) suspended solids exclude light, reducing the growth of oxygen producing plants.

5.3 Theory:

Water has a boiling point of 100°C. It may rise by a few degrees due to the presents of impurities. When water with solids is kept at 103 to 100°C for 24 hours, the water gets evaporated and the solids either in dissolved state or in suspended state remain as residue.

A rapid assessment of the dissolved solids content of water can be obtained by specific conductance measurements. Such measurement indicate the capacity of a simple to carry an electric current, which in turn is related to the concentration of ionized substances in the water. Most dissolved inorganic substances in water are in ionized form and so contribute to the specific conductance. Although the nature of the various ions, their relative concentration, and the ionic strength of the water affect this measurement, such measure can give practical estimate of the dissolved mineral content of water. The dissolved solids content can be approximated by multiplying the specific conductance (in PS/cm) by an empirical factor varying from 0.55 to 0.99.

5.4 Apparatus:

i) Beaker (150 ML) : 2 pcs
ii) Measuring cylinder : 1 pcs
iii) Funnel : 1 pc
iv) Dropper : 1 pc
v) Filter paper : 2 pcs

5.5 Procedure:

A. Total Solids:

i) A clear glass breaker (which was kept in 103°C in an oven for 1 hour) of 150 ml capacity was taken and appropriate identification mark was put on it. The beaker was weighed and the weight was noted.

ii) 100 ml. of the thoroughly mixed sample was poured and measured by the measuring cylinder in the beaker.

iii) The beaker was placed in an oven maintained at 103°C for 24 hours, ~~cool~~ the beaker was cooled and weighed. The weight of solids in the beaker was found out by subtracting the weight of the clean beaker determined in step(1)

iv) ~~e~~ Total solids (TS) was calculated as follows

Total solids, TS (mg/l) = mg of solids in the beaker ×1000/ (volume of sample)

B. Dissolved Solids:

i) Same as above (step(1) of total solids)

ii) A 100 ml of sample was taken and litter it through a double layered filter paper and the filtrate was collected in a beaker.

iii) Then the same procedure was repeated as in step (iii) and (iv) of the total solids determination and the dissolved solids content was determined as follows :

Total dissolved Solids {TDS (mg/l) = mg of solids in the beaker x 1000 / (volume of sample)

c. Suspended Solids:

Total Suspended Solids TSS (mg/l) = TS (mg/L) - TDS (mg/L)

5.6 Calculation:

$$\text{Total solids} = \frac{W_2 - W_1}{V} \times 1000 \text{ g/L}$$

$$= \frac{(113.85 - 113.83)}{100} \times 1000 \text{ g/L}$$

$$= \frac{0.2 \times 1000 \times 1000}{100} \text{ mg/L}$$

$$= 200 \text{ mg/L}$$

Here,

$W_1 = 113.83$ g

$W_2 = 113.85$ g

$V = 100$ ml

Total suspended solids = Total solid - Total dissolved solids

$$= (200 - 100) \text{ mg/L}$$

$$= 100 \text{ mg/L}$$

5.7 Results:

a) Total solids of the sample is = 200 mg/L

b) Total dissolved solids of the sample is = 100 mg/L

c) Total suspended solids of the sample is = 100 mg/L

5.8 Discussion:

The standard value of TDS is not more than 1000 mg/L according to the Bangladesh Environment Conservation rules (1997), since the value of TDS from experiment was 300 mg/L which was less than the standard value so the sample water was acceptable.

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Department Of Civil Engineering

Expt No. 06

Name of Expt. Determination of chloride concentration of water.

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SUBJECT: Environmental Engineering Sessional-I	**NAME:** Most. Afrin Sultana
COURSE NO. : CE 3142	**GROUP :**
DATE OF EXPT. : 14-03-21	**ROLL NO:** 1700082
DATE OF SUB. : 22-03-21	**SESSION :** 2017-18

Experiment No: 06

Experiment Name: Determination of chloride concentration of water.

Date of experiment: 14-03-2021

6.1 Introduction:

Chloride occurs in all natural waters is widely varying concentration. The chloride content normally increases as the mineral content increases upland and mountain supplies usually are quite low in chlorides. Whereas, rivers and ground water supply usually normally have a considerable amount sea and ocean water represent. The residue resulting from partial evaporation of natural waters that flow into them and Chloride level as high.

The solvent power of water dissolves chloride from top to soil and deeper formation. The salt water being denser, ground areas adjacent to the ocean in hydrostatic balance with sea water. Over pumping of ground water produces a different in hydraulic head in favour of sea water and it introduces to the fresh waters area.

Such importance has occurred in many areas of the coastal southern region of Bangladesh etc. particularly the urine contain in an amount of equal to the chlorides consumed with food and water. This amount average about 6gm of chloride per person per day. And increase the amount of Cl^- in municipal waste water about 15gm/l above that of the carriage water.

6.2 Environmental Significance:

i) Chloride in reasonable concentration aren't harmful to human.

ii) At concentration 250 mg/l they give a salty test of water which is objectionable to many people. For this reason chloride are generally limited to 250 mg/l in supplies intended for public use.

iii) According to Bangladesh Environment Preservation Act (1997) drinking water standard for chloride is 150-600 mg/l

iv) But for coastal region of Bangladesh the limit has been relaxed to 1000 mg/L.

v) Chlorides are used to some extent as in sanitary engineering

6.3 Theory:

Chloride may be measured by means of volumetric procedure. For most purposes, the mohr method implying $AgNO_3$ as titrant and potassium chromite as the indicator is satisfactory. The chloride concentration will be determined by the Mohr method. It is determined by titration with the help of standard $AgNO_3$ solution in the presence of ~~K_2Cr_2~~ K_2CrO_4 indicator the standard method recommends a 0.0141 N $AgNO_3$ solution in which each ml is equivalent to 0.50 mg of chloride ion. ~~NaCL~~ NaCl is precipitated as

$AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$

As the concentration of Cl^- ion becomes exhausted the Ag^+ concentration increases and reddish brown precipitator of AgCl is formed.

$2AgCl + K_2CrO_4 \longrightarrow Ag_2CrO_4 + 2KCl$

The indicator is subtracted from all titrate. Several precaution must be considered.

i) A uniform sample size must be used preferably 100 ml. So that ion concentration needed to indicate the end point will be constant.

ii) The pH must be in the range of 7 to 8

iii) A definite amount of indicator must be used to provide a certain concentration of CrO_4^{2-} otherwise, Ag_2CrO_4 may form too soon or not soon enough. The usual range is 0.2 to 0.4 ml of titration. An error of 2ml will be used in this.

6.4 Reagent:

i) Potassium chromate indicator

ii) Silver Nitrate Solution

6.5 Apparatus:

i) Measuring cylinder

ii) Beaker

iii) Dropper

iv) Strainer

6.6 Procedure:

i) First of all, 100 ml of sample was taken and added to 5 drops of K_2CrO_4 indicator.

ii) Standard $AgNO_3$ (0.0141 M) solution was taken and added from a burette untill permanent reddish color appears. That was determined by comparison with a distilled water blank, recorded the ml of silver nitrate used.

iii) If more than 7 to 8 ml of silver nitrate solution were required to repeat using a smaller sample diluted some with distill water.

6.7 Calculation :

Initial burette reading of $AgNO_3$ = 25 ml

Final burette reading of $AgNO_3$ = 17.50 ml

So, 0.0141 $AgNO_3$ used = (25-17.50) ml = 7.5 ml

Now multiplying factor = 4.97

So Chloride (Cl) mg/L = 7.5 × MF

= 7.5 × 4.97

= 37.275 mg/L

6.8 Result:

The amount of chloride is 37.275 mg/L

6.9 Discussion:

Standard rate of Cl^- concentration in water is 250 mg/L to 600 mg/L, since the Cl^- concentration in the sample water was 372.75 mg/L (in 1000 L), so the sample water was drinkable with respect to Cl^- ion concentration standard value.

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Rajshahi University of Engineering & Technology

Dept. of Civil Engineering

Course No: CE 3142
Course Name: Environmental Engineering Sessional-I

Submitted By:	**Submitted To:**
Name: Most. Afrin Sultana **Roll No:** 1700082 **Section:** B **Class:** 3rd year odd semester **Session:** 2017-18	**Dr. Md. Zahanggir Alam** Associate Professor Dept. of Civil Engineering, RUET

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Heaven's Light Is Our Guide

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department Of Civil Engineering

Expt No. 07

Name of Expt. Determination of carbon-dioxide of water (Titration method)

SUBJECT: Environmental Engineering Sessional-I

COURSE NO. : CE 3142

DATE OF EXPT. : 29-06-2021

DATE OF SUB. : 07-08-2021

SUBMITED BY :

NAME: Most. Afrin Sultana

GROUP :

ROLL NO: 1700082

SESSION : 2017-18

Experiment No: 07

Experiment Name: Determination of Carbon-dioxide of Water (Titration Method)

Date of Experiment: 29-06-2021

7.1 Introduction :

Carbon di oxide is present in water in the form of dissolved gas. Surface water normally contain less than 10 PPM. CO_2 is readily soluble in water. Over the ordinary temperature range (0-30°) the solubility is about 200 times that of oxygen. Calcium and magnesium combine with CO_2 to form carbonates and bicarbonates.

Carbon dioxide does dissolved in water; however the system is somewhat complex. First the CO_2 dissolves according to

$$CO_2\ (g) = CO_2\ (l)$$

At room temperature, the solubility of CO_2 is about 90 cm^3 of CO_2 per 100ml water. Any water soluble gas becomes more soluble as the temperature decreases, due to the thermodynamics of the reaction.

GAS (l) = GAS (g)

The effect is particularly larger gases like CO_2 that undergo specific reactions with water. Equilibrium is established between the dissolved CO_2 and H_2CO_3, carbonic acid.

7.2 Environmental significance:

a) Aquatic plant life depends upon CO_2 and bicarbonates in water for growth.

b) Microscopic plant life suspended in water, phytoplankton as well as large rooted plants utilize CO_2 in photosynthesis. The CO_2 all these materials comes from the CO_2 in water.

c) The rises of CO_2 makes it more difficult for fish to use the limited amount of oxygen present.

d) To take fresh oxygen, fish must first discharge the CO_2 in their blood streams and this is in a much slower process when there are high concentrations of CO_2 in water itself.

e) Corrosion is the principle difficulty caused by CO_2

f) The gas on solution in water produces carbonic acid resulting in lowering in pH.

g) Decrease in pH corrosive characteristics is induced in water resulting severe corrosion of heat exchanges pipes, valves.

h) Corrosion in boiler system takes place due to presence of carbonate and bicarbonate although CO_2 is not present in this case.

7.3 Theory:

This test for determination of free carbon dioxide in water is based on the titration of the water sample with stand and sodium hydroxide solution in the presence of phenolphthalein indicator. The carbon dioxide reacts with sodium hydroxide to form sodium bicarbonate with consequent in pH value. The reaction of sodium hydroxide with free calcium of about 8.3. As soon as the pH is reached a slight pink color is developed and this is taken as end point of reaction. The reaction may be considered to occurs as follows.

$$CO_2 + H_2O = H_2CO_3 \tag{1}$$

$$H_2CO_3 + NaOH = HCO_3^- + Na^+ + H_2O \tag{2}$$

$$HCO_3^- + NaOH = CO_3^{2-} + Na^+ + H_2O \tag{3}$$

7.4 Reagents:

1. Phenolphthalein indicator
2. Standard N/44 sodium hydroxide

7.5 Apparatus:

1. Beaker : 2pc
2. Measuring cylinder : 1pc
3. Dropper : 1pc
4. Stirrer : 1pc
5. Burette : 1pc.

7.6 Procedure :

1. 100 ml. of sample was taken in a beaker and same quantity of distilled water was taken into another beaker.

2. 10 drops of Phenolphthalein indicator was added to each beaker. (Not pink color developed means the presence of carbon-dioxide)

3. N/44 -Sodium Hydroxide solution was added from the burrette to the sample and stirring gently until a slight permanent pink color appeared as compared with the distilled water.

4. The ml amount of sodium hydroxide used was recorded.

7.7 Calculation :

Multiplying factor,

$$MF = \frac{\text{Normality of NaOH} \times \text{Equivalent weight of } CO_2 \times 1000}{\text{ml amount of sample taken}}$$

$$MF = \frac{(N/44) \times 44 \times 1000}{100}$$

$$= 10$$

Carbon-dioxide present (mg/L) = MF × ml of N/44 NaOH added

= 10 × 11.5

= 115 mg/L

7.8 Result:

The amount of CO_2 in the sample water is 115 mg/L

7.9 Discussion:

Sodium hydroxide and phenolphthalein indicator were added very carefully. All the readings were taken properly.

7.10 Assignment:

1. Discuss CO_2 limit for industrial use?

Answer:

CO₂ Emission: Nearly a third of world's energy consumption and 36% of carbon dioxide emissions are attributable to manufacturing industries. The large material industries are accountable for more than two thirds.

The industrial carbon dioxide emision reduction potential amounts to 1.9 to 3.2 gigatons per year, about

7 to 125 of today's global emision of carbon dioxide.

CO$_2$ Exposure: There are several industrial hygiene standards setting groups all over the world. "National Institute for Occupational Safety and Health" (NIOSH) & Occupational Safety and Health Adminstration (OSHA) are most renowned. They has fixed some recomendation for standard use.

NIOSH limits on CO$_2$ Exposure: NIOSH recommended carbon-dioxide exposure limit for 15 minutes is 13% CO$_2$ level of 4% is designated by NIOSH as immediately dangerous to health.

OSHA limits on CO$_2$ Exposure: They set the limit for CO$_2$ exposure in workplace atmosphere at 10,000 ppm as measured as a time weighted average level of exposure and OSHA has set 30,000 ppm of CO$_2$ as a short-term exposure limit.

2. Discuss NH_3 gas leakage hazard in Chittagong.

Answer: On 23 August 2016, a gas disaster occurred at CTG. As a result, nature faces a catastrophe. At that ~~sa~~ time, Bangladesh Chemical industries Corporation (BCIC) chairman Mohammad Iqbal said, "It is just an accident."

According to the report of newspaper,

1. About 250 people falling sick from inhalling toxic gas.
2. An air quality test found ammonia in the air at 600ppm (parts per million) in a radius of 140 metres from the emission source on that day. And it was 20ppm beyond a radius of 200 metres and ammonia below 25 ppm in air quality check after 6 hours later. Whereas, people can bear it if the ammonia level is five ppm in the air.
3. 10 tonnes of fish in the pond died because of this explosion.
4. For being ammonia is a corrosive gas; it slowly diffuses into the air. It increases the pH level in water which impacts the aquatic ecosystem.

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RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department Of Civil Engineering

Expt No. 08

Name of Expt. Determination of alkalinity of water (Titration Method)

	SUBMITED BY :
SUBJECT: Environmental Engineering Sessional-I	**NAME:** Most. Afrin Sultana
COURSE NO. : CE 3142	**GROUP :**
DATE OF EXPT. : 29-06-2021	**ROLL NO:** 1700082
DATE OF SUB. : 07-08-2021	**SESSION :** 2017-18

Experiment No: 08

Experiment Name: Determination of alkalinity of water (Titration Method).

Date of Experiment: 29-06-2021

8.1 Introduction:

The alkalinity of a water is a measure of its capacity to neutralize acids. It is the sum of all the treatable bases. The measured value may vary significantly with the end point pH used. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

Alkalinity is significant in many uses and treatments of natural waters and wastewaters. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate and hydroxide content. It is taken as an indication of the concentration of these constituents. The measured values also may include contributions from borates, phosphates, silicates or other bases if these are present.

Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes. Raw domestic waste water has an alkalinity less than, or only alightly greater than that of water supply.

8.2 Environmental significance:

1. Alkalinity is important for fish and aqualic lives.
2. It protects rapid pH changes.
3. Higher alklinity levels in surface waters buffer. acid rain wastes and prevent pH changes that are harmful to aquatic life.
4. Large amount of alkalinity imparts bitter taste in water.
5. Alkalinity is an important factor determining the suitability of water for irrigating plants.
6. It is believed by some advocates, drinking of alkaline water can neutralize the acid in our body.

8.3 Theory :

There are three kinds of alkalinity ; d hydroxide (OH), normal carbonate (CO_3) and bicarbonate (HCO_3). Normal carbonate is also called monocarbonate. This test is based on the determination of the alkaline content of a sample by titration with a standard acid solution. In this measurement the end points of change in color of the organic indicators, phenolphthalein (CHO) and methyl orange [(CH) NC] representing definite points to which the alkalinity of the sample has been reduced by the addition of the standard acid solution. Phenolphthalein gives a pink color only in presence hydroxide or normal carbonate. The change from pink to colorless occurs at a pH value of 8.3. Methyl orange is yellow in presence of any of the three types of alkalinity and red in the presence of acid. The change in color occurs at a pH value of approximately 4.4. When alkalinity is measured to the phenolphthalein end point called phenolphthalein alkalinity which is due to the methyl orange end point called methyl orange alkalinity which is due to any of the three alkalinities or OH and normal carbonate together or normal carbonate and bicarbonate together.

The following equations illustrate the reactions occuring when each of the three types of alkalinity is titrated with an acid.

Hydroxide : $2NaOH + H_2SO_4 = Na_2SO_4 + 2H_2O$

Normal carbonate : $2Na_2CO_3 + H_2SO_4 = Na_2SO_4 + 2H_2CO_3$

8.4 Indicators:

1. Phenolphthalein
2. Methyl orange

8.5 Table: Determination of alkalinity

Result of titration	Hydroxide alkalinity as $CaCO_3 (OH^-)$	Carbonate alkalinity as $CaCO_3 (CO_3^{--})$	Bicarbonate alkalinity as $CaCO_3 (HCO_3^-)$
$P=0$	0	0	T
$P<0.5T$	0	2P	T−2P
$P=0.5T$	0	2P	0
$P>0.5T$	2P−T	2(T−P)	0
$P=T$	T	0	0

8.6 Reagents :

1. Phenolphthalein indicator
2. Standard 0.02N (N/50) sulfuric acid.
3. Methyl orange indicator

8.7 Apparatus :

1. Beaker : 2pcs
2. Measuring cylinder : 1 pc
3. Dropper : 1 pc

8.8 Procedure :

1. 100 ml of the sample was taken into one beaker and the same amount of distilled water into another beaker.
2. pH of the sample was measured with pH meter.
3. 3 drops of phenolphthalein was added to each, if the sample became pink, went to step 3 otherwise went to step 4.
4. 0.02N H_2SO_4 acid from a bottle was added until the pink color just disappeared. The ml of acid use

was recorded.

5. 3 drops of methyl orange indicator to each beaker was added. If the sample became yellow, 0.02 N H_2SO_4 acid added until the first change in color was noted. The end point was a slight orange. The ml of acid use was recorded.

8.9 Calculation:

Initial reading = 21.8 ml

Final reading = 24.50 ml

Phenolphthalein alkalinity = (ml of N/50 H_2SO_4 to pH 8.3) × (1000/ml of sample)

= (ml of N/50 H_2SO_4 to pH 8.3) × MF

Total Alkalinity = (total ml of N/50 H_2SO_4 to pH approx. 4.5) × (1000/ml of sample)

= total ml of N/50 H_2SO_4 to pH approx. 4.5 × MF

Where MF = Normality of H_2SO_4 × equivalent wt of $CaCO_3$ × 1000/(ml of sample taken)

From equation

$MF = (0.02 \times 100 \times 1000) / 100$

$= 20$

Phenolphthalein Alkalinity $= (\text{ml of } H_2SO_4 \text{ used}) \times MF$

$= 2.70 \times 20$ mg/L

$= 54$ mg/L

8.10 Result:

The amount of alkalinity = 54 mg/L

8.11 Discussion:

Standard amount of alkalinity is not given directly as according to WHO or Bangladesh guideline. Here, the finding amount of alkalinity of water, collect from tap is 54 mg/L, it is acceptable for palatability.

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RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department Of Civil Engineering

Expt No. 09

Name of Expt. Determination of Arsenic Concentration of Water sample

	SUBMITED BY :
SUBJECT: Environmental Engineering Sessional - I	**NAME:** Most. Afrin Sultana
COURSE NO. : CE 3142	**GROUP :**
DATE OF EXPT. : 06-07-2021	**ROLL NO:** 1700082
DATE OF SUB. : 07-08-2021	**SESSION :** 2017-18

Experiment No: 09

Experiment Name: Determination of Arsenic Concentration of Water sample.

Date of Experiment: 06-07-2021

9.1 Introduction:

Bangladesh is currently facing a serious threat to public health, with 85 million people at risk from arsenic (As) in drinking water and in food crops. In Bangladesh is currently facing a serious threat to public health, with 85 million Bangladesh, the groundwater As contamination problem is the worst in the world. Ninety seven percent of the population in the country uses groundwater for drinking and domestic purposes as surface water is mismanaged. High levels of as in groundwater are causing widspread poisoning in the Bangladesh. Different studies have addressed various aspects of the As issue in Bangladesh. The review is undertaken to give an overview of the latest findings and statistical data on the issue especially on soil, water and food cycle. The World Health Organization (WHO) recommends a safe limit for As in drinking water of $10\ \mu g\ L^{-1}$. A recent survey looked at the As concentrations of drinking water from deep wells in 64 districts in the country and found that 59 had concentrations $>10\ \mu g\ L^{-1}$ and 43 had concentrations $>50\ \mu g\ L^{-1}$. Contaminated groundwater is also used for irrigation of paddy rice, which is the main staple food for the population. This practice enhances the level of As in the soils rendering them unsuitable for agriculture. A few recent studies have reported that 85-95% of total As in rice and a vegetable was inorganic, which outlines the need for more studies for standardization. Arsenic concentration is higher in Bangladeshi soils, groundwater and plants (data based on 4% area of the country) than the permissible limits or normal range reported. This situation poses a ~~r~~ serious threat on human and livestock health and highlights the need for scientific studies that would better describes the fate of ~~as~~ As in the natural environment and identify all potential routes of exposure.

Arsenic, the 20th most abundant element in the earth's crust and 12th most abundant element in the biosphere, is a common trace inorganic contaminant in drinking and is identified as a significant health risk. Arsenic is known for its high toxicity and its ability to induce cancer after long time ingestion. Presence of elevated levels of arsenic in ground water (especially from shallow aquifer) has become a major concern in Bangladesh. Arsenic pollution in ground water is especially challenging in Bangladesh since tube-wells water extracted from shallow is the major source of drinking water for most of its population.

In Bangladesh the arsenic in ground water is of geologic origin and is probably only apparent now because it is only the last 20-30 years that ground-water has been extensively used for drinking in rural areas. Weathering of arsenic-rich base metal sulfide in the upstream of the gang's basins appears to be a major sources of arsenic-rich base iron ox hydroxides in the sediments of Bangladesh Arsenic-rich iron Ox hydroxides appear to be the major source of arsenic, from which arsenic is released as a result of dissolution and desorption. Reducing Environment in the alluvial aquifer, primarily due to presence of organic matter. Promotes dissolution of iron ox hydroxides and release of arsenic. Use of phosphate fertilizer can potentially enhance release of arsenic as a result of replacement of arsenic by phosphate ions on the adsorption sites of iron ox dhydroxides. Natural anthropogenic process that may lead to release/mobilization of arsenic in the subsurface are being investigated.

9.2 Environmental Significance:

In a population drinking arsenic contaminated water, a great variety of specific as well as nonspecific symptoms may be observed. Some effects are given below:

1. Black foot disease arsenical dermatosis caused dermal lesion, peripheral neuropathy keratosis, hyperkeratosis, hyperpigmentation which may necessitate operation.

2. Nausea, Abdominal pain, Diarrhoea, vomiting, conjunctivities, and oedema is mainly caused due to acute intoxication.

3. Pregnancy disorders, sponteneous abortions,

miscarriage is happened.

4. Heart diseases like Coarctation of aorta, Cardivascular disturb is happened among children.

5. Cancer like Bladder, Kidney, Skin & lungs, Liver & Colon is caused.

6. Mortality is mainly due to cancer is caused by arsenic.

Table 1: Arsenic compounds and species and their environmental and toxicological important in water.

Compounds	Example	Environmental significance/Dominant pH region	Toxicity
Arsenic	As	minor importance	most toxic as species
Elemental Arsenic	As	minor importance	least toxic as species
Trivalent Arsenic	As (III)	anaerobic	10 times more toxic than As (V)
Arsenic Inorganic	H_3AsO_3 H_1AsO_1 $HAsO_3$ AsO_3	pH = 0-9 pH = 10-12 pH = 13 pH = 14	
Methyllates As (III) Organo As (III)		minor importance	less toxic than inorganic As (III)
Pentavelent arsenic		aerobic	10 times less toxic than As (III)

Compounds	Example	Environmental significance / Dominant pH region	Toxicity
Arsenic Inorganic	H_3AsO_3 H_2AsO_3 $HAsO_4$ AsO_4	pH = 0-2 pH = 3-6 pH = 7-11 pH = 12-14	
Methylated As (V) Organo As(V)		minor importance	less than inorganic As (V)

9.3 Theory:

There are different methods of determination of arsenic One of them is Hydric generation - Scaper - spectrophotometry (SDDC) method which is low cost economic method.

As (III) / AS (III) + $HCl/KI/SnCl_2$ = AS(III) + Zn + AsH_3 (Arsenic Hydric Gas)

Equation 1-3 reactions or arsine generation or formation of Colored complex.

$Zn(\text{metal}) + 2H^+ = Zn^{2+} + 2H$ ——— (1)

$H_3AsO_3 + 6H = AsH_3 + 3H_2O$ ——— (2)

AsH_3 + SDDC / bromide = Coloured Complex ——— (3)

9.4 Reagents :

1. Sulphamic acid powder
2. Metallic Zinc powder

9.5 Apparatus:

1. Sample vial
2. Arsenic testing strip
3. Assembly for BUET Arsenic kit
4. Beaker.

9.6 Procedure:

a. At first the sample vial was taken and sample water was poured upto the mark.

b. The reagent sulphamic acid was added with water in vial. After 15 to 20 sec another reagent Zn was added.

c. An arsenic test strip was set on the cap of the vial and the cap was put on the vial and tightened. Then the sample vial was stirred about 20 minute.

d. Then the test strip was taken out and the color of the sensitive part was observed and this colour was compared with the calibrated colour for different valve of arsenic.

9.7 Result:

The amount of arsenic was 0.01 mg/l or 10 ppb.

9.8 Discussion:

This sample water is drinkable with respect to the tolerable value of arsenic in Bangladesh If the other parameter of water was controlled.

9.9 Assignments:

Q.1: In which chemical form arsenic is likely to exist in ground water explain?

Answer: In groundwater arsenic is primarily exist as inorganic arsenic. Inorganic trivalent arsenic As (III) or arsenic in the dominant from reducing environment pentravalent arsenic or arsenic in the environment. dominant from in oxidizing or aerotic environment. In groundwater environment where the conditions are mostly reducing a significant part of the arsenic exist as AS(III). In the pH range of most ground water dominant chemical form of AS(III) ~~As~~ H_3As_3. while dominant chemical form of As(V) in this pH range are $H_2AsO_4^-$, $HAsO_4^{2-}$.

Q.2: In determination of arsenic why the sample are acidified and pre concentrade before actual determination of arsenic?

Answer: The Arsenic is often present in very small concentration on it water. Therefore, water sample are often pre concentrated in order to increase the quantity of arsenic in a given value of pre concentration is usually done by acidifying 200ml to 500ml water sample and then reducing the volume to about 35ml and a water bath

Q.3: What is the basic difference between two arsenic determination methods (SDDC) method and mercuric bromide strain method?

Answer: SDDC method is involved with the conversion of all arsenic in water into As (III). Mercuric bromide strain is involved with the reduction of as (V) in water to As (III).

a) SDDC method is involved with the determination of arsenic concentration from a standard curve developed with known concentration of arsenic.

Mercuric bromide strain method is involved with the determination of arsenic concentration by comparing the provided color with a standard color with a standard color chart.

b) SDDC method is involved with the generation of arsenic gas in the form of arsenic hydried AsH_3. Mercuric bromide strain method is involved with the generation of arsenic hybrid (AsH_3).

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RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department Of Civil Engineering

Expt No. 10

Name of Expt. Determination of Iron Concentration of Water.

SUBJECT: Environmental Engineering Sessional-I

COURSE NO. : CE 3142

DATE OF EXPT. : 06-07-2021

DATE OF SUB. : 07-08-2021

SUBMITED BY :

NAME: Most. Afrin Sultana

GROUP :

ROLL NO: 1700082

SESSION : 2017-18

Experiment No: 10

Experiment Name: Determination of iron concentration of water.

Date of Experiment: 06-07-2021

10.1 Introduction:

Iron, as well as manganese, creates serious problems in public water supplies. The problems are most critical for groundwater. Iron exists in soils and minerals as insoluble ferric oxide/hydroxide and iron sulfide (pyrite). In some areas, it also occurs as ferrous carbonate, which is very slightly soluble. since groundwater usually contains significant amounts of carbon dioxide, appreciable amounts of amounts of ferrous carbonate may be dissolved according to the following equations:

$$FeCO_3 + CO_2 + H_2O = Fe^{2+} + 2HCO^{3-} \quad \text{——— (1)}$$

If reducing (anaerobic) conditions exist in groundwater environment, the insoluble ferric iron $[Fe^{3+}]$ is reduced to more soluble ferrous $[Fe^{2+}]$ and iron concentration in water increases. There seems to be enough evidence to suggest that development of reducing (anaerobic) condition is essential for appreciable amount of iron (as well as manage) to gain entrance into water.

10.2 Environmental significance:

1. As far as is known, human suffer no harmful effects from drinking waters containing iron and manganese.
2. Such waters, when exposed to the air so that oxygen can enter, become turbid and highly unacceptable from the aesthetic viewpoint owing to the oxidation of iron and manganese to the Fe^{3+} and Mn^{4+} states which from colloidal precipitates.
3. The rates of oxidation are not rapid, and thus reduced forms can persist for some time in aerated waters.
4. This is especially true when the pH is below 6 with iron oxidation and below 9 with manganese oxidation.
5. The rates may be increased by the presence of certain inorganic catalysts through the action of microorganisms.
6. Both iron and manganese interfere with laundering operations, impart objectionable stains to plumbing fixtures and cause difficulties in distribution

systems by supporting growths of iron bacteria.

7. Iron also imports a taste to water, which is detectable at very low concentrations. According to Bangladesh Environment Conservation Rules (1997), drinking water standard for iron is 0.3 - 1.0 mg/L.

10.3 Theory:

Iron may be present in two forms namely the reduced from (ferrous Fe^{2+}) and the fully oxidized form (ferric, Fe^{3+}). Ferric iron is seldom found in true solution in natural waters, unless they are highly acidic, because of the formation of insoluble ferric hydroxides. Ferrous iron is more likely to be found in true solution, although it is easily oxidized to the ferric state and precipitated in alkaline waters as ferric hydroxide. Ferric iron is determined by producing a red-colored iron compound, ferric thiocyanate, by the addition of potassium thiocyanate (Eq.2)

$$Fe^{3+} + 3KCNS = Fe(CNS)_3 + 3K^+ \quad \text{———} \quad (2)$$

The quantity of ferric iron is determined by comparison with the red colour produced by standard iron solutions.

Since some iron may exist as iron hydroxide precipitates, it is necessary to make sure that all iron is in soluble condition. This is done by treating the sample, to be tested with hydrochloric acid to dissolve the ferric hydroxide. For determination of total iron following the procedure, it must be ensured that all iron exists in ferric form (Fe^{3+}). This is readily accomplished by using potassium permanganate, and oxidizing agent.

Ferrous iron is also determined calorimetrically by producing a blue compound, known as Turnbull's blue by the addition of potassium ferriocyanate (Eq.3)

$$3Fe^{2+} + 2K_3Fe(CN)_6 = Fe_3[Fe(CN)_6]_2 + 6K^{++} \text{ ——— } (3)$$

The quantity of ferrous is determined by comparison with the colour produced by standard iron solutions. Standard iron solutions (in both cases) are prepared from ferrous ammonium sulfate crystals

$[FeSO_4 (NH_4) 2SO_4 \cdot 6H_2O]$.

10.4 Reagents:

1. Hydrochloric acid (61)
2. Potassium permanganate solution (28)
3. Potassium thiocyanate solution (29)
4. Standard iron solution (27)

10.5 Apparatus:

1. Nessler tube (2)
2. Measuring cylinder (1)
3. Dropper (1).

10.6 Procedure:

1. 100 mL of water sample was placed in a Nessler.
2. 5 mL of dilute hydrochloration acid was added.
3. Two drops of potassium permanganate ~~solution~~ ~~(28)~~ was (28) was added.
4. 5 mL of potassium thiocyanate solution (29). The solution was turned brown as iron was present.

5. The brown color formed was compared with the standard prepared as follows:

a) 100 mL of distilled water was added in a Nessler tube.

b) 5 mL of the dilute hydrochloric acid (61) was added.

c) Two drops of potassium permanganate solution (28) was added.

d) 5 mL of potassium thiocyanate solution (29) was added.

e) 4 mL of the standard iron solution (27) was added at total time until the colour of the standard was matched

10.7 Calculation:

Iron present (mg/L) = 0.4 mL of the standard iron solution used.

10.8 Result:

Iron present (mg/L) = 0.4 mL of the standard solution used.

10.9 Discussion :

1. All individual amount of reagents are taken with care

2. The colour of the standard solution and the sample colour were marched properly.