Aim :- To determine pH and alkalinity in given samples of water.

Apparatus Used :- pH meter, Burette, Burette stand, conical flask, measuring cylinder, Beakers.

Reagent used :- Buffer solution of pH 4 and pH 9.2, $\frac{N}{50}$ H_2SO_4, two indicator - (i) phenolphthalein, (ii) methyl orange.

Theoretical Background :- pH stands potential of hydrogen. pH of water is a measure of amount of hydrogen ions that is present in the water. It determine if the water is alkaline or acidic in nature. And it can be calculated as

$$pH = -\log[H^+] = \log\left(\frac{1}{H^+}\right)$$

Alkalinity :- Alkalinity is defined as the quantity of ions in water that will react to neutralize hydrogen ions. Alkalinity is thus a measure of the ability of water to neutralize acids.

Sources :- The most common constituents of alkalinity are bicarbonate (HCO_3^-), carbonate (CO_3^{2-}), and hydroxide (OH^-).

$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \text{ (dissolved } CO_2 \text{ and carbonic acid)}$$

$$H_2CO_3 \rightleftharpoons H^+ + HCO_3^- \text{ (bicarbonate)}$$

$$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-} \text{ (carbonate)}$$

$$CO_3^{-2} + H_2O \rightleftharpoons HCO_3^- + OH^- \text{ (Hydroxide)}$$

Alkalinity measurements are made by titrating the water

with an acid and the determining the hydrogent equivalent. Alkalinity is then expressed as milligrams per liter (mg/L) as $CaCO_3$.

For the PH more than 8.3, add phenolphthalein indication, the colour changes to pink colour. This pink color is due presence of hydroxye ions. It indicated the caustic alkalinity.

Procedure :-

pH :-

1- Take a water sample of 100 mL.
2- Plae the electrode of pH meter in the water sample whose pH is to be determined.
3- Note down the reading and repeat or take three or four readings of different samples.

Alkalinity :-

1- Rinse the burette with 0.02 N H_2SO_4 and discard the solution.
2- Fill the burette with $\frac{N}{50}$ sulphuric acid (H_2SO_4) and adjust it to zero.
3- Fix the burette in the stand.
4- using a measuring cylider excatly measure 100 mL of sample and pour it into a 250 mL of conical flask.
5- Add few drops of phenolphthalein indicator to the sample. The color of sol^n will turns to pink.
6- Titrate the contents with $\frac{N}{50}$ sulphuric acid.
7- Continue the titration till the color changes to colourless. This indicates that caustic alkalinity is removed and note down the vol. of titrant (V_1).

8) To the same solution add few drops of mixed indicator. The color of the solution turn to blue. This color changes due to the presence of CO_3^{-2} and HCO_3^- in water sample.

9) Now titrate it against $\frac{N}{50}$ H_2SO_4.

10) continue the titration till the color changes to red. And note down the volume of titrant used and say to V_2 (mL).

11) similarly repeat the titration for other sample.

Observation and Calculation

pH of sample 1 — 7.82
pH of sample 2 → 9.77

Normality of H_2SO_4 = 0.02N
Vol. of sample 1 → 100mL Vol. of sample 2 → 50mL
Equivalent weight of $CaCO_3$ = $\frac{\text{Molecular mass}}{\text{Valency}} = \frac{100}{2}$
= 50

Sample	Burette Reading		Vol. of titrant used (mL) (V_1)	Remark
	Initial (mL)	Final (mL)		
1	0	34.5	34.5	
2	0	15.5	15.5	

$$\text{Alkalinity} = \frac{\text{Vol. of } H_2SO_4 (V_1) * \text{Normality} \times 50 \times 1000}{\text{Vol. of sample taken}}$$

For sample 1–

Alkalinity as $CaCO_3$ equivalent

$$= \frac{34.5 \times 0.02 \times 50 \times 1000}{100}$$

$$= 345 \text{ mg/L as } CaCO_3$$

For sample 2–

Alkalinity as $CaCO_3$ equivalent

$$= \frac{15.5 \times 0.02 \times 50 \times 1000}{50}$$

= 155 mg/L 310 mg/L

From the above calculation, the alkalinity of sample 1 is 345 mg/L and for sample 2 155 mg/L.

Result and Discussion :–

- ① pH
  → pH value of sample 1 = 7.82
  pH value of sample 2 = 9.77

Alkalinity

Alkalinity of sample 1 = 345 mg/L
Alkalinity of Sample 2 = 310 mg/L

- As pH value of given water sample is found to be 7.82 and 9.77. As per IS-Code the acceptable limit of pH value for drinking purpose is 6.5 to 8.5. Here the pH of sample 1 is 7.82 which comes in the range hence it is good for drinking purpose.

Acidic water with a pH of less than 6.5 is more likely to be contaminated with pollutants, making it unsafe to drink. It can also corrode metal pipes. For sample 2 pH will be 9.77; alkaline drinking water is considered safe. but it can sometimes cause skin problems and will taste bitter.

Alkalinity of given samples of water is found to be 345 mg/L and 310 mg/L. for Sample 1 and Sample 2 respectively.

According to BIS the acceptable limit for alkalinity is 200 mg/L and in case when no other source of water is present, then 600 mg/L is acceptable.

Acceptable limit - 200 mg/L
Rejection limit → 600 mg/L.
(Maximum)

Engineering Significance

Determination of pH is one of the important objectives in biological treatment. In anaerobic treatment if pH goes below 5 due to excess accumulation of acids. The process is severly effected. Lower value of pH below 4, will produce sour taste and higher value above 8.5 will produce bitter taste.

Alkalinity is a measure of the capacity of water to neutralize acids. Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes.

References :- Enviromental Engineering By Peavy H.S.

Allowable limit from BIS code.

Aim :- To determine turbidity in given sample of water.

Apparatus used :- Turbidity meter, glass cuvette, measuring flask (100ml) of capacity, Measuring cylinder (100ml), measuring cylinder (10ml), & Beaker (100 ml).

Reagents :- stock solution of 400 NTU turbidity.

Theory :- Turbidity is the technical term referring to the cloudiness of a solution and it is a qualitative characteristics which is imparted by solid particles obstructing the transmittance of light through a water sample.

Turbidity often indicates the presence of dispersed and suspended solids like clay, organic matter, silt, algae and other micro-organism.

Turbidity is based on the comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. The turbidity of the sample is thus measured from the amount of light scattered by the sample taking a reference with standard turbidity suspension.

The higher the intensity of scattered light the higher is the turbidity.

Firstly we prepare a stock solution of 400 NTU with the help of two chemicals named as i) Hexamethylenetetramine (ii) Hydrazine Sulphate and some amount of

distilled water.

Procedure

(i) Using the standard solution calibrate the instrument.
standard sol^n → Prepare standard sol^n of 40NTU, 30NTU, 20NTU and 10NTU using 10mL, 7.5mL, 5mL and 2.5 mL respectively of the stock sol^n 400NTU and diluted in each sol^n to 100mL.
Using the eq^n of $N_1V_1 = N_2V_2$

(ii) Observe the meter reading for each of the standard sol^n. and noted down.

(iii) Draw the calliberation curve using observed meter reading for standard solution.

(iv) Note the meter reading separately for each of the given sample of water.

(v) If the meter reading for excked maximum reading obtained from caliberation then dilute the sample accordingly. And note down the meter reading of diluted sample.

(vi) And multiply the turbidity value with dilution factor in case of diluted sample.

Observations

For determining the turbidity of the given water sample the readings are required to be tabulated.

Table 1-
Observations for caliberation

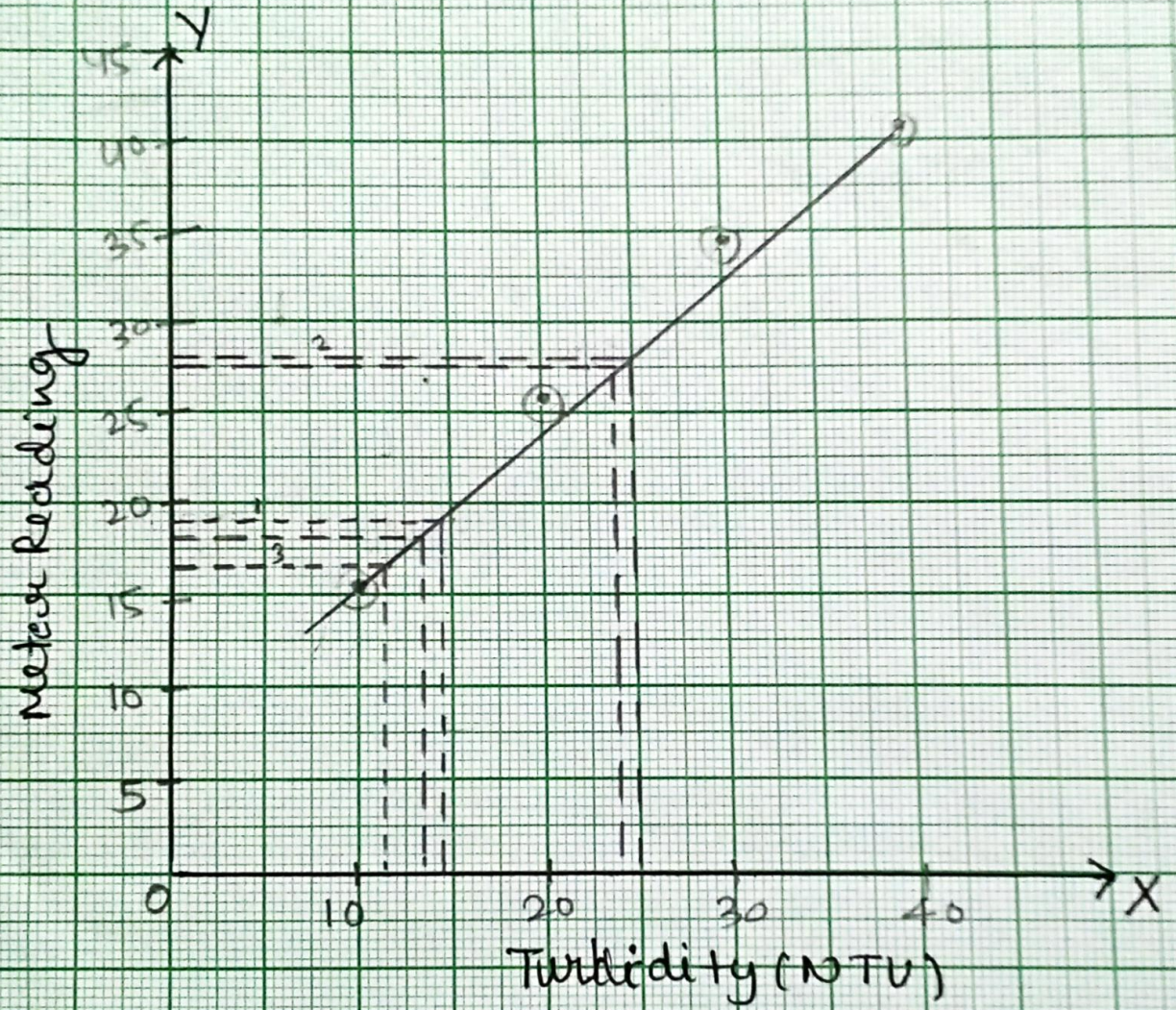
S. No	Turbidity (NTU)	Meter Reading	Remarks
01	40	40.2	standard sol^{n}
02	30	34.8	"
03	20	25.2	"
04	10	15.1	"

Observations for sample

S. No.	Meter Redding	Turbidity	Remarks
01	19.1	14.5	Sample 1
02	47.5	–	Sample 2- Dilution Factor - 1
03	28	25x2 = 50	Sample 2- DF - 2
04	16.6	11.5	Sample 3
05	27.7	24	Sample 4
06	72	–	Sample 5 → DF → 1
07	18.2	13.5x3 = 40.5	Sample 5 → DF - 3

Result and Discussion

Turbidity of sample sol^{n} 1 :- 14.5 NTU
Turbidity of sample 2 :- 50 NTU
Turbidity of Sample 3 :- 11.5 NTU
Turbidity of Sample 4 :- 24 NTU
Turbidity of Sample 5 :- 40.5 NTU


Y
X
Meter Reading
Turbidity (NTU)
0
5
10
15
20
25
30
35
40
10
20
30
40
1
2
3

Five sample (1, 2, 3, 4, 5) were tested for measuring turbidity and were found to be of the following results:-

According to IS-10500-2012, the acceptable limit of turbidity is 1NTU and permissible limit in the absence of alternate source is 5NTU.

ENGINEERING SIGNIFICANCE

Turbidity of water is an important physical parameter of drinking water. It's determination tell us how fit the water is for the consumptions in households. Turbidity plays an important role in treatment plant also.

Reference :-

IS : 10500-2012 :- Drinking Water Specification.
Water supply Engg. (Env. Engg-I) by P N MODI.