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Physico-Chemical studies on the water of Ramganga River, Moradabad

Abstract

The pH, Hardness, alkalinity studies of various water samples have been carried out to check the quality of various water samples collected from different places (hand pumps, wells, ponds, ditches, etc.).The pH scale is a measure of hydrogen ion concentration. The pH scale varies from 0-14. Below pH -7 is acidic & above pH-7 is considered basic. The pH-7 is considered neutral. The solubility of the metals & Non-metals depend upon the pH of the solution.

The Alkalinity is produced in water system due to the presence of alkaline salts. The alkalinity may be due to OH ions, or due to carbonate ions or bi-carbonate ions. The alkalinity causes hazardous effect on the fauna & flora of the water system.The hardness of water is caused due to the presence of calcium & magnesium Sulfates, chlorides, Bi-carbonates. The slight hard water 60mg/l is almost soft water. The 60mg/l to 100mg/l the water becomes moderately hard water. 101mg/l to 180mg/l the water becomes hard water. 180 onward the water becomes very hard.
The pH, high level of hardness and alkalinity are dangerous and causes cardio vascular problems.

Keywords: Hardness, water sample, titration, indicator, pH, parameters, indicator, distilled water.

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Introduction

The determination of Hydrogen ion concentration is a important tool to identify the acidic and basic character of water samples. The pH scale varies from 0 to 14. Below pH-7 is acidic and above pH-7 is considered basic. The pH -7 is considered neutral. The water samples collected from various sources may have variable pH (StummW.1995) .The hydrogen ion concentration is also effected by discharge The different samples showed different pH values. The change in pH means water is changing chemically. The pH of rivers and underground water shows the quality of water. If water is acidic it means carbonates, sulfite and sulfates are present. If water

is basic it shows that more alkali metals are present which changes the pH by making basic hydroxides in the underground water. **T**he solubility of the metals and non metals depends upon the pH of the solution .The pH of solution plays an important role in controlling the eco system of water. The higher concentration is harmful to aquatic life and also to human health. If the pH is basic it means the earth crust is rich in alkali metals. The acidic medium is also bad and causes corrosion in the pipe lines. The solubility of metals and non metals also depend upon the pH of the water .The solubility of heavy metals also enhances the solubility of other metals. Due to the presence of heavy metals the toxicity of water increases.

The pH scale is a measure of hydrogen ion concentration. The diagram given below shows pH in various colors. The zero pH is dark reddish and this type of pH is used in battery water. The sulfuric acid has pH -1 and shows orange color. The pH of lemon juice is 2. The orange juice shows pH-3 and cold drinks shows pH -4. The yellow color indicates the pH of banana. The healthy pH starts from 6.5 to 6.8. The pure water has pH 7.0. The alkalinity start from 7.1 but sea water has alkalinity about 8.0. The Baking soda has pH 9.0. The milk of magnesia (magnesium hydroxide) has pH around 10 and used as antacid i.e used to neutralize the excess acid in the body (WHO1973, National Research Council 1977).

As mentioned in the pH scale the alkalinity is produced in water system due to the presence of alkaline salt. The soil act as buffering effect on the pH change of the water system. The alkalinity is of two types. The phenolphthalein alkalinity and total alkalinity which is measured by methyl orange. The alkalinity may be due to OH ions, or due to carbonates ions or bicarbonates ions. The alkalinity due to OH and carbonates is called phenolphthalein alkalinity. The total alkalinity due to OH, carbonates and bicarbonates causes total alkalinity. The alkalinity causes hazardous effect on fauna and flora of the water system. The animals are also affected by the high alkalinity. It causes disturbance in digestive system. It also changes pH of the blood. The high alkaline value has negative impact on health. .The acid rain also changes the alkalinity of the soil. The slightly acidic soil is good for plants. Few plants prefer slightly alkaline soil .The carbon dioxide also balances the alkalinity of soil and water reservoirs. Normal acidity and alkalinity has no adverse effect on human health.

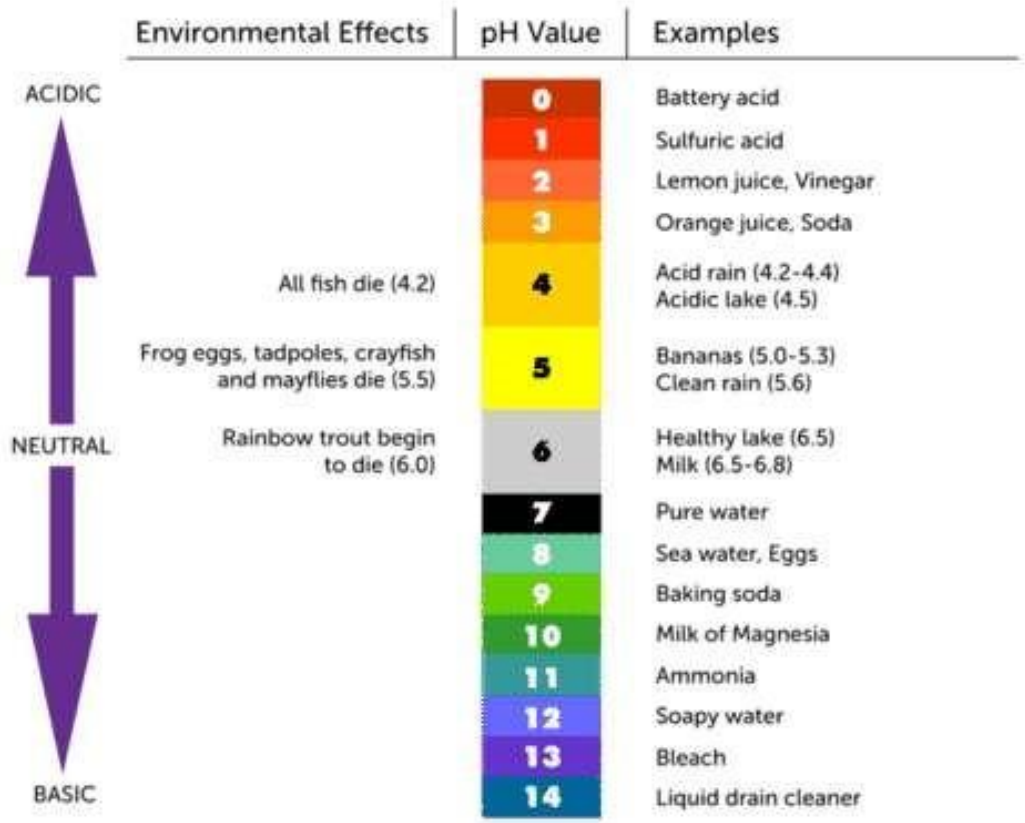

Fig 1: pH scale of various chemical substances. The pH of ammonia is 11.00 and soapy water shows high alkalinity. The bleach and liquid drain cleaner has highest alkalinity

High acidity and alkalinity causes' adverse effect on aquatic life, insects, and human health.The high alkalinity is produced due to the large amount of detergents in bodies (Neri LC.1978). The soap and detergents produce colloidal particles in water system which are precipitated by coagulating agents. The softening of water is done by external and internal methods. Alkalinity also causes caustic embrittlement in boilers (Sawyer CN et.al.1978)

The hardness of water is caused due to the presence of calcium and magnesium sulfates, chlorides and bicarbonates. The temporary hardness is caused due to the presence of bicarbonates of calcium and magnesium. The permanent hardness is caused due to the presence of sulfates and chlorides of calcium and magnesium. The temporary hardness is removed by simple boiling the water or by treating temporary hard water with lime. The lime is added into the water. The carbonates of calcium and magnesium are precipitated along with the magnesium hydroxides. The permanent hardness is removed by soda-lime process or by Zeolite. The hard water on large scale is treated with ion exchange resins. The cation exchange resin remove the all cations like calcium,

magnesium, aluminium, and ferrous ions (McNally NJ. 1998). The hardness is of four types. The slight hard water (60mg/l) is almost soft water. The 60mg/l to 100mg/l the water become moderately hard water. 101mg/l to 180mg/l the water become hard water. 180 onward the water becomes very hard. It is given in Table no.1 &2.

Table 1- Description of sampling location

Sampling Site No	Sampling Sites	Location	Activities
1.	MDA Colony	6km North to the Moradabad	Sand digging & occusional Bathing
2.	Jigar Colony	3km South to the Site-1	Washing, Laundering, Bathing, Cattle Bathing
3.	Kali Ji Tample	3km for from sites-2	Bathing, Cremation, Activites
4.	Upstream Nawabpura Nullah	510m away to the Sites-3	Cremation Activites

Table 2- Pre-monson Physico-Chemical Parameters calculation at different sampling locations.

Parameter	SS-1	SS-2	SS-3	SS-4	SS-5	Mean	Min	Max	S.D
Temprature	35.9	35.1	35.9	36.1	35.1	35.4	34.9	36.1	0.54
ph value	8.71	8.9	8.42	7.52	7.42	8.34	7.42	8.9	0.64
Conductivity	0.95	0.59	0.56	0.67	2.99	2.00	0.51	3.1	0.87
Turbidity (mg/l)	3.61	2.98	2.8	2.93	4.55	2.82	2.6	3.60	0.57
Total Solid (mg/l)	152	295	515	1999	2845	1216.80	143	2841	1033.8
TDS (mg/l)	103	235	433	569	1749	835.15	103	2398	770.25
Total Hardness (mg/l)	149	140	170	160	405	228.90	126	403	116.76
Calcium (mg/l)	22.13	22.14	29.25	42.86	185.10	73.52	21.13	185.10	59.93
Magnisium (mg/l)	130.2	122.8	147.4	140.1	295.2	179.62	98.2	290.2	78.55
Acidity (mg/l)	132.5	133	125.5	137.5	545	238.23	121.16	534	165.79

MATERIALS AND METHODS

Determination of pH value by pH digital meter

The pH meter is placed on a plane surface. The pH electrode is washed with distilled water and kept in water. The digital pH meter is calibrated with help of two buffer solutions 4.00 and 9.00.Now the pH values of

different water samples are noted by dipping electrodes in the water samples. The calibration is repeated every after 10 samples. The pH meter is handled with safety and there should not be any fluctuation in electric current.

Determination of Alkalinity by titrimetric method

In this case the reagents N/50 standard sulfuric acid, phenolphthalein, methyl orange indicator, ethyl alcohol,and distilled water is used. The determination of alkalinity is based on the principle that there may be OH ions or Carbonates ions or bicarbonates ions. The presence of OH ions and carbonates ions is determined by Phenolphthalein indicator and the total alkalinity is determined by methyl orange alkalinity.The alkalinity is expressed in equivalent of calcium carbonates. The concentration of CO_2 also changes the alkalinity of water.

$$CO_2 + H_2O \Rightarrow H_2CO_3$$

$$H_2CO_3 \Rightarrow HCO_3^- + H^+$$

$$HCO_3^- \Rightarrow CO_3^{2-} + H^+$$

In acidic medium the alkalinity becomes negative. In slightly basic medium the alkalinity exist as bicarbonates. At about pH 11.5 the alkalinity exists as carbonates. 25 ml of water sample is taken in a beaker and few drops of phenolphthalein as indicator is added in it. If OH ions are present the pink color appear and then it is titrated against the N/50 HCl or H_2SO_4 solution. The acid is filled in burette and added drop by drop in the conical flask. The disappearance of pink color shows end point. The concordant reading is noted and alkalinity is calculated. The normality of water is calculated by using the formula:

$$N_1V_1 = N_2V_2$$

The strength of phenolphthalein Alkalinity(S) is calculated and expressed in equivalent of calcium carbonate by using S=NE, where N denotes for normality and E for equivalent weight. In order to determine the total alkalinity, water sample is taken in a conical flask. The Methyl Orange indicator is added in it. The color becomes yellow.Now it is titrated against the standard HCl solution. The appearance of pink color shows end point. The titration is repeated and concordant reading is obtained. $N_1V_1=N_2V_2$ and S=NE is applied to calculate total alkalinity.

Estimation of hardness by EDTA method

The hardness determination is based on the formation of complex with calcium and magnesium in presence of buffer solution.The Eriochrome Black T+ calcium and magnesium form wine color. The EDTA solution is added in the conical flask drop by drop.The color change from wine to blue.This is called end point. The concordant reading is obtained by repeating the process.

Determination of Total hardness

The 25 ml of water sample is taken in conical flask and 10 ml of buffer solution is added to maintain 9.00-10 pH. The EDTA solution is added drop by drop till color change from wine to blue. The concordant reading is obtained and permanent hardness is calculated. N1V1=N2V2 and S=NE are applied for the calculation of total hardness of water sample. The temporary hardness is also calculated. The water samples are boiled. In this way temporary hardness is removed. The bicarbonates are converted in to Carbonates, the carbonates are filtered and permanent hardness is calculated after titration again.

Temporary hardness= Total hardness - Permanent hardness

RESULTS AND DISCUSSION

Sampling method

When we go for collecting the water sample. Firstly we locate the number of water sources in a particular area. We keep plastic bottles.The bottles are filled with water sample. In this way we collect all water samples. As per standard, the samples can't be analyzed immediately. They are stored at zero degrees centigrade to stop any change in the composition of water. Values of different parameters have been collected in Table3, whereas standard values of different parameters are given in Table 4.

Table 3: Table showing Hardness, pH and alkalinity of water samples collected from different places

S. No.	Sample	Sample Source	Hardness	pH	Alkalinity (ppm)
1.	A	Hand pump- Bank colony, Gajraula.	200	9.20	80
2.	B	Hand pumpTeacher's colony, Gajraula.	226	8.70	100
3.	C	Rain water-Kavi Nagar, Gajraula.	260	5.30	40
4.	D	Ditch-Basti, Gajraula.	670	8.20	150
5.	E	Drain water-Mda colony, Gajraula .	956	12.50	133
6.	F	Ditch-Mehal colony, Hasanpur.	867	10.60	140
7.	G	Hand pump-Lal Bagh Mohalla, Hasanpur.	320	6.90	50
8.	H	Drain waterRajput colony, Hasanpur.	450	11.3	90
9.	I	Hand pump- Kayasthan Mohalla, Hasanpur.	160	8.4	78
10.	J	Rain water-Block Wala Mohalla, Hasanpur.	110	6.50	54
11.	K	Hand PumpNaveen Nagar, Moradabad.	340	8.9	137
12.	L	DitchMadhubani, Moradabad.	760	8.0	143
13.	M	Ditch- Ashiyana1, Moradabad.	560	13.8	130
14.	N	Hand Pump-Jama Masjid, Moradabad.	210	8.6	67
15.	O	River-Ramganga Vihar. Moradabad.	650	4.7	90

Table 4 : Water standard of various parameters(in ppm):

Parameter	BIS Standards(BIS 2012)		WHO Standards (McGowan W; 2000)
	Desirable	Max. permissible	
Colour	5	30	-
Odour Taste	Unobjectionable	No problem	-
TA TDS	Agreeable	Agreed	6.4-9.0
$C1^-$	6.5-8.5	6.4-8.4	315
SO_4^{2-}	300	645	-
NO_3-	200	656	550
F^- , Ca^{2+}	300	1501	255
Mg^{2+}	250	1007	204
K^+	250	405	55
Na^+	45	46	0.6
NH_4^+	1.0	1.7	101
Phenol	75	204	151
B	30	102	205
Fe	-	-	200
			1.6

Conclusion

The present studies have been carried out to compare the pH, alkalinity and hardness of12 water samples from the surrounding of Moradabad and Gajrola. The water samples collected were studied for pH, alkalinity and hardness. The water samples showed a wide range of variation in pH, alkalinity and hardness of water. Out of 12 samples 5 samples are having pH below 7.00 and they varied from 6.2 – 6.8. This type of water is good for plants like rose plants but for drinking it is harmful as it enhances the acidity in the digestive system. 3 samples showed pH above 7.0 that 7.9, 8.3, and 8.5. The other three samples are having pH 7.4, 7.4, and 7.5. Such water is not bad for drinking.

Alkalinity also showed variation in the values. Five samples are having high level of alkalinity and such water is very bad for drinking as it disturb the physiology of the human body as well as bad for animals, fishes and other animals (Soyinka CN, 1980**).** The values are reported in the table -1. The water samples also showed variable values of hardness. The 4 samples were showing very high hardness. The 2 samples can be used for drinking, rest of the 6 samples are hard water as values are ranging from 120 -190 mg/l. The studies are very useful for the people, as they are informed about the quality of water. The calcium and magnesium concentration were found high. The traces of aluminum and ferrous salts were also determined by ion exchange method.

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