Analysis of pH Value of Water for Treatment Plant of Kekri and Surajpura (Rajasthan) India

Roop Singh Sinsinwar
Department of Civil Engineering, Bhagwant University

Verma, Munna
Department of Mechanical Engineering, Bhagwant University

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Analysis of pH Value of Water for Treatment Plant of Kekri and Surajpura (Rajasthan) India

Roop Singh Sinsinwar[1], Munna Verma[2*]
[1]Department of Civil Engineering, Bhagwant, University, India
[2]Department of Mechanical Engineering, Bhagwant University, India

*Author to whom correspondence should be addressed:
unibhagwant@rediffmail.com

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Abstract: The basicity and acidity of a liquid are measured in terms of pH value and neutral pH value of water is 7.0. Hydrochloric acid (HCl) is added to reduce the pH value of water and carbon dioxide is added to increase the pH value of water. Temperature is one of the most important parameters that affect the equilibrium and pH value of water. The value of pH should be 6.5 to 8.5 in permissible drinking water if its value is lower than 6.5 in the water, then sodium carbonate and above than 8.5 then citric acid can be found. The pH value of blood in healthy people is more or less than 7.42. In the current research work three water treatment plants with a size of 600 MLD, 142 MLD and 132 MLD was used for treatment of raw water of a dam located in Tonk district named as Bisalpur. Poly aluminium chloride (PAC) was used in these water treatment plants as a coagulant to accumulate suspended particles such as sand, clay and biological organic load. The results obtained nearby the neutralized pH value 7.0 in increasing trend between 7.35 to 7.45.

Keywords: PAC coagulant; water impurities; water treatment; pH level, Poly-aluminum chloride (PAC)

1. Introduction

Water treatment is a quite up to date practice. Firstly, different type of biological techniques designed in the early of 19th century [1)]. The increase of several industry branches has considered by enhanced people's lifestyle in various modes. However, many plants growth having started to release a huge amount of polluted water so that pH value of water present in a source changes day by day [2)]. The pollutants obtained from unprocessed agricultural industries and human being used (Domestic) waste water is responsible to water quality degradation[3,4)]. Wastage from the Mining operation and different industrial activities contaminate the fresh ground water reservoirs and may cause several skin and cancer related diseases.[5,6)].Therefore, it is necessary to find out new and efficient technique for water treatment to overcome above problems so that human lifestyle improve[7)]. The various methods for water treatment are shown in Fig.1.

The Acid and basic values of the water is measured by the pH value. The side effects of extreme pH value increase the irritation in eyes and rashes on the skin of body. Such side effect is appeared when the pH value more than 11. The problem of gastrointestinal and skin swelling is found when pH value of water found between 10-12 and when the pH of the water is falling below 6, irritation of the eyes and itching of the skin types disease occurs[4)]. pH value below than 2.5 can damage Epithelium[8)]. The corrosion resistance of metal and the ability to be corrosion potential efficiency depend on the pH value of water. pH of water can affect the corrosion of metals and disinfection efficiency. Its direct impact results on health of human and corrosively of the metal[9,10)]. PAC coagulant, a type of an inorganic coagulant has been extensively harnessed in the treatment of water due to its strong, coagulant and sludge recycle to bio products likely titanium oxide (TiO_2). To remove color, taste and turbidness of water, PAC as an Aluminum Sulphate is widely utilized for the treatment of water and the pH of the treated water remains unchanged.[11)]. PAC.

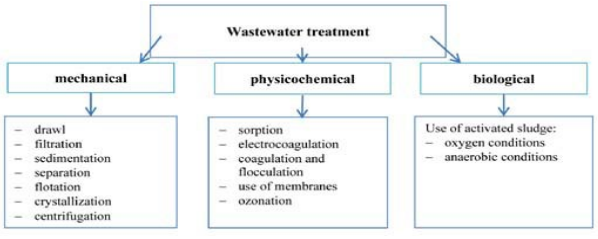

Fig. 1: Water Treatment Methods (Zajda and Kwaterczak, 2019).

coagulant (Poly aluminium chloride) having strong

coagulant property and sludge recycling to produce new titanium oxide (TiO_2) by products[10].

Pollution reduction is the key component of the supportable improvement. It is necessary to clean water for that nowadays technology that has changed the modern workplace and revolutionized the complete working process to the more friendly to the environment[12-14]. The Ozone disinfection method has been conducted in which water and waste water was diluted before the process[15,16]. The ultra-filtration process is the energy efficient and environment friendly[16].Water quality standard for the various processing industries, according to the ministry of environment has been observed between 5.5-9 pH value[18,19]. Protecting the environment is very important to minimize the negative impact[20]. In WTP, chlorine use to kill the pathogenic micro-organism [21]. Ozone used for disinfecting water in a wide range of pH[22]. Ozone eliminates odour of the inorganic substances likely sulphur, iron and manganese[23]. The tofu water is good source of vitamin B-12[24]. The TDS, TSS, turbidity, COD & BOD of tofu water as per norms are 2000 mg/l, 100 mg/l, 25 mg/l, 275 mg/l &175 mg/lit respectively[25]. The multi-filtration process consumes less energy than the ultra-filtration process in membrane prier Reverse Osmosis process. Furthermore, in the RO process, the produced water has already meet the requirement of Indonesian standard for discharged water[25].

Further, many water reservoirs throughout the globe suffers from oligotrophic and proliferation of algae which causes fatal impacts on human beings[26-28]. Therefore, it is necessary to recognize the driving factors of these identities in water body, so that corrective measures may be implemented.

2. Water Treatment Methodology

Three units of water treatment plants are considered for comparative analysis of pH value of water. The water treatment plant net purifying capacity 600 MLD located in Surajpura (Rajasthan) and two water treatment plants of Kekri with a capacity of 142 MLD & 132 MLD is selected for this research work. The Surajpura water treatment plant is based on modern pulsator clarifier Swiss Technology. Pulsator are installed compressor in middle in clarifiers, compressor pumps create vacuum and it is released after some fixed time in minutes as per pulsation of raw water and draw out sludge from pulsator. In Kekri Rajasthan, two water treatment plants consist four clarifiers with flocculator's, in each. In these WTD raw water enters at entry channel and after that it is distribute to all four-clarifier flocculator's Poly-aluminum chloride (PAC) liquid 13-19). Similar PAC liquid is used in all three plants. Pre chlorination is done by means of chlorine gas is being added at the entry point of receiving raw water as well as PAC dosage and after settling of flocks in the bottom of the clarifier, settling water impurities the clarifier raw water over topped in receiving channel for small V-notches fixed around the whole circumference of clarifier structure body. Aim of V-notches is increasing setting time in clarifier water collected from all clarifiers which is entered in a common channel that spread water on open sky rapid gravity type filter beds. Filtered water enters in pure water channel by adding post chlorination dosage in the water to make free from all microorganism and bacteria's and lowering the pH value as required.

3. Equations

for any neutral solution pH+pOH=14

The ion product of water, k_w , is the equilibrium condition for the self - ionization of water and is express as follow

$$kw=[H_3O^+][OH^+]=1.0X10^{-}14 \quad (1)$$

To Calculate the pH of an aqueous solution to the know the concentration of the hydronium ion in moles per litre (morality).

$$pH = -\log [H_3O^+] \quad (2)$$

$$H_3O^+ = 10^{-pH} \quad (3)$$

$$P^{OH} = -\log [OH^-] \quad (4)$$

$$P^{OH} = -\log_{10} [OH^-]$$

In pure water, a decrease in pH of about 0.45 occurs as the temperature is raised by 25^0C.

$$pH=pOH \text{ ions} \quad (5)$$

4. Results and Discussion

4.1 Control of pH of Raw Water

Raw water sources have taken some for each water treatment plant, but 600 MLD plant used direct water from the raw water reservoir dam located 6 km distance apart whenever 132 MLD and 142 MLD plant having raw water from reservoir to intermediate boosting located at village Thadoli at a distance of 35 km from Kekri filter plant.

From reservoir to an intermediate boosting station located at village Thadoli at a distance of 35 km from Kekri filter plant. When the water has pH value less than 6.5, then such water can be nuancing. In this way, the pipeline carrying such water and sources can generate dangerous metal from pipe etc. These deadly metals can be iron, zinc in water treatment to raise the pH of water the neutral level, sodium hydroxide and sodium carbonate is added to the water in excess, if the pH of the water is very less than sodium bicarbonate is added to raise the pH. Hence, to control the pH level of the water, if the water is acidic to treatment of water than soda ash and sodium hydroxide used to increase the pH near to neutral value.

The pH balance in water naturally some amount of squeeze of lemon or lime to make water more alkaline as human being digest properly it. Baking soda is also

added to lower the pH of the water. After filtration, treated water is collected in pure water reservoir for disinfection and removing micro-organism from filtered water. PAC coagulant is added to control pH value of water. To be correct of PAC coagulant is decided with the help of JAR test. Shown in Fig. 2 (APHA, 1989; ASTM, 1976).

Fig. 2: Image of flocculator.

The optimumum value of PAC coagulant dose is found 22mg/l for 600 MLD and 30mg/l for 142 MLD & 132 MLD water treatment plant. The pH should be 6.5-8.5 for drinking water. The variation of pH value of Raw water and treated water are shown in Fig. 3 and 4 for 600 MLD, 142 MLD and 132 MLD water treatment plants.

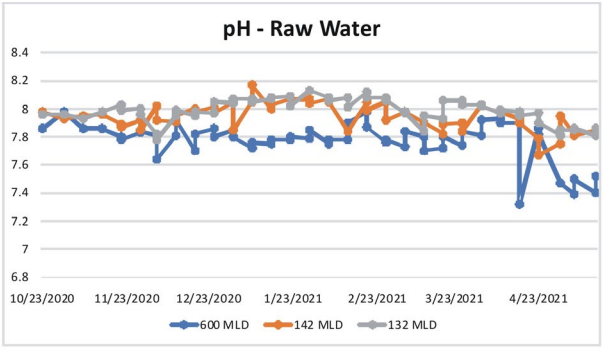

Fig. 3: Variation of pH value of raw water for 600 MLD, 142 MLD and 132 MLD water treatment plant.

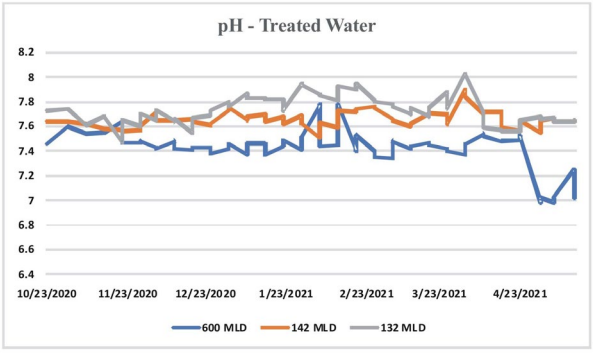

Fig. 4: Variation of pH value of treated water for 600 MLD, 142 MLD and 132 MLD water treatment plant.

From the Fig. 3 it is observed that, the 600 MLD water treatment plants, treated water pH value having nearer to neutral and 142 MLD water treatment plant, treated water pH results are higher than the 600 MLD water treatment plants and 600 MLD WTP is more efficient, reducing the pH value of treated water. The reason behind to get different value of pH is its used technique and place from which raw water is entered into the plant. The 600 MLD water treatment plant is based on Swiss technology. In this, the pulsator is used instead of flocculator but, 142 MLD & 132 MLD water treatment plants are based on flocculator technique. There is a sudden increase and decrease in pH value at various points as shown in Fig. 4, which is due to vegetation and temperature effect.

The chemical analysis was found satisfactory in water sample of raw water taken from Bisalpur Dam and shown in Table-1.

Table-1: Characteristics of raw water and treated drinking water.

S. no.	Characteristic of water	Values of Dam Raw Water	IS Code 10550-2012	
			Acceptable limit	Permissible limit
1	pH	7.9	6.50-8.50	No relaxation
2	Colour (Hazen)	5.0	5.00	15
3	Chloride (as Cl.) mg/l Max	60	250	1000
4	Fluorides (as F/mg/l) Max.	0.3	1.0	1.50
5	Nitrates (as NO3) mg/l Max.	2	45	No relaxation
6	Total dissolved solids (as TDS) mg/l Max.	320	500	2000

4.2 Effect of Temperature on pH Value

It has been observed that pH value is reduced by raising the temperature. In this study, clean (pure) water having an equal concentration of Hydrogen ions and Hydroxide ions. Now the water is just neutral at 100ºC, if the pH interchange. The pH of 6.13 is the new neutral value on the pH scale at the oppressive heat. The sweltering heat (temperature) plays a significant

character in pH measurement.

Table-2: Variation of pH with temperature.

S. No.	Temperature (^{0}C)	pH
1	0	7.46
2	25	7.01
3	50	6.64
4	100	6.13

Table-3: pH values of a solution at non-identical temperature.

S. No.	Property of liquid	pH at 0 ^{0}C	pH at 25 ^{0}C	pH at 50 ^{0}C
1	Acid	2.00	2.01	2.01
2	Neutral (water)	7.46	7.02	6.64
3	Basic	13.84	12.81	12.16

Table 2 shows the variation of pH with temperature. It has been observed that the pH of water at 0ºC is 7.46 and that at 100ºC is 6.13 for the same water. If the pH decreases with increase in temperature, water becomes acidic due to the temperature enhancement. In this case hydrogen ion can be less than hydroxide ions. The amount of hydrogen ions and hydroxide ions are equal at a temperature of 25 ºC. The pH of water is neutral at 25 ºC. A solution with a pH 7.0 at 0 ºC is a bit acidic because its pH has been a just lower than the neutral value of 7.46. The pH values of a solution at different temperature are presented in Table 3.

4.3 Effect of Variables on pH Value

When carbon dioxide gas is mixed with water, it forms weak acid. If acidic and alkaline rocks, coral and soil mixed than organic debris adversely affect pH level. Sodium and Calcium Hypochlorite will have a minor effect on pH level. Calcium hydrochloride is frequently used in treating potable water treatment plants. Air born can affect pH of water as can rock and clay. Chlorine gas radically also lowers the pH value of the water.

5. Conclusion

The pH is one of the important parameters to check the quality of water. Water purification in water treatment plants, clarification measurement of pH is essential in the process of water purification. A coagulant is used for water treatment like poly aluminium chloride (PAC) chlorine is used for disinfection. Chlorine is being used in the Surajpura and Kekri water treatment plants. The pH value from 6.5 to 8.5 values is acceptable for drinking water. In 600 MLD water treatment plant the value of pH is found in the range of 7.0 to 7.20 and both plants of Kekri (142 MLD & 132 MLD) the observed value found between the range from 7.73 to 7.75. Treated water obtained from all three plants is potable, non-corrosive, non-harmful to the consumer.

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Nomenclature

MLD	Million liter per day.
WTP	Water Treatment Plant.
RO	Reverse Osmosis.
UF	Ultra-filtration.
TSS	Total Suspended Solids.
TDS	Total Dissolved Solids.

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