A Study on Quality of Drinking Water Supplied Through Various Pipes

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Abstract— In the water sector during the last several decades, one of the most significant concerns has been the quality of the water that may be consumed. Changes in the water's physical state, its chemical composition, or its microbial makeup might bring to its degradation as it travels through the distribution system. The quality of the water that is being delivered may also be impacted by factors such as the material of the pipes and the breakdown of a disinfection chemical. In this study we have taken the water samples from various location throughout the distribution system and were checked for the all physical, chemical and biological characteristics. All the tests were carried out according to WHO standards. After all the tests were carried out then the results are compared with the WHO standards and were found safe.

Indexed Terms-- Pipe Distribution System, Pipe Materials, Chemical Parameters, Physical Parameters, Biological Parameters, Sampling, Setting.

I. INTRODUCTION

As 783 million people throughout the world still lack access to clean drinking water, providing drinkable water is one of the most significant millennium development objectives established by the United Nations (UN, 2012). Despite the fact that certain communities have easy access to improved water supply through piped supply systems, the quality of such water is sometimes inadequate, especially in developing nations. Microbiological quality is one of the most significant characteristics to consider among the various potable water quality parameters. Various disinfectants are used to maintain the microbiological purity of pipe-borne drinking water. Chlorine and chloramine are widely used for disinfection in areas where more costly non-chemical disinfection procedures, like as ionization, or UV treatments, are difficult to implement. Free chlorine is the most widely used disinfectant on the planet due to its cheap cost, consistency, and efficacy. Chlorine and chloramine, on the other hand, may degrade when treated water travels via distribution networks. Because iron pipes make up the majority of outdated water distribution systems in cities, especially in developing nations, this must be taken seriously. Due to internal corrosion, such ancient, unlined cast iron pipe lines contribute iron oxides to water, causing significant water quality degradation.

The proliferation of bacteria is unavoidable in a DWDS. Researchers have previously looked at the corrosion of old tubing by microbes in a variety of systems. Because of biological instability, bacteria thrive and reproduce, causing corrosion and a degradation in water quality in the DWDS. waterworks effluent is now chlorinated and disinfected, there is still a tiny quantity of bacteria present, and germs that are not destroyed by chlorine are more persistent. Furthermore, since the TDW contains organic debris, the bacteria in the water may utilize these organic resources for renewal and reproduction. Bacterial growth is aided by factors such as tube wall roughness, boundary layer effect, laminar flow zone, sedimentation of suspended matter and colloidal matter, corrosion, rust, calcium and magnesium scale formation, and so on, while bacterial reproduction is aided by factors such as tube wall roughness, boundary layer effect, laminar flow zone, sedimentation of suspended matter and colloidal matter, corrosion, rust, and the entry of external bacteria into the pipeline.

II. PLACE OF WORK

The impact of iron pipe corrosion on the residual chlorine in water will be researched utilizing various representative samples from the distribution systems, including the beginning sites and different home end points in the Jammu and Kashmir area. A 50 year old drinking water distribution system with iron tubes of the twin regins will be chosen for the field level examination, viz; Damjan Water Supply Anantnag. Three distinct water purifying systems (placed at Srinagar and Jammu) provide drinking water to this distribution system which comprises of badly corroded pipe lines. Representative samples from these sites encompassing the beginning points and various domestic end points will be obtained in duplicate.

FOR SAMPLING
1. Damjan water supply, Anantnag.
2. K.P Road Anantnag.

FOR TESTING: -
1. NIT Srinagar
2. Govt Degree College Anantnag.

III. OBJECTIVES OF THE STUDY

In a system in which the speciation of the chlorine relies on the pH of the water, the rapid conversion of free chlorine to an equilibrium mixture of chlorine, hypochlorous acid (HOCl), and hydrochloric acid (HCl) leads to the formation of hydrochloric acid. Therefore, free chlorine has the ability to oxidize ferrous ions, which results in the formation of ferric ions.
1. The efficiency of the process of disinfection is diminished when free chlorine, which is present in water, is consumed. As a result, the primary purpose of this investigation is to evaluate the effect that iron corrosion has on the process of disinfecting a cast iron water distribution system.
2. An investigation will be conducted to determine the level of free chlorine and the microbiological quality in an iron pipe system.
3. An in-lab research simulating an experiment will be carried out to assess the influence of dissolved iron on the amount of residual chlorine and the amount of microorganisms present in the water.

The other main objectives of the study are to determine the fallowing parameters:-
1. To determine the characteristics of water flowing through the various pipes .
2. To make the water wholesome .
3. To check the health and sanitation conditions of the distribution system .
4. To check the water quality parameters.
5. To study the contamination due to the rain .
6. Examine the differences in microbiological water quality between intermittent and continuous water distribution systems at service reservoirs, residential taps, and in the water that is consumed in houses.
7. Gain an understanding of, and locate evidence for, the factors that affect the microbiological water quality in piped water distribution systems that receive intermittent supplies of water.
8. Find ways to estimate water availability and losses in the distribution system, and utilize these estimates to develop techniques for quantifying water consumption in homes without water meters that get water on an intermittent basis.
9. in order to reduce secondary pollution and address the issue of red water, as well as to enhance the quality of drinking water.
10. To analyze the de-chlorination process of the water.

IV. METHODLOGY

The effects of dissolved iron on the level of residual chlorine in water will be investigated using a batch experiment. This experiment will involve the addition of known concentrations of free chlorine dilutions to a series of ferrous standards. The concentration of ferrous ions and the amount of free chlorine present in each of the solutions that were generated will be measured and tallied right away, and each experiment was repeated three times. Verification of the nature of the reaction between free chlorine and ferrous ions in water will be tested by first preparing a ferrous dilution series and a free chlorine dilution series, and then adding known amounts of free chlorine and ferrous ions to the above dilution series, respectively. This will be done while simultaneously evaluating the impact of iron corrosion in the disinfection process of a cast iron water distribution system. During the process of water purification, more chlorine of a greater concentration is added so that the appropriate amounts of residual chlorine may be maintained at the point of consumption. Despite this, an investigation will be carried out to determine whether or not there are enough quantities of residual chlorine available for disinfection throughout distribution. It is conceivable that the chlorine that was accessible in the iron pipes was consumed by the Fe2+ ions, and it is also plausible that the chlorine was used in order to battle any microbial contamination that may have been present along the distribution line as a result of seepage.

- Setting

The distribution pipe network of Dhmajan treatment plants serves as the setting for this research work that is being carried out. The entire area of the Dhamjan Water Works was sampled by collecting water samples at five distinct points or locations spread out across the facility. We have chosen this location in order to concentrate our attention on determining whether or not it is still possible to extract potable water from pipes that were installed in 1972 and have already outlived their thirty-year design lifespan.

- Sampling

Careful and conscientious collection of water samples for laboratory examination was carried out. The tap water from throughout the service area was used for the sample, while the water from the treatment plant was used for the control sample. Each sample was obtained using a white airtight container that held 2 liters of liquid. After letting the water from the tap run for a while, the container that will be sampled was given two thorough washings with the help of the sample that will be collected. Under the cover, there was a gap that was left open for air. The samples of water that were taken were promptly sealed in containers, labeled, and delivered to the laboratory after prior notification was provided. This was done so that the samples could be processed as quickly as possible.

CHEMICAL PARAMETERS

1. pH of water sample

Results

1. The pH value of the water sample taken from the distribution system is. 7.5.

2. Alkalinity of water sample

S.NO	VOL.OF SAMPLE (ML)	INITIAL BURRETE READING	FINAL BURRETE READING	DIFFERENCE
1	20	18.6	18	0.6
2	20	19.5	18.7	0.8
3	20	38.5	39.30	0.8
4	20	39.30	40.20	0.9
5	20	38.30	39.30	1.0

Results:-

a. The alkalinity of the water was measured using phenolphthalein, and the results were as follows zero.
b. A total alkaline reading of 41 mg/l was obtained from the sample of water that was collected.

V. EVALUATION OF THE ACIDITY

When attempting to quantify the volume of water required neutralizing a strong base to a certain pH, milliliters are the unit of measure of choice. There is a possibility that the acidity level is caused in part by hydrolyzing salts such as ferric and aluminum sulates, as well as by powerful mineral acids such as calcium hydroxide. It is very necessary for there to be acidity present. This is due to the fact that acid causes corrosion and has an influence on a variety of chemical and biological processes. In chemistry, this phrase is used to indicate the amount of base that is necessary to neutralize a particular sample to the desired pH level.

Description	Trail No	Burette Reading		Volume of NaOH Used
		Initial	Final	
Sampling	1	22.4	23.1	0.72
	2	23.2	23.9	0.73
	3	23.9	24.6	0.69
	4	30.75	31.5	0.75
	5	39.80	40.60	0.80

Results:-

1. Acidity in mg/L as $CaCO_3$ = 7.1 mg/l

4. Chloride content

Adding silver nitrate solution to chloride-rich water precipitates out the chlorides as white silver chloride, which is toxic. Chromium is delivered to the system by potassium chromate, which is utilized as an indicator. Until a reddish brown silver chromate precipitate is produced, it is important to lower the chloride ion concentration to the point where the maximum concentration of chloride ions is obtained.

Description	Trail No	Burette Reading		Volume of silver Nitrate(ML)	Chloride in mg/L
		Initial	Final		
Sampling	A	7.00	14.20	7.20	179.94
	B	19.20	26.20	7.00	174.94
	C	26.20	33.40	7.20	180.00
	D	16.10	24.20	8.10	202.44
	E	24.20	32.20	8.00	200.00

Calculations:-

$$\text{Chloride in Mg/L} = \frac{(V1-V2) \times N \times 35.46 \times 1000}{V}$$

Result:-

1. The amount of chloride that is present in the water sample = 187.46 mg/l

4. Hardness of Water

The quantity of divalent metallic ions present in water is the primary factor that determines its hardness. Calcium and magnesium are the two elements that are primarily responsible for the hardness of the water. Iron (Fe^{2+}), strontium (Sr^{2+}), zinc (Zn^{2+}), manganese (Mn^{2+}), and several other ions are some of the other elements that contribute to the hardness of the water. The concentrations of calcium and magnesium, on the other hand, are almost always much higher than the concentrations of the other two elements. Calculating the water's hardness by adding up the calcium and magnesium levels is, in the vast majority of instances, sufficient

Observation table:-

Details of parameter	Vol. of sample (ml)	Initial reading	Final reading	Vol .of EDTA (Ml)
Total hardness	20	9.20	10.10	0.90
		10.20	11.20	1.0
		4.20	6.10	1.90
		6.10	8.10	2.0
Calcium hardness	20	6.0	6.5	0.5
		7.2	7.85	0.65
		0	1.4	1.4
		1.4	2.75	1.35

Results :-

1. The total hardness expressed as milligrams per liter of $CaCO_3$ is 58.5
2. The calcium carbonate crystal structure has a relative hardness of 39.0 mg/l
3. The hardness of magnesium is 19.50 mg/l

PHYSICAL PARAMETERS

1. Turbidity
   Results :-
   The Level of Cloudiness in the Selected Water Sample = 0.02NTU
2. Color
   Results :-
   The color of the water sample = 3 TCU
3. Temperature
   Results :-
   The temperature of the water sample that had been collected was 15 degrees Celsius

VI. CONCLUSION

Within a period of 25 days, the water quality change in the DCI is the most notable, and the color could reach up to 10 on the 8th day, and was maintained at 4 in later stages: the turbidity, pH, and TOC also increase at the same time, and the decline of residual chlorine and total chlorine was also noticeable. Conductivity was consistently maintained at a level that was more than 0.15 mS cm1. The inner wall of the DCI transformed from having the shape of a loose porous particle to that of a rather dense, irregular three-dimensional shape; the components that made up the DCI were mostly composed of oxygen and calcium. The SS inner wall in the early stage, but in later stages there were evident spherical balls of unequal size visible, and the elemental makeup of the SS inner wall was mostly composed of carbon and oxygen. In the early stage, the inner wall of the HDPE was smooth and had a few tiny holes. In the middle and late phases, however, these perforations became larger and became more scale-like and rough. When compared with previous studies, the percentage of Proactive bacteria found in the effluents showed a significant rise from 72.82 percent to 86.87 percent.

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