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Quality Analysis of Drinking Water: A Case Study of PCMC, Pune

Mr. Ranjeet Sabale[1], Mr. Mayur Shinde[2], Jagruti Pagar[3], Satyajit Adsule[4], Mohammad Shaikh[5], Krushna Bhadke[6], Shubham Joshi[7], Pravin Kolhe[8].

[1, 2, 3, 4, 5, 6, 7,8]*Assistant Professor Civil Engineering Department, Dr. D Y Patil Institute of Engineering Management and Research Akurdi Pune (MH) INDIA*

Abstract: Water is crucial factor in our life. It is one of fundamental needs of human being. As far as our health is concerned the water should be fit for drinking, it should not contain any undesirable substances rendering it unfit for drinking and domestic use. For such water we have to depend on sources of water such as Water Treatment Plant, river, lake, well etc. but to make it up to the standards of drinking water it should be treated1. In big cities municipal corporation supplies water to the people after treating it in treatment plant. In pimpri & chinchwad city PCMC treats and supplies water to city. Corporation divided city in 46 sectors to distribute water. Samples were collected from each of these sectors and conducted various tests such as hardness test, chloride content test, etc. To examine the contamination of water at tap sources. In this study it was found that the water is pure upto all standards except residual chlorine in certain sectors. So it is concluded that what care should be taken for distribution to such sectors. ***Keywords: pH Test, Alkalinity Test, Chloride Test, Total Dissolved Solids, Total Hardness Test, Residual Chlorine Content.***

I. INTRODUCTION

Water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As of now only earth is the planet having about 70 % of water. But due to increased human population, industrialization, the use of fertilizers in the agriculture and man-made activity, it is highly polluted with different harmful contaminants. Water should be free from the various contaminations while supply is done as well as all its parameter like pH, alkalinity, Total Hardness, Chloride, residual chlorine, Total Solid, turbidity, color, odor, taste etc. should be within a permissible limit by taking tab water samples from different areas. Safe drinking water is essential for human existence. Hence, the right to adequate drinking water is considered as fundamental human right (Ramachandraiah C. (2001), Kanmany J.C. (2003)). The proportion of urban population of India is projected to increase from 28 per cent of the total population to about 38 per cent in 2026.The current state of supply of core services in the urban areas, viz, water supply, sewerage, solid waste management and street lighting, is inadequate by any standards. The higher growth of urban population will add further pressure on provision of these services (MoF 2009). The growth of urbanisation is higher in Maharashtra. The government has promoted industrialization due to such policy automobile, engineering, electronic, information technology (IT) and biotechnology industries have grown fast. Such industries have created huge employment opportunities in the state. Therefore immigration of the indigent rural labour and qualified professionals from other states took place. Along with the production and manufacturing, the growth of services sector also occurred in the state. The BPO, call centres", banking, and insurance companies have opened their corporate offices and grown significantly in terms of numbers. The abandoned industrial sights are getting converted into residential locations. Township planning and low cost vii affordable housing is developed for growing population. Urbanisation is putting more pressure on the existing civic amenities in all the municipal corporations.

II. LITERATURE REVIEW

In this research work, Physico-Chemical characteristics of Khadakwasla reservoir near Pune were monitored by Nagamani.c (2015), Kumar nitin (2013) for Physico-Chemical parameters like temperature, pH, electric conductivity, Sodium, Potassium, Calcium, Magnesium, Silica, Iron, Bicarbonate, Chloride, Sulphate, Nitrate, Phosphate, dissolved Oxygen, biological Oxygen demand & chemical Oxygen demand. These parameters were analyzed by collecting water samples at 4 different locations of reservoir from July-2005 to Jan-2006. From this study, it is observed that there is a seasonal variation in concentration of Physico-Chemical parameters & some of parameters are beyond permissible limit, which shows degradation of water quality due to pollution. According to the research topic of Omran .A. (2011) pollution analysis of water in lime industry area by Shaskikant R, Reveals the facts that lime is used in industrial & mining, waste water treatment. It neutralizes acid waste, adjusting pH, removes Phosphorous, fluorine, Magnesium & organic matter & it precipitates heavy metals. In fact lime treats potable & industrial water supplies including drinking water which disinfects bacteria. Because of this the contamination occurs in a water supply system and it makes water polluted. Another research work deals with the physico chemical analysis of characteristics of bore wells at Himalaya Vishwa residential area by Logsdon. G. S.(2006), Wardha. The physico chemical tests were conducted employing standard scientific methods like conductivity, calorimetry, pH metry, heavy metal analysis etc, In the present study the water samples shows colorless, odourless & agreeable & hence water can be considered for human consumption. In the study of the assessment of ground water quality in Kokrajhar district of Bodoland territorial council by Mane. A. V. (2015) Assam, it is observed that values of most of the parameters are within the WHO permissible limit. The ground water is very rich in iron (>0.3 mg'l) & is not suitable for drinking & laundering. So many factor like the absence of scientific drainage system, poor sanitary system, presence of stagnant water, unhygienic conditions e.tc, are causing water quality degradation & these causes have to be eliminated to maintain the quality of water & get relief from the fatal diseases.

III. METHODOLOGY

A. Desk study.
B. Analysis of water sample (physico-chemical properties).
C. Mapping of affected areas.
D. Measurements of seasonal variation by comparing physico-chemical parameters.

Sampling: The value of any laboratory results depends on the sampling integrity of sample. The object of sampling is to collect a portion of water small enough in volume to be conveniently handled in the laboratory. It must be collected in such manner that nothing is added or lost in portion collected and no change occurs during the time between collection and laboratory examination. Unless this conditions are met, laboratory results may be misleading and worse than no results. Types of Tests: pH Test b) Alkalinity Test c) Chloride Test d) Total Hardness Test e) Acidity f) Turbidity g) Residual Chlorine h) Conductivity i)Fluoride

1) *pH:* The pH was determined using ELICO-LI 127 pH meter. The pH of water sample was directly determined with the electrode while pH of the sediment sample was determined by preparing (1:5, sediment: water) suspension in distilled water. The contents were stirred well and allowed to settle and supernatant was used to check pH.
2) *Electrical Conductivity (EC):* EC of the water samples and sediment suspension was measured by using ELICO EC-TDS meter (CM 183, Make-India) where electrode was directly dipped into the respective solutions for the direct display of result on a digital scale. It was reported in micro Siemens (µS). The clear supernatant used for pH was also used for EC measurement.
3) *Alkalinity of Water sample:* 100 ml of water sample was mixed with 2-3 drop of phenolphthalein. The development of pink colour to the solution indicated the presence of alkalinity and was then titrated with 0.02N H_2SO_4 till the colour disappears.

$$\mathbf{Alkalinity = B \times N \times 50 \times 1000 Volume\ of\ Sample}$$

4) *Total Hardness of Water sample:* The total hardness of the water samples was determined by EDTA titration method where 50 ml of well mixed sample was mixed with 1-2 ml buffer of pH 10 and a pinch of Eriochrome black-T indicator. The contents were then titrated with0.01M EDTA till wine red solution changes to blue.Where C=ml of EDTA for titration, D= mg of $CaCO_3$equivalent to 1ml of EDTA

$$\mathbf{Hardness(mg/l) = C \times D \times 1000 Volume\ of\ Sample}$$

5) *Residual Chlorine:* When chlorine is added to water, some of the chlorine reacts first with inorganic and organic materials and metals in the water and is not available for disinfection (this is called the chlorine demand of the water). After the chlorine demand is met, the remaining chlorine is called total chlorine. Total chlorine is further divided into: 1) combined chlorine, which is the amount of chlorine that has reacted with inorganic (nitrates, etc.) and organic nitrogen-containing molecules (urea, etc.) to make weak disinfectants that are unavailable for disinfection and, 2) Free chlorine, which is the chlorine that is left over and is available to inactivate disease-causing organisms; it is a measure of the potability of the water. Thus, total chlorine equals the sum of the combined chlorine and free chlorine measurements. For example, if using completely clean water with no contaminants, the chlorine demand will be zero, and since there will be no inorganic or organic material present, no combined chlorine will be present. Thus, the free chlorine concentration will be equal to the concentration of chlorine initially added. In natural waters, especially surface water supplies such as rivers, organic material will exert a chlorine demand, and inorganic compounds like nitrates will form combined chlorine. Thus, the free chlorine concentration will be less than the concentration of chlorine initially added (Free chlorine = Total chlorine measurement – Combined chlorine measurement).

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6) *Chloride:* Chloride in the form of chloride (Cl-) ion is one of the major inorganic anions in water and wastewater. The chloride concentration is higher in wastewater than in raw water because sodium chloride is a common article of diet and passes unchanged through the digestive system (Average estimate of excretion: 6 g of chlorides/person/day; additional chloride burden due to human consumption on wastewater: 15 mg/L). Along the sea coast chloride may be present in high concentration because of leakage of salt water into the sewage system. It also may be increased by industrial process. In potable water, the salty taste produced by chloride concentration is variable and depends on the chemical composition of water. Some waters containing 250 mg/L Cl- may have a detectable salty taste if sodium cation is present. On the other hand, the typical salty taste may be absent in waters containing as much as 1000 mg/L
7) *Fluoride:* Wash the measuring cylinder, test-tube and cork Rinse the measuring cylinder, test-tube and cork with a little bit of the water sample to be tested Shake the measuring cylinder, test-tube and cork to remove as much of the residual water as possible. Measure 4 ml of the water sample using the measuring cylinder. Keep the measuring cylinder at eye level to avoid parallax error Transfer this 4ml into the test-tube Put 15 drops of the fluoride reagent into the test-tube that has the water sample Cork the test-tube and shake it gently so that the reagent mixes uniformly with the water sample You will notice a change in the colour of the water sample Compare the colour of the water sample with the colours on the chart in the kit Against the water sample details (date/time/location) make a note of the level of fluoride mentioned against the closest colour on the chart Empty the contents of the test-tube in the sink and wash the test-tube, cork and measuring cylinder thoroughly You are now ready to test the next sample of water.
8) *Acidity*: 25 mL of sample is pipette into Erlenmeyer flask. If free residual chlorine is present, 0.05 mL (1 drop) of 0.1 N thiosulphate solution is added. 2 drops of methyl orange indicator is added. These contents are titrated against 0.02 N hydroxide solution. The end point is noted when colour change from orange red to yellow. Then two drops of phenolphthalein indicator is added and titration continued till a pink colour just develops. The volumes of the titrant used are noted down. where, A = mL of NaOH titrant B = normality of NaOH V = mL of the sample.

Acidity in mg/L as $CaCO_3$ = A x B x 50,000/V

9) *Turbidity:* The meter should be switched OFF.Open the test chamber cover and Insert the testing bottle completely into the chamber.Line up the white mark of the testing bottle with the white mark on the edge of the test chamber.Close the chamber cover and lock it in place.Press the "POWER" button to turn on the meter,Momentarily press the "TEST" button. The display will flash "TEST" for approximately 10 seconds and then the turbidity value, in NTU units, will be displayed.Momentarily press the OFF button to turn off the meter.

IV. RESULTS

Table No. 1 : Monsoon Readings

Sample No.	PH	Alkalinity (mg/l)	Acidity	Residual Chlorine (mg/l)	Chloride (mg/l)	Hardness (mg/l)	Turbidity (NTU)	Flourides (mg/l)	Conductivity (us)
1.	7.98	192.07	0.013	0.4	36.43	156.25	7.4	0.27	183.2
2.	7.85	187.04	0.024	0.2	34.7	163.4	5.6	0.18	145.78
3.	7.62	186.57	0.032	0.3	35.24	166.51	5.9	0.32	165.66
4.	7.78	185.68	0.045	0.5	32.8	158.7	6.4	0.28	179.32
5.	7.97	184.28	0.023	0.2	35.92	160.87	5.1	0.22	157.98

Table no. 2 : Post Monsoon Readings

Sample No.	PH	Alkalinity (mg/l)	Acidity	Residual Chlorine (mg/l)	Chloride (mg/l)	Hardness (mg/l)	Turbidity (NTU)	Flourides (mg/l)	Conductivity (us)
1.	6.56	127.69	0.08	0.1	24	47.7	3.3	0.58	192.43
2.	7.36	126.36	0.019	0.3	21.7	53.09	2.6	0.74	190.6
3.	6.89	125.8	0.16	0.5	29	60.36	2.4	0.69	196.2
4.	7.2	129.63	0.036	0.2	28.8	57.83	3.5	0.45	197.06
5.	7.34	124.06	0.12	0.4	25.01	60.0	3.6	0.61	195.79

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V. CONCLUSIONS

Detailed analysis of chemical parameters of Drinking Water during Monsoon and Post Monsoon has been carried out. A few of the significant conclusions drawn are as follows.

A. Variations in Alkalinity.
B. Variations in Turbidity.
C. Variations in Hardness.
D. Variations in Chloride content. Above changes has been observed due to leakages and contamination in water supply system.

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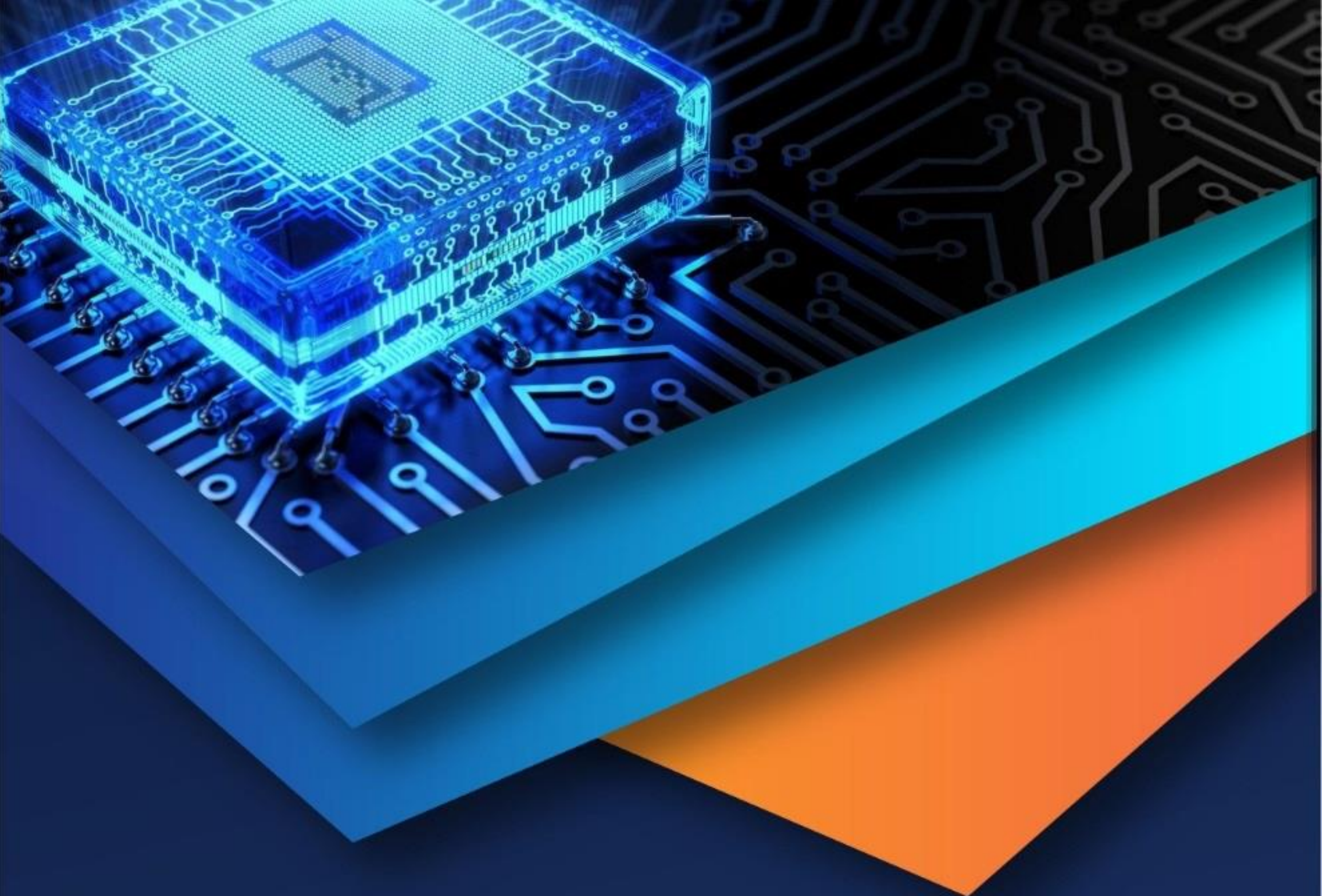

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