Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 08, August-2019

Analysis of Water Quality Parameters at Tap water and Treatment for its Improvement in Kolhapur

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Abstract- **Water is the most crucial natural resources discovered on land. Safe and clean water are one of the most enormous resources vital to the survival of all sentient creatures. The essence of water can be inspected by focusing its physico-chemical characteristics. Deterioration of water quality could be due to pipe corrosion and triggering persistent leakage and cracking in which the E-coli degraded water flowed into the pipe expropriation configuration. In this respect, a thorough physical and chemical analysis of drinking water specimens was performed in a territory of 'A' ward of Kolhapur city of Maharashtra state. The present research paper outlines the relevance of investigating different water quality parameters of tap water assessments.**

Keywords- Water Quality Parameters, Drinking Tap Water, Water Distribution Pipe Network, Water Quality, Water Supply.

I. INTRODUCTION

Water is an unusual worthy source which is the fundamental necessity for presence of each sentient creature. The WHO (2000) discovered that 75% among all ailments in creating nations rise from polluted drinking water. Water quality concerns are as often as possible the most huge fragment for evaluating access to improved water sources. Tasteful quality exhibits the prosperity of relishing water terms of its physical, compound and biological parameters.

In a modern society, water is something in life we frequently underestimate. When we turn on the tap, we expect water to be pure, safe and reasonable for all family unit undertakings. In any case, as of late, it seems like there's a developing worry about pollution of our water supplies. We hear agitating news accounts that make us question the wellbeing of our water. In this examination, undertakings were made to look at the samples gathered at random points and its investigation.

Provision of drinking water ought to plainly be fit for human use, for instance of consumable quality and they should be worthy, for instance elegantly engaging. The emotional target of consumable water scattering is to defend the ideal excellence across the system during the movement time.

The study will be completed on examination of specific physiological-chemical configuration water from tap tests of Kolhapur city's 'A' ward region. The points of sampling were chosen with the goal that it can cover a piece of 'A' ward zone of Kolhapur city. In Kolhapur city, there are various wards which are under Municipal Corporation in this manner all the open water supply frameworks in such specific zones are kept. In the region of A ward of Kolhapur city, 50% of public water regime is through Balinga WTP and staying 50% is provided through Puikhadi WTP which are lifted from Bhogavati river. The principle objective of the exploration is to improve access to water supply frameworks of specific territory by surveying current services and flow benefits that give spotless, healthy water to families. In several instances, frequency of pollution in pipe borne water could be greater to such an extent that isn't fitting to drink water legitimately from tap.

II. METHODOLOGY

Experimental Section-

1. **Study Area:-** Kolhapur is most seasoned and socially noteworthy urban communities of Maharashtra, India, lying along the side of river Panchganga. Kolhapur has flourished with the good quality of environment. Kolhapur city located 574 meters above mean sea level, is spread across an area of 66.82 km^2 and situated between $16^0 46'$ and $16^0 39'$ North and $74^0 11'$ and $74^0 17'$ East longitude. Kolhapur city covers area of about 6682 hectare. In Kolhapur municipality there are 5 wards namely, A, B, C, D and E. From which in the vicinity of A ward of Kolhapur city, 50% of the municipal water program passes through Balinga pumping station and remaining 50% is provided through Puikhadi which are lifted from Bhogawati river. **Puikhadi WTP:-** It is situated at Puikhadi, 14 km. away from Shingnapur siphoning station. This plant is ongoing plant set up by KMC and began working in 2001. Current capacity is about 50MLD.
   Balinga water treatment plant:- This water works authorized in the year 1949 with the limit of 10.90MLD which was expanded by giving growth plans. Presently the complete limit of it is 43MLD and the wellspring from Bhogawati waterway.
2. **Parameters and Methods of Determination:-** The physical, chemical and bacteriological parameters analyzed (expressed in mg/L) and the methods used for evaluation are as follows:-

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Sr.No.	Parameter	Method/Instrument
1.	pH	pH-meter
2.	Turbidity	Nephelometer
3.	Total Dissolved Solids	Aquasol Digital Pen Type Meter
4.	Total Hardness	EDTA Titrimetric method
5.	Alkalinity	Titrimetric method(H_2SO_4)
6.	Chloride	Titrimetric method ($AgNO_3$)
7.	Nitrate	UV- Spectrophotometer (220nm & 275nm)
8.	Sulphate	UV- Spectrophotometer (420nm)
9.	Calcium	EDTA Titrimetric method
10.	Potassium	Flame Photometric method
11.	Phosphate	UV- Spectrophotometer (nm)
12.	Nitrogen	Kjeldahl method (TKN)
13.	Total Coliform	Bacteriological method
14.	Magnesium	EDTA Titrimetric method
15.	Sodium	Flame Photometric method

Table 1– Parameters and Method used for Determination

3. **Sampling:-** Water tests were taken from sources of tap water for audit. Test was accumulated in a white 5 liters hermetically fixed compartment and some were assembled in 1litre holders. The example to be accumulated was to flush the holder / bottles twice after the tap water was allowed to continue running for a longer period. A space for air was left under the spread. The water taken were immediately verified, checked and sent to the research facility due notice being as of late given all together that they may be overseen right away. Faucet water tests were gathered from eight unique areas in morning and evening sessions.

Sampling Points - Eight distinct locations were shortlisted from A ward area of Kolhapur town for this research work. Namely, rajrachana nagar (ghatage colony), shivaji nagar, rachanakar society (colony), sardar park, jaldarshan colony, jay bhavani colony, shri krishna colony and nikam park. Tapwater extracts were obtained from these eight places for analysis.

Water Supply Management in Kolhapur:-

KMC delivers approximately 120 to 130 MLD (million liters per day) of water to Kolhapur City with an estimated average per capita supply of nearly 135 LPCD (liters per capita per day). This involves water for domestic, commercial, floating populations, fire fighting, industrial and institutional use and so on. The water comes primarily from the 4 jack wells installed by KMC, which have a mixed capacity of 137 MLD to lift water specifically from rivers Panchganga and Bhogawati, which would be around 1 to 2 km from the city.

Table 2 - Existing water sources and their capacities for Kolhapur city.

Sr.No.	Name of Water Treatment Plant	Capacity (MLD)
1.	Puikhadi	50
2.	Balinga	43
3.	Bawda	36
4.	Kalamba	8
	Total	**137**

Water Supply Status - There are in all 28 storage reservoirs, 20 ESR's (Elevated Storage Reservoirs) and 8 GSR's (Ground Water Reservoirs) with a total capacity of about 53 Million Litres.

Table 3 - List of ESR's and GSR's and their capacities in 'A' ward area of Kolhapur city.

Sr. No.	Name	Ward	Type	Capacity(Lakh Litres)
1.	Salokhe Nagar	A	ESR	22.5
2.	Apte Nagar	A	ESR	18
3.	Kalamba Filter House	A	ESR	18
4.	Phulewadi	A	ESR	15
5.	Padmavati	A	ESR	5
6.	Puikhadi Filter House	A	ESR	5
7.	Chambulhadi	A	GSR	95
8.	Puikhadi	A	GSR	70
	Total			**248.5**

Data Source: City water supply and Drainage Division, KMC.

Water Distribution Pipe Network –

Once the water gets treated at the treatment plants, it is supplied to city through pipelines. The distribution network is segregated into 22 zones. Out of 140,748 households in Kolhapur city, around 89% (125,505) of the households are connected with water supply lines of about 600km in length. The piped water in all wards indicates presence of coliform bacteria because of contaminations in the distribution system.

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Table 4: Ward wise water distribution in Kolhapur urban area.

Ward	Area (Sq.Km.)	Supply water (MLD)
A	9.9	25 MLD
B	10.2	25 MLD
C	2.4	20 MLD
D	2.9	20 MLD
E	41.4	70 MLD

Source: Kolhapur Municipal Corporation.

Analysis of Physico-Chemical And Bacteriological Parameters:-

Table 5-Pre-Monsoon Sampling Analysis:-

Sr.No.	Parameters	Unit	Samples							
			1	2	3	4	5	6	7	8
1.	pH	-	8.06	7.76	8.02	7.66	8.01	8.66	8.02	7.89
2.	Turbidity	NTU	0.96	0.98	0.94	0.99	0.97	0.99	1.4	1.2
3.	TDS	mg/L	110	95	110	98	120	115	54	115
4.	Hardness	mg/L	180	140	70	62	180	170	60	160
5.	Calcium	mg/L	32	30	28	32	34	40	23.2	34
6.	Magnesium	mg/L	24	28	30	25	27	35	29	26
7.	Chloride	mg/L	12	10	15	12	17	26	27	15.4
8.	Alkalinity	mg/L	112	110	120	115	111	119	100	112
9.	Nitrate	mg/L	0.55	1.10	0.48	1.59	08	06	6.42	5.2
10.	Sulphate	mg/L	03	02	05	04	08	07	11.2	06
11.	TKN	mg/L	15	18	14	17	13	20	20	22
12.	Sodium	mg/L	05	04	07	09	04	05	06	08
13.	Potassium	mg/L	05	08	03	09	07	4.42	5.13	6.90
14.	Phosphate	mg/L	02	1.25	2.12	2.80	2.67	4.34	2.65	3.25
15.	TSS	mg/L	02	04	1.90	07	06	5.99	07	6.98
16.	Total coliform	MPN/100 ml	25	20	22	22	26	21	27	23

Table 6-Post-Monsoon Sampling Analysis:-

Sr.No.	Parameters	Unit	Samples							
			1	2	3	4	5	6	7	8
1.	pH	-	7.06	7.79	8.26	7.46	7.78	8.02	8.02	7.89
2.	Turbidity	NTU	1.96	0.99	1.26	3.37	1.16	2.25	0.99	2.99
3.	TDS	mg/L	107	90	98	96	120	97	61	117
4.	Hardness	mg/L	170	177	178	79	175	169	76	177
5.	Calcium	mg/L	29	35	30	31	31	28	30	36
6.	Magnesium	mg/L	27	27	22	27	27	20	26	27
7.	Chloride	mg/L	15	10	11	16	15	10	14	18
8.	Alkalinity	mg/L	115	111	110	118	119	108	117	115
9.	Nitrate	mg/L	0.60	0.71	0.59	0.60	0.61	0.48	0.62	0.59
10.	Sulphate	mg/L	05	05	05	05	04	05	05	06
11.	TKN	mg/L	17	16	17	18	18	11	19	20
12.	Sodium	mg/L	09	07	04	08	07	04	04	09
13.	Potassium	mg/L	08	02	03	06	09	08	03	07
14.	Phosphate	mg/L	04	1.87	2.75	1.99	03	3.96	2.97	3.1
15.	TSS	mg/L	02	06	1.90	07	06	04	03	05
16.	Total coliform	MPN/100 ml	14	20	27	15	27	19	Nil	Nil

Graphical representations of analyzed parameters -

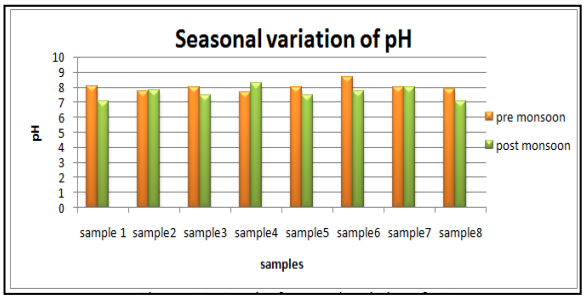

Fig.no.1- Graph of seasonal variation of pH

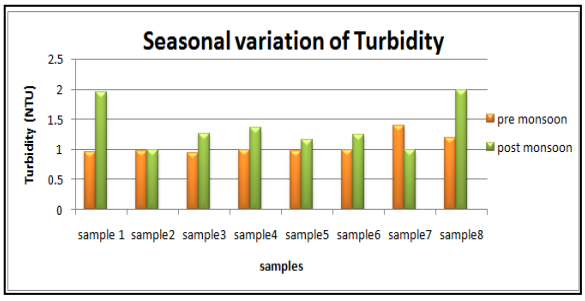

Fig.no.2 - Graph of seasonal variation of Turbidity

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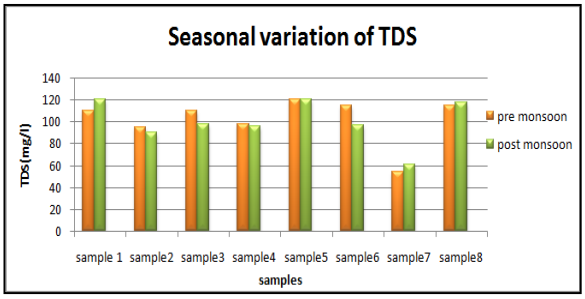

Fig.no.3- Graph of seasonal variation of TDS

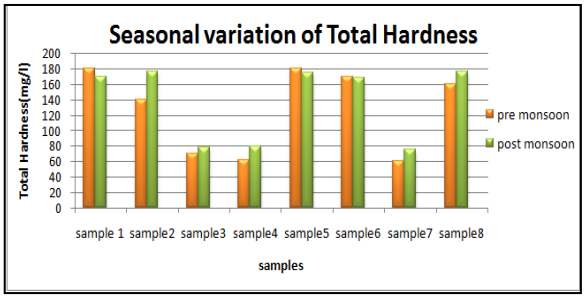

Fig.no.4- Graph of seasonal variation of Total Hardness

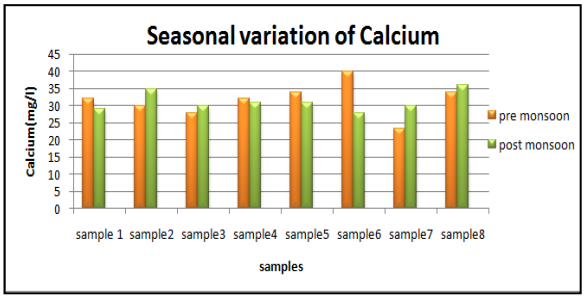

Fig.no.5- Graph of seasonal variation of Calcium

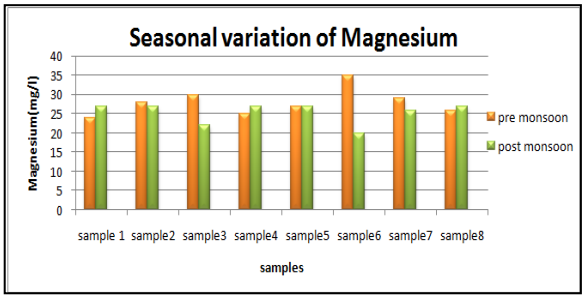

Fig.no.6- Graph of seasonal variation of Magnesium

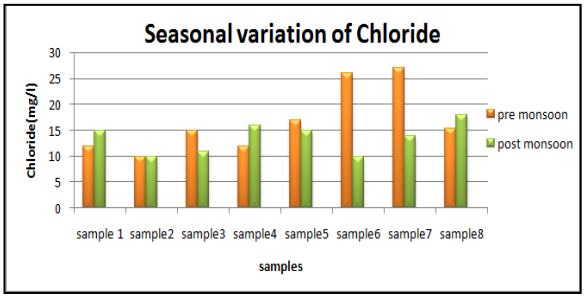

Fig.no.7- Graph of seasonal variation of Chloride

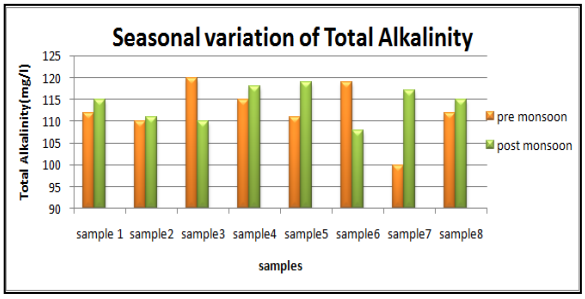

Fig.no.8-Graph of seasonal variation of Total Alkalinity

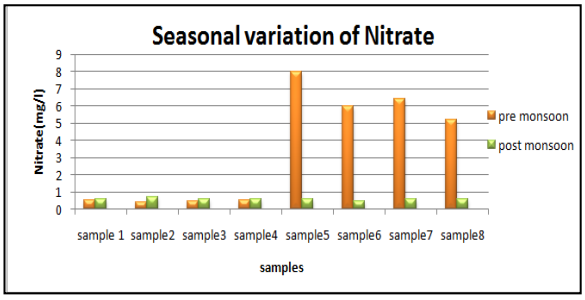

Fig.no.9-Graph of seasonal variation of Nitrate

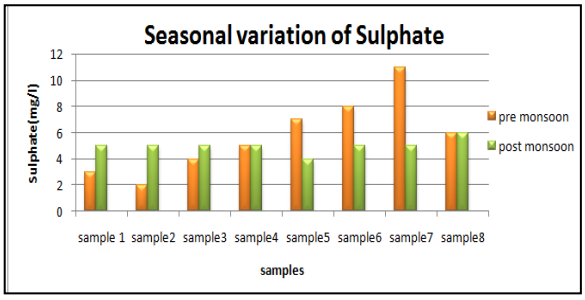

Fig.no.10 -Graph of seasonal variation of Sulphate

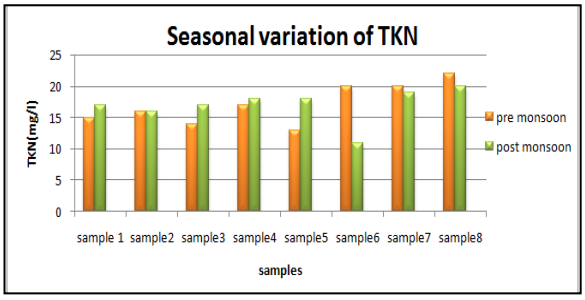

Fig.no.11 -Graph of seasonal variation of TKN

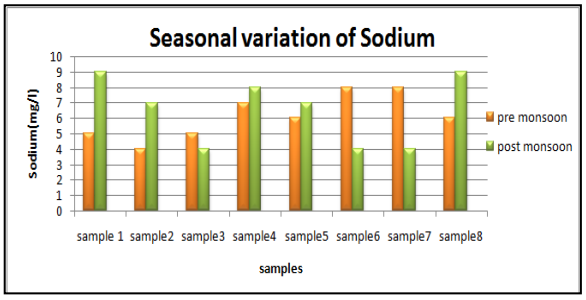

Fig.no.12 -Graph of seasonal variation of Sodium

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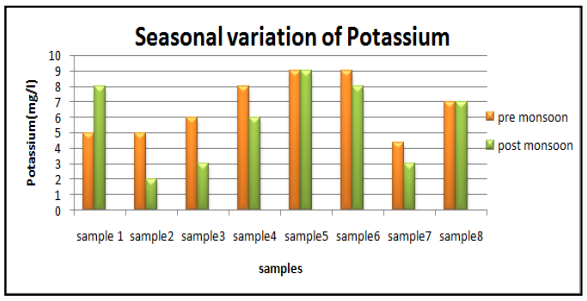

Fig.no.13-Graph of seasonal variation of Potassium

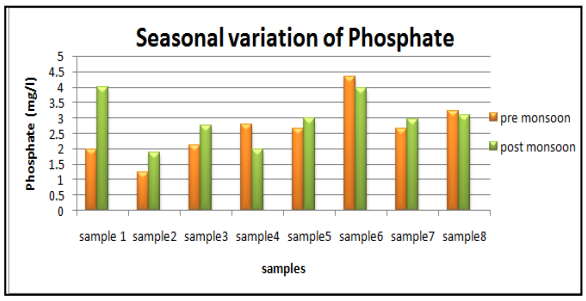

Fig.no.14 -Graph of seasonal variation of Phosphate

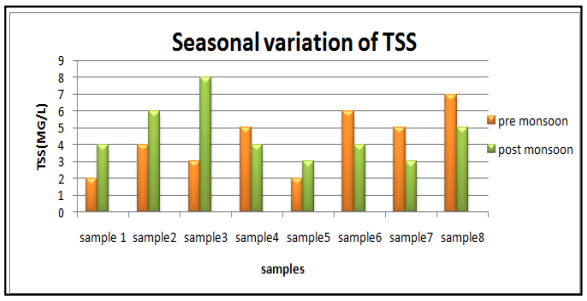

Fig.no.15 -Graph of seasonal variation of TSS

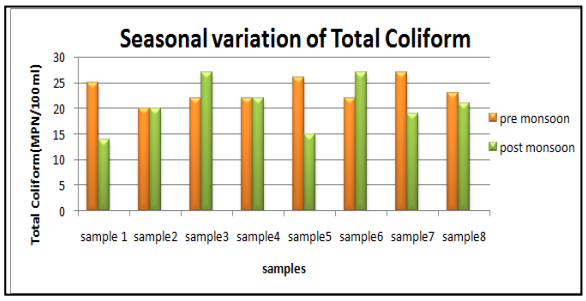

Fig.no.16 -Graph of seasonal variation of Total Coliform

III. RESULTS & DISCUSSIONS

1. **pH-** It is proportion of the grouping of hydrogen ions in water, mirroring the acidic or alkaline state of water. Neutral water has a pH of 7.0. Any unsettling influence from this worth prompts water being acidic (pH < 7.0) or soluble (pH > 7.0) because of imbalance in H+ and OH-ions concentrations. Generally, most periodic waters are alkaline in enormous quantities. Changes happen because of natural movement, modern waste transfer etc. Thusly, pH has no direct unfriendly impact on strength of living systems. A pH beneath 6.5 starts erosion in pipes while higher pH esteems incites scale arrangement.

   The pH generally varied in a range from 7.06 to 8.66 overall considering all the places of study which are in a desirable limit given by WHO.(6.5-8.5) The seasonal variation of the pH values is shown in the table no. 5 and 6 and is graphically represented in the figure no.1.

2. **Turbidity -** Turbidity is because of particles which have sizes greater than the true particles that is, sizes more greater than 10-9m, like clay, silt, organic matter and microscopic organisms.

   The seasonal variation (pre-monsoon and post-monsoon) in the turbidity levels of water is shown in table no. 5 and 6 and graphically displayed in the figure no.2. In the current review, it is seen that on a normal turbidity is marginally more for post-storm when contrasted with pre-rainstorm however is inside an attractive breaking point as endorsed by WHO. (5NTU)

3. **Total Dissolved Solids -** Concentration of fractured solids is an vital parameter for monitoring water quality**.** In natural waters, carbonates, bicarbonates, sulfates, nitrates, phosphates and chlorides of calcium, magnesium, sodium and potassium structure the dissolved solids.

   The seasonal variation of TDS is depicted in the table no. 5 and 6 and graphically displayed in the figure no. 3. The results fluctuated from 54 mg/l to about 120mg/l taking into considerations all the 8 places. The TDS value of below 100mg/l is categorized as non-saline. In the recent research work, sample no. 2, 4 and 7 are non-saline.

4. **Total Hardness -** Hardness is characterized by the all out concentrations of calcium and magnesium ions in water. On the basis of hardness, water can be classified as:

Type	**Range of Hardness**
Soft water	0-60 mg/L
Moderately hard	60 – 120 mg/L
Hard	120- 180 mg/L
Very hard	> 300 mg / L

   The seasonal variation of total hardness is shown in the table no. 5 and 6 and is graphically depicted in the figure no. 4.

   This study demonstrates that the water hardness in the examination area varies from 60 mg/ l to 186mg / l. Therefore, for present investigation it ranges from reasonably hard to hard.

   In the unique situation, the water tests at all the areas of study region demonstrated a scope of hardness beneath as far as possible. (300mg/l)

5. **Calcium -** Calcium typically occurs in water. It is disintegrated from rocks and soils that credit

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ISSN: 2278-0181
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hardness to water. The appearance of calcium in water prompts scale formation. The primary source of calcium in ground water are silicate minerals, igenous and changeable rocks, limestone and sedimentary rocks. As stated by WHO, the allowable calcium limit in water is 75-100mg / l.

Calcium was present in the range of 23.2mg / l to 40mg / l in the latest research. The seasonal variation of calcium is shown in table no. 5 and 6 and is shown graphically in figure no. 5.

6. **Magnesium** - Magnesium likewise contributes towards hardness of water which is sourced from minerals like dolomite, magnetite and so on. Approximately 100mg / l is the serviceable farthest magnesium in water.

   The seasonal variance of the magnesium concentration is shown graphically in Figure 6 and the magnesium concentration readings given in table no. 5 and 6. Generally, the magnesium content ranged from 24mg/l to 35mg/l and was well within permissible limit(WHO) in this.

7. **Chlorides** - The increase in chloride levels increases the water's electrical conductivity**.** Chloride has no antagonistic health effects, yet it provides drinking water a poor taste. Chlorides are generally available in a wide range of waters, with low levels of fresh water. It is harmless upto 1500mg/l yet confers a salty taste at 250-500mg/l (Trivedi and Goel)

   The seasonal variation of chloride is depicted in the table no. 5 and 6 and is graphically represented in the figure no. 7. Here, chloride ranges from 10mg/l to 27mg/l. The relevant limit being 250mg/l as prescribed by WHO, the water tests of all 8 locations displaced chloride content well within this limit.

8. **Total Alkalinity** - The seasonal variation of alkalinity is provided in table no.5 and 6 and graphically given in the figure no. 8. Alkalinity was from 108mg/l to 120mg/l which is in feasible limit of WHO (200mg/l)

9. **Nitrate -** Nitrates are obtained as the last oxidation result of ammonia and furthermore because of oxidation of nitrites by miniaturized scale microbes. If present in huge amounts it could demonstrate lethal notwithstanding prompting passing. Nitrate as a rule happens in follow amounts in surface water. It can cause methomoglobinemia in babies which pulverizes the capacity of RBC to convey oxygen.

   The seasonal variation of nitrates is shown in the table no. 5 and 6 and is graphically presented in figure no. 9.Nitrates shows a range of 0.44mg/l to 8mg/l.

10. **Sulphate -** Existence of sulphate in water has no unpleasant influence on wellbeing in that capacity. Sulphate is a noteworthy anion exists in water and is seen in minerals like gypsum and pyrite The admissible allowances of sulphate (SO42-) as per WHO is 500mg/l. Sulphate ions if in low concentrations don't change the flavor of water (Hariharan, 2010). It is gastro intestinal aggravation if present in high concentrations.

    The measures of sulphate were well below 500mg/l from 2mg/l to 11.2mg/l. The seasonal variation of nitrates is shown in the table no.5 and 6 and is graphically presented in figure no. 10.

11. **Total Kjeldahl Nitrogen (TKN) -** The fundamental source of nitrogen compounds in water are composts, fertilizers that principally contain nitrate, yet additionally ammonia ammonium, urea and amines. The nitrogen composts are presumably NaNO3 (sodium, nitrate and NH4NO3) ammonium nitrate. Too much nitrogen, as nitrate, in consumable water can be unsafe to youthful newborn children or youthful animals.

    The seasonal variation of total kjeldahl nitrogen is tabulated in table no. 5 and 6 and is graphically depicted in figure no.11. In this current study, the TKN value ranges from 13mg/l to 22mg/l.

12. **Sodium** - Sodium is a major segment of consumable water with a normal presence of more prominent than 100mg/l. (Khopkar, 1993) High groupings of sodium prompts trouble in evaporator tasks, boiler operations. It likewise influences wellbeing. The standard value of sodium in water is 200mg/l. (WHO)

    The seasonal variation of sodium is represented in table no. 5 and 6 and graphically displayed in figure no. 12. The variation in sodium content is between 4mg/l to 9mg/l which is not beyond standard limit.

13. **Potassium** - Water that experiences potassium permanganate has lower levels of potassium than water that utilizations potassium-based water conditioner. The degrees of potassium found in drinking water is low enough not be a worry for healthy peoples, says the WHO.

    The seasonal variation of potassium is depicted in table no. 5 and 6 and is graphically given in figure no. 13.The potassium values ranges from 4.4mg/l to 9mg/l which is applicable. (WHO-250mg/l)

14. **Phosphate** - Phosphate can happen both as dissolvable and insoluble structures. It happens normally in water from filtering of phosphorous rich rocks, and furthermore from anthropogenic sources (Girija et. al, 2007). The WHO admissible limit of phosphate in water is 5 mg/L.

    The seasonal variability of phosphate is demonstrated in Table 5 and 6 and is displayed graphically in Figure 14. In this phosphate values range from 1.25 mg / L to 4 mg / L, which is within the desirable limit (WHO 5mg/L). The phosphate ion is either absent or present below the advisable limit.

15. **Total Suspended Solids -** TSS is the dry heap of suspended particles not separated in a case of water that can be obtained by a channel. TSS gives a proportion of the turbidity of the water.

    The seasonal variation of TSS is depicted in the table no. 5 and 6 and graphically displayed in the figure no. 15. The values ranged from 2 mg/l to

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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about 6.98 mg/l taking into considerations all the 8 places.

16. **Total Coliform -** Biological parameters are significant factor that decide water safe for drinking reason. It could easily compare to parameters in term of direct impact of human wellbeing. MPN is most ordinarily connected for quality testing of water for example to guarantee whether sheltered or not for microscopic organisms present in it. The nearness of not very many fecal coliform microorganisms would demonstrate that a water likely contains no illness causing creatures, while the nearness of enormous quantities of fecal coliform microbes would show an extremely high likelihood could contain infection delivering life forms making the water hazardous for utilization. The seasonal variation of total coliform is tabulated in table no. 5 and 6 and is graphically depicted in figure no. 16. Here, the Total Coliform value ranges from 14 MPN/100 ml to 27 MPN/100ml.

IV. CONCLUSION

It can be concluded from the evaluation of eight different locations of tap water sources that physical-chemical and biological parameters were absent yet in amounts destructive to living framework.

Most of them were inside, making water safe for consumption or domestic purposes. The aftereffects of water test tests completed in this investigation demonstrated that, notwithstanding the age of the treatment plant, it is as yet creating consumable water that isn't physically, artificially and bacteriological from the universal norms.

The basic problem identified in this examination is the disintegration of water reliability into the circulation organization. The expansion in weakening or tainting inside the circulation framework as water moves from the treatment plant could be because of the accompanying: the breaks or spilling of the conveyance pipes, the sullied pool of water conformed to the spilling channels during the high weight may discover its way into the appropriation funnels during the low weight.

Suggestions –

The water used for domestic usage must be kept up as for the diverse physical-substance parameters well inside the all-inclusive cutoff points. Starting at now the water test concentrated of the eight areas of some part having a place with A ward of Kolhapur region don't show water contamination to the degree to cause concern. If in any place water tests show parameters in abundance of reasonable cutoff points, steps must be taken. Capacity and dispersion influence character of fresh water more, regardless of whether the treatment plant is sufficient. The more we screen our water the better we will most likely perceive and anticipate sullying issues.

i. Water should be supplied at an adequate pressure.
ii. Water should be supplied in adequate quantity with good quality.
iii. Operational problems solved through computer models (softwares) like EPANET or WATERGEMS –
a. Pipe breaks
b. Taking a tank offline
c. Shutting down a section of system
d. Water Distribution System (WDS) flushing-models identify low velocity pipes, flow path and direction.
e. Assessment of effects of various operational changes in WDS.
iv. SCADA system (Supervisory Control And Data Acquisition). Also called as “Real Time Monitoring System” should be applied or used for more reliable water supply.
v. Use of graded sand filter or trickling filter in particular area to reduce the water contamination in pipes through the treatment plant to consumers tap water sources.

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