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"IMPACT OF OPEN SOLID WASTE DUMPING ON GROUND WATER QUALITY NEAR DUMPING SITE OF JALGAON CITY, MAHARASHTRA"

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ABSTRACT :

vAahuja Nagar is middle profile area, situated away from National Highway No. 6 in middle part of Jalgaon city having approximately 3000 population. Aahuja Nagar is situated on the land which was formed by landfill of municipal solid waste. The municipal solid waste treatment plant "Hanjir Biotech" is situated near this area so while transportation most of the waste fall out and spread in this area. Such practice causes environmental pollution by deteriorating the ground water quality, encourage the breeding of disease-vector insects, animal scavengers and rodents resulting in spreading of air and water borne diseases. The present study was conducted to assess the ground water quality for various physical, chemical and biological parameters to assess the contamination due to solid waste dumping. The obtained results showed that various parameters were exceeding the permissible limits given by BIS. The MPN test for all samples was also positive showing biological contamination of this water. The polluted water requires certain levels of treatment before use. Public awareness regarding waste

minimization and sorting, adoption of clean technology and the use of sanitary landfill to prevent further contamination of ground water quality in this area are important and to be recommended by this research work.

KEYWORDS : Open Solid Waste Dumping, Ground Water Quality,

INTRODUCTION:

Water is an important part of our lives, as many of the internal and external activities of human being are depending upon the water. Water is a basic need not only for humans but also for animals and plants. According to availability, water divided into Surface water (River, Lake and Pond) and Ground water (Open well & Bore well). GW is used for different activity. If we compare the GW with SW, there are fewer chances to contamination of GW as these water bodies are in closed conditions. Percolation is one of the important chart eristic for contamination of GW. GW can be contaminated by polluted soil containing hazardous pollutants; such percolation into the ground causes the GW pollution. Poor sanitation, open dumping of municipal solid waste is also responsible equally for GW contamination. The present research work deals with such GW contamination near one of the solid waste dumping site namely Aahuja Nagar of Jalgaon city. Aahuja nagar was develop by landfill method of open dumping of soild waste.The open dumping of solid waste was ban from last 4 years but the solid waste processing company (Hanjir Biotech) is situated near this area which causes problems to this residential area. The lay down and dumped solid waste generate leachate. Seeping of leachate in to GW sources of this area may contaminate the bore well water. As the many people in this area used this GW for drinking purpose, the effect of solid waste dumping on ground water quality is evaluated. The obtained data is helpful to create the awareness among the people livening in this area regarding the ground water quality and its effect on their healthand maintained proper hygiene conditions in this area.

Objectives of the Study

• To assess the physical, chemical and biological characteristics of ground water in the selected study area to assess it portability.

• To create awareness among the people living near open dumping site regarding the ground water quality, Sanitation, hygiene condition and its effect on their health.

Literature Review

Muhammad Irshad and Faridullah (2011) study the effect of solid waste on heavy metal composition of soil and water at Nathiagali-Abbottabad, Pakistan. They concluded that the metal forms in the soils were materially changed by waste application. The amounts of metals increased significantly with the addition or haphazard disposal of waste in soils. EC and pH of the soils and water samples significantly enhanced with waste. The parameters measured in water samples were compared to WHO water quality standards. Most of these parameters tested found in excess of the WHO recommendations.

Mohammed Saidu (2011) carried out a study on ground water quality at Minna, which is the administrative headquarters of Niger state. In his study he observed that most of the parameters were within the permissible limits but all samples of hand dug wells shows bacteriological contamination which make the water unsafe for drinking purpose.

N.Rajkumar et al. (2010) study the groundwater contamination due to municipal solid waste

disposal in Erode City. They reported that the groundwater in the study area is mainly alkaline in nature. The concentrations of cations such as Na+ and Mg2+ exceed the maximum allowable limits for drinking water at some locations which are near to the MSW dumping yards in the study area. The anions such as SO42-, NO3- and F- are well within the permissible limits for drinking except at one location which is near to the area of location of tanneries. Only at four locations out of which three are very near to the MSW dump yards in the study region, the chloride concentrations are found to exceed the permissible limits during February 2009.

Study Area

Aahuja Nagar is middle profile area, situated away from National Highway No. 6 in middle part having approximately 3000 population. Aahuja Nagar is situated on the land which was formed by landfill of municipal solid waste. The municipal solid waste treatment plant "Hanjir Biotech" is situated near this area so while transportation most of the waste fall out and spread in this area.

Image 1 & 2:- Actual position of open solid waste at the study area

Materials & Methods

Water sampling:-Water samples from groundwater sources that are extensively used for drinking purposes by the local residents were collected randomly by grab sampling technique. Total 5 samples were collected from selected open dumping site to evaluate its effect on groundwater aquifer. The plastic container having 2 litre capacities was used for collection and storage of water sample. The containers were thoroughly washed and rinsed before every collection. All samples were properly labeled with details of the source, date of sampling, time of sampling and address. Sample containers for bacteriological examinations were sterilized before use. For each sampling site separate container was used.

Sr. No.	Sample No.	Source	Area
1	**AN-1**	Bore Well	Chandu-anna Nagar, Aahuja Nagar
2	**AN-2**	Bore Well	Makra colony, Aahuja Nagar
3	**AN-3**	Bore Well	Anjali Park, Aahuja Nagar
4	**AN-4**	Bore Well	Gurudatta Scoiety, Aahuja Nagar
5	**AN-5**	Bore Well	Anjali Residency, Aahuja Nagar

Table No.: 1: Details of groundwater sampling locations Aahuja Nagar Area

The collected ground water samples were analyzed for 3 physical and 20 chemical parameters respectively. Most Probable Number (MPN) test was determined to assess the biological contamination of water. All analysis was estimated as per standard methods (APHA, 1998) and the

results were compared with Bureau of Indian Standard (BIS) / Specification for Drinking Water (BIS: 10500:1991)

Results & Discussions

The analytical results of the various physico-chemical analysis of the groundwater samples of Aahuja Nagar area (AN-1 to AN-5) are tabulated in Table No.:2. All obtained results are compared with Bureau of Indian Standard / Specification for Drinking Water (BIS: 105001991)

Sr. No.	Parameters	Units	AN-1	AN-2	AN-3	AN-4	AN-5	BIS Limits
1	Colour		**Clear**	**Clear**	**Clear**	**Clear**	**Clear**	**5**
2	Odour		**Non-objectionable**		**Non-objectionable**			**Unobjectionable**
3	Taste		**Agreeable**		**Agreeable**			**----**
4	Turbidity	NTU	**6.1**	**6.2**	**6**	**5.8**	**6.5**	**5**
5	pH		**7.84**	**7.73**	**8.12**	**7.83**	**7.93**	**6.5 to 8.5**
6	Electrical Conductivity		**7.65**	**5.7**	**4.32**	**7.54**	**4.38**	**----**
7	Total Acidity	mg/l	**310**	**420**	**520**	**420**	**370**	**120**
8	Total Alkanity	mg/l	**11**	**18**	**22**	**16**	**12**	**200**
9	Total Hardness (as $CaCO_3$)	mg/l	**290**	**350**	**280**	**320**	**270**	**300**
10	Calcium Hardness	mg/l	**160**	**120**	**80**	**110**	**100**	**200**
11	Magnesium Hardness	mg/l	**130**	**230**	**200**	**160**	**170**	**100**
12	Ca	mg/l	**33.6**	**25.2**	**16.8**	**23.1**	**21**	**75**
13	Mg	mg/l	**30.43**	**53.84**	**46.82**	**37.46**	**39.80**	**50**
14	Total Dissolved Solids	mg/l	**381.4**	**280.7**	**212.8**	**370.8**	**215.7**	**500**
15	Total Suspended solids	mg/l	**0.45**	**0.6**	**0.3**	**1.4**	**0.4**	**No Standard**
16	Total Solids	mg/l	**381.85**	**281.3**	**213.1**	**372.2**	**216.1**	**500**
17	Chloride	mg/l	**346.9**	**155.7**	**162.8**	**226.5**	**233.6**	**250**
18	Nitrate	mg/l	**0.8**	**0**	**0.8**	**0**	**1.2**	**45**
19	Sulphate	mg/l	**14.4**	**6**	**8.1**	**8.6**	**11.8**	**200**
20	Fluoride	mg/l	**5.3**	**5.8**	**5.5**	**5.8**	**5.3**	**1.0**
21	Sodium	mg/l	**ND**	**0.19**	**ND**	**0.09**	**ND**	**200**
22	Phosphate	mg/l	**1.6**	**1.3**	**1.2**	**1**	**1.5**	**5**
23	MPN	MPN/100 ml	**33**	**4**	**4**	**900**	**240**	**0/100 ml**

Table No.: 2: Analytical results of ground water quality of Aahuja Nagar area

pH: The pH value decided that the water sample is acidic, neutral or basic in nature. pH is an important parameter in water body since most of the aquatic organisms are adapted to an average pH and do not withstand abrupt changes. The pH values of the ground water samples of all study locations were fluctuated between 7.83 to 8.12. The limit of pH value for drinking water is specified as 6.5 to 8.5. All reported values shows slightly alkaline trend. The pH of all samples was within prescribed limits.

Electrical conductivity: Electrical conductivity (EC) is a measure of the capability of water to conduct an electrical current. It is concentration of soluble salts in the water. Pure water, such as distilled, water will have a very low specific conductance & sea water have a high specific conductance. The EC values in the study areas were vary widely from 4.32 to 7.65 mS/cm. The higher values of EC may be due to long residence time and existing litho-logy of the region.

Turbidity : In the present research work the turbidity values ranged from 5.8 to 6.5 NTU. All five samples showed higher turbidity than the prescribed limit given by BIS standards. The highest Turbidity value found at AN-1, AN-2 and AN-5 i.e. 6.1, 6.2, and 6.5 respectively. Fig. 1 shows the turbidity graph at all locations.

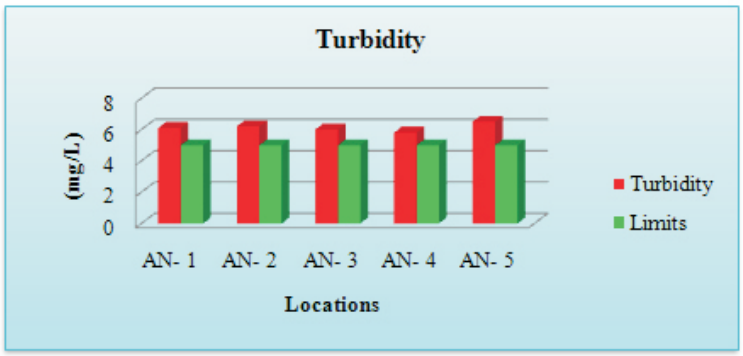

Figure 1:- Graphical representation of Turbidity at all locations

Acidity: The total acidity in the study area were fluctuated between 310 to 520 mg/L. The standard limit for acidity is 200 mg/L prescribed by BIS. The acidity of Aahuja Nagar areas water samples was found beyond the permissible limits. The highest acidity found at AN-3 location and the lowest acidity found at AN-1 i.e. 520 mg/L and 310 mg/L respectively. Fig.2 shows acidity graph of all study areas.

Alkalinity: The standard desirable limit of alkalinity in potable water is 200mg/L. The maximum permissible level is 600 mg/L. The alkalinity in all study areas were fluctuated between 11 to 22 mg/L. Hence, the observed value of alkalinity at all locations in study area is within the permissible limits prescribed by BIS. The value of alkalinity in the ground water provides an idea of natural salts present in water.

Total Hardness (TH): Total hardness of both areas varies from 270 to 350 mg/L. Acceptable limit of TH for drinking is 300 mg/L prescribed by BIS. At Aahuja Nagar site except at location AN2, the observed total hardness values at all locations were found to be within the permissible limit given by BIS standard. The highest hardness was observed at location AN-2 and AN-4 i.e. 350 mg/L and 320 mg/L. Other observed values were lies between 270-290 mg/L. The higher values of hardness may be due to presence of excessive amounts of Ca and Mg salts in ground water samples. Fig.3 shows the total hardness graph indicating higher values at all locations. Absolutely soft water is tasteless whereas hardness above 600 mg/lit can be affecting the human cardiovascular & excretory system It cause the kidney & bladder strong. Hardness is the property of water which prevents the lather formation with soap & increases the boiling points of water.

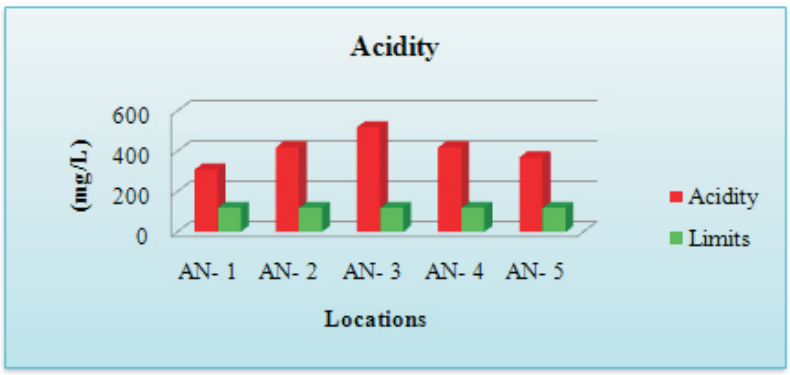

Figure 2: Graphical representation of Acidity at all locations

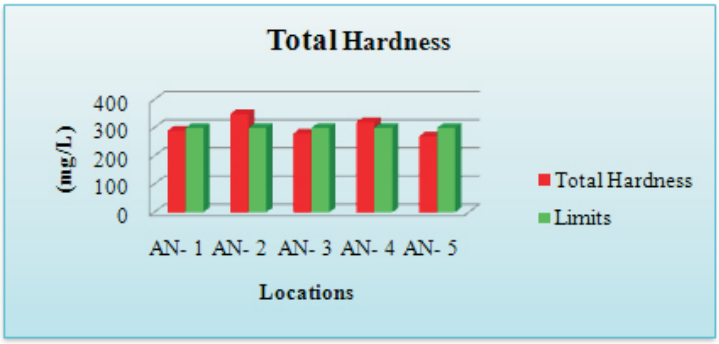

Figure 3:- Graphical representation of Total Hardness at all locations

Calcium Hardness: The standard desirable limit of Ca hardness in potable water is 200mg/L. The Ca hardness in both study area fluctuated between 80 to 160 mg/L. The Calcium hardness values in Aahuja Nagar site at all five locations were found within the permissible limits. The lowest concentration of Ca hardness was found at AN-3 location i.e. 80 mg/L followed by AN-5, AN-4, AN-2 and AN-1 location. The Ca hardness at all locations was within the permissible limit given by BIS. Fig. 4 shows the Ca hardness graph indicating lower values at all locations by green colour bar graph.

Magnesium Hardness: The Mg hardness in both study area varied from 130 to 230 mg/L. The standard limits for Magnesium hardness is 120 mg/L prescribed by BIS. The concentration of Mg hardness in Aahuja Nagar site at all locations was found beyond the permissible limit prescribed by BIS. The Mg hardness was higher at AN-2 location i.e. 230 mg/L. While the lowest concentration of Magnesium hardness found at AN-1 i.e. 130 mg/L. Fig 5 indicating higher values of Mg hardness at all five locations.

Calcium : Calcium concentrations were found to vary from 16.8 to 33.6 mg/L. The standard limit of calcium ion in drinking water is 75 mg/L. The concentration of calcium ions in all samples were found within the permissible level given by BIS. The highest concentration of Ca found at AN-1 while the lowest concentration of Ca observed at AN-3 i.e. 33.6 mg/L and 16.8 mg/L respectively.

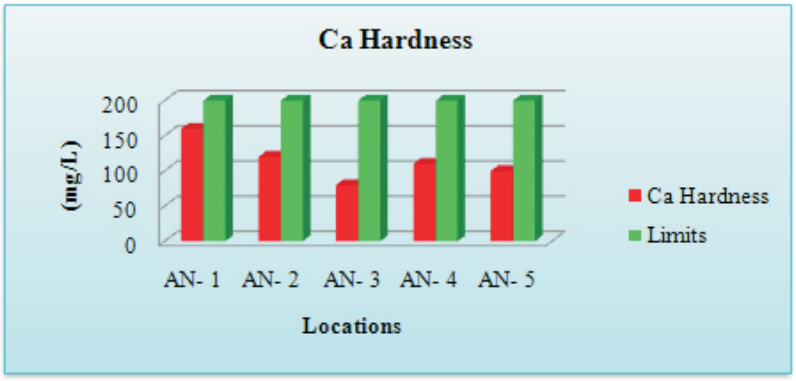

Figure 4:- Graphical representation of Calcium Hardness at all locations

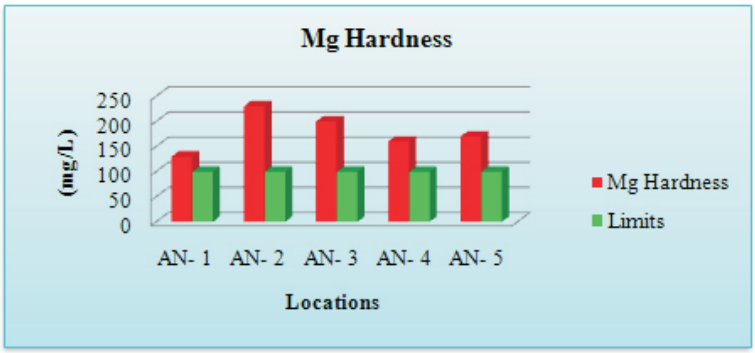

Figure 5:- Graphical representation of Magnesium Hardness at all locations

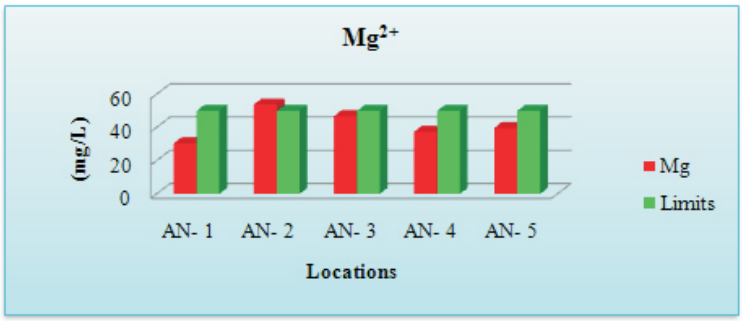

Figure 6:- Graphical representation of Magnesium ion at all study locations

Magnesium: Magnesium content in groundwater varies from 30.43 to 53.84 mg/L. Excess of Mg content present in ground water samples prove that the water is not good for drinking. The upper limit of calcium concentration in drinking water is specified as 50 mg/L. At Aahuja Nagar site except AN-2, the Mg concentration at all locations were found within the prescribed limits given by BIS. The magnesium concentration at AN-3 location was near to permissible level while the concentration of magnesium ion at remaining three location (AN-1, AN-4 and AN-5) were observed within prescribed limit. Fig.6 illustrates high values of magnesium content.

Total Dissolved Solid (TDS): TDS content in groundwater varies from 212.8 to 381.4 mg/L. The standard limits for TDS is 500 mg/L given by BIS. The concentration of Total Dissolved Solids at all study location was found within the permissible level given by BIS. The highest concentration of TDS found at AN-1 while the lowest concentration of Ca observed at AN-3 i.e. 381.4 mg/L and 212.8 mg/L respectively. Fig. 7 illustrates the concentration of TDS at all study location.

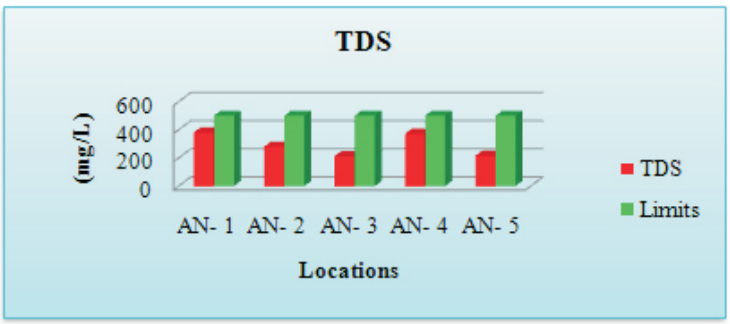

Figure 7:- Graphical representation of Total Dissolved Solid at all study locations

Chlorides: The permissible limit of chloride in drinking water is 250mg/L. The chloride values ranges from 155.7 to 346.9 mg/L in Aauhuja Nagar area. When chlorine combined with sodium gives salty taste to drinking water, excess chlorides causes cardiovascular diseases. The concentration of chlorides was found high at AN-1 location i.e. 346.9 mg/L. The concentrations of chlorides were observed near to permissible limits at AN-4 and AN-5 location i.e. 226.5 and 233.6 respectively. Expect AN-1, the chloride concentration at all study locations were found within the permissible limit given by BIS. Fig. 8 indicates high chloride concentration at some location of study area.

Nitrate and Sulphate: The concentration of Nitrate and Sulphate in groundwater samples in all study areas varied from 0.00 to 1.2 mg/L and 6.00 to 14.4 respectively. The concentration of Nitrate in all study location water samples were found within the permissible limit as the prescribed limit for Nitrate concentration is 45 mg/L. the concentration of Sulphate also observed within the prescribed limit given by BIS i.e. 200 mg/L.

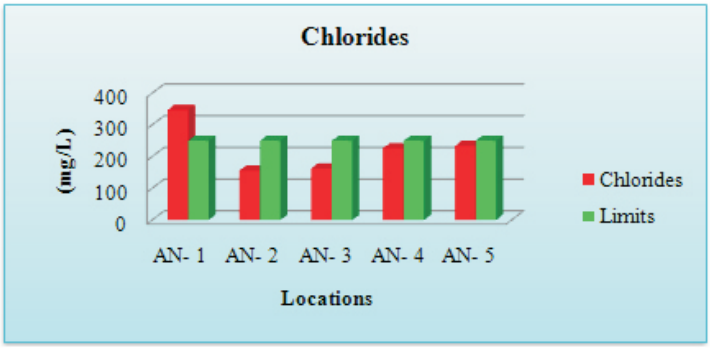

Figure 8:- Graphical representation of Chlorides at all study locations

Fluorides: The standard prescribed limit for fluoride concentration in 1.0 mg/L. The concentration of fluoride in groundwater samples at all study areas varied from 5.3 to 5.8 mg/L. In Aahuja Nagar site the higher concentration of fluoride was observed at AN-2 and AN-4 location, i.e. 5.8 mg/L. Fluorides at all study locations exceeded the prescribed limit. The graph of fluoride concentration in groundwater is as shown in fig. 9.

Sodium: The concentration of sodium in groundwater samples of both areas varied from 0.09 to 0.19 mg/L. Sodium were detected in only 2 samples of Aahuja Nagar area namely AN-2 (0.19 mg/L) and AN-4 (0.09 mg/L). The Sodium was not detected at remaining locations of the study area.

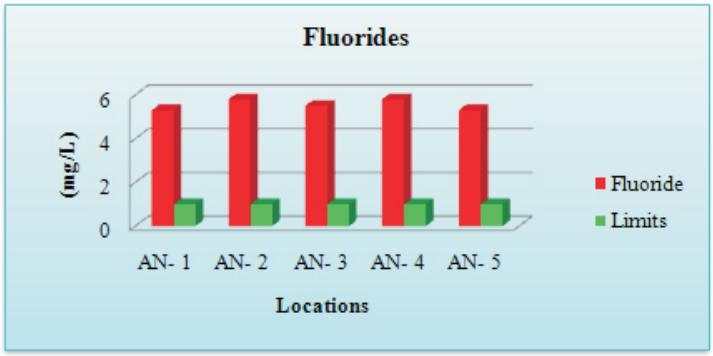

Figure 9:- Graphical representation of Fluorides at all study locations

Most Probable Number (MPN) Test:-MPN Test indicates the biological contamination of water. If the MPN test is positive then its means there is presence of organisms in this water. This type of water is unfit or not suitable for drinking purpose. The observations for MPN test at all study area were found the positive results showing the biological contamination of ground water in this area. The spatial distribution of MPN concentration in groundwater is as shown in fig 10.

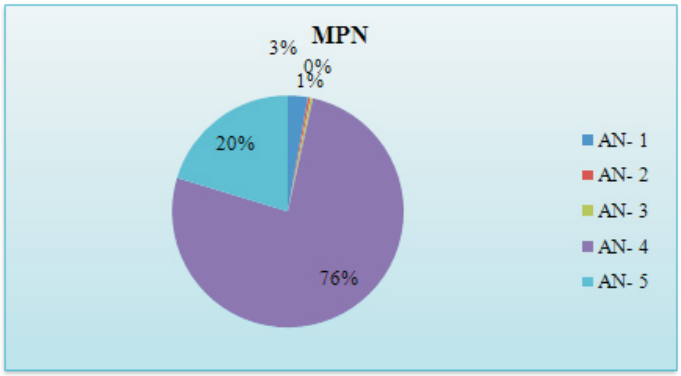

Figure 10:- MPN present in ground water sample at Aahuja Nagar location

CONCLUSIONS

From the results of the study, the following conclusions were drawn. All results were compared with WHO international Standard (1971 and 1983) and Bureau of Indian Standard / Specification for Drinking Water (BIS: 10500:1991). The pH of all samples from Aahuja Nagar area was within range in between 7.83 to 8.12. As compare with WHO international Standard (1971 and 1983) and BIS (10500:1991), all pH values were within the prescribed limits. From the observed value it was conclude that all samples from this area were slightly basic in nature. During the study period it was observed that, the Turbidity of all water samples of Aahuja Nagar area was high, beyond the prescribed limits prescribed by BIS. From the obtained result regarding Turbidity, it is concluding that this water is not suitable for drinking purpose. Total acidity of all samples was exceeding the permissible limits given by BIS. Total Hardness was found high, exceed the prescribed limit at AN-2 location. Higher concentration forms the scale formation. The remaining locations were show lower concentration of total hardness. From the result values, Mg concentration at one location (AN-2) at Aahuja Nagar site was above the prescribed limits, while the concentration of magnesium was near to permissible level at one location (AN-3) given by BIS. Ca concentration at all locations of Aahuja Nagar site found within the prescribed limits. Concentration of Chlorides was found higher at AN-1 location. Remaining location was within prescribed limits. The desirable limit of Fluoride is 0.6 to 1.5 as per BIS standard. From the obtained results it is conclude that all study areas of Aahuja Nagar having high concentration of Fluorides. At Aahuja Nagar area, the concentration of fluoride varies from 5.3 to 5.8 mg/L. Excess concentration of Fluorides may cause the Dental & Skeletal Fluorosis to human being. The MPN test for all ground water samples is positive. From the result obtained from MPN Test, it is conclude that there is presence of micro-organisms in all locations samples. This type of water is unfit or not suitable for drinking purpose. Use of this type of water for drinking purpose causes serious health problems.

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Authors Contributions

KPP lead the study, collected the water samples from selected study area and analyzed all chemical parameters in the laboratory. GMR helped in performing the MPN test for all samples and in data interpretation. KPP and GMR contributed equally for the study design, editing, final writing and compilation of the manuscript.

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