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To Study the Groundwater Quality this is affected Due to Industrial Area (Ichalkaranji-Kolhapur)

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Abstract: ***Analysis of groundwater indicates that water at most of the places is slightly hard comparing with WHO and ISI standards for drinking water. Most of the tube well water is contaminated hence unsuitable for drinking. Regular monitoring of all open wells and tube wells is essential. Now in the area of economic growth, groundwater is becoming contaminated due to the relocation of textile industrial waste through nallahs. The major problem with groundwater is that once contaminated, it is very difficult to restore it. Intensive use of natural resources and various human activities are posing a great threat to under water quality. The characteristics of groundwater in and around Ichalkaranji in industrial area, industrial residential mixed area, thick residential area and remote area studded. It is found that the days by day, the pollution parameters like hardness and TDS, MPN are increasing as compared to the last few year results. The present status of Ichalkaranji is highly polluted in nature due to the impact of textile industries, urgent need to control the groundwater.***

Keywords: ground water, contaminated, impact, quality

1. Introduction

Groundwater is present in permeable geological formation known as aquifer. Ground water is an essential and vital component of our life support system. The ground water resources are being utilized for drinking, irrigation and industrial purposes. There is growing concern on deterioration of ground water quality due to geogenic and anthropogenic activities. The quality of ground water has undergone a change to an extent that the water is not fit for drinking purpose. Increase in overall salinity of the ground water and presence of high concentrations of fluoride, nitrate, iron, arsenic, total hardness and few toxic metal ions have been noticed in large areas in several states of India. Ground water contains wide varieties of dissolved inorganic chemical constituents in various concentrations as a result of chemical and biochemical interactions between water and the geological materials through which it flows and to a lesser extent because of contribution from the atmosphere and surface water bodies. Study area includes the Ichalkaranji city which is situated on latitude of $16^{/} - 40^{/}$ North and longitude of $74^{/} - 32^{/}$ East. The town is situated at an altitude of 556 meters above the mean sea level. It is situated in the filled up valley of river Panchganga. Ichalkaranji is about 29 Kms away to the south – east of Kolhapur and 26 Kms away to the south – west of Sangli. The present study is taken up only to assess the quality of groundwater in Industrial Estate area of Ichalkaranji (having area = 106 Acres and 28 Gunthas). The entire area is divided into two parts, one part covers, 38 acres and 26 guntha, situated on west side of Ichalkaranji – Hatkanangale road and other part covers 68 acres and 02 gunthas, named Expanded Part of Industrial Estate, situated on west side of Ichalkaranji – Hatkanangale road.

The water pollution in the Ichalkaranji is mainly caused due to discharge of sewage and industrial effluent into public sewers, inland surface water, nallahs etc. which is having high to very high total solids and high BOD values and it does not confirm to the limits set by Pollution Control Board, hence it is not suitable for discharge into any receiving bodies without treatment. Power looms of sizing units 120, power looms 7100, shuttles looms 7000 and processing units 25.

The water pollution by processing industry is mainly attributed to the various waste streams coming out of the wet processing operations like desizing, scouring, bleaching, mercerizing, dying and printing which leads to contamination of the groundwater, so it is necessary to assess the groundwater quality and reduces the impacts on its quality. The effluents from most of the above industries get in the Panchganga river through a Chandur nallah of Industrial Estate Area. The water pollution is mainly caused by discharging their liquid effluent into various receiving bodies like public sewers, inland surface water like rivers, nallahs etc. Waste water generated in sizing varies between 500 to 8000 liters per 1000 Kg of yarn sized. Though the volume of effluent is less, it is having high to very high total solids and high BOD values and it does not confirm to the limits set by Pollution Control Board. Hence, I is not suitable for discharge into any receiving bodies without treatment. Wet processing of fabric requires huge quantities of water for various operations as stated earlier. On an average of processing 1 Kg of fabric, it requires 80 liters to 120 liters of water. A large population of Ichalkaranji depends upon bore well water for drinking or for other purposes. There are more than 2000 bore wells in Ichalkaranji, so that need arises to check its quality.

The total area of under jurisdiction of Municipal Council is 20.38 hectors. Ichalkaranji having good numbers of spinning mills, sizing units, processing units, and power looms of sizing units 120,power looms 7100,shuttles looms 7000 and processing units 25. The Ichalkaranji has the two main textiles industrial areas are The Ichalkaranji Co – Operative Estate and other is Babasaheb Khanjire Industrial Co – Operative Estate Limited. Total area of both the industrial estates is 207 acres with 689 plots and 520 buildings. There are another two industrial estates namely Laxmi Industrial

Estate and Parvati Industrial Estate, which do not fall under the Ichalkaranji Municipal limits. Out of these two main industries – The Ichalkaranji Co –Operative Estate Limited is selected for project work to analyze the quality of groundwater; which consists of sizing industries, processing industries, and power looms. The entire area is highly polluted due to the groundwater contamination. Most of the peoples are using bore well water for domestic as well as industrial purposes. The textile industry also consumes large quantities of water. Major portion of the water is used for wet processing of textiles (i.e. 60% to 70%). Humidification of spinning and weaving sheds require about 5 to 10% water. Generally the quantity varies from 125 liters to 200 liters of water per Kg of cloth produced. Therefore the analysis of groundwater is becoming a essential part to control the groundwater pollution, and suggests a preventive, curative, and a control measures for the entire area.

The preliminary survey is worked out to cover the entire area into two parts. For choosing the bore well points as per the situations, topography so the area. For monitoring water pollution in bore wells, the collection of water samples and selection of bore wells is the important task, so before collecting a specimen or samples.

A suitable questionnaire can be drawn by him. It is very important for the sample collector to pursue the sample without any changes and label them properly before actual testing. The first region of industrial estate area having 38 acres and 26 gunthas, is locked on Westside of Ichalkaranji – Hatkanangale road. The 10 bore well points are locked on the entire area. The five bore well points on the west side and other five on east side of road are selected and all the samples are collected in the free and post monsoon period and preserved in polythene bottle. The second region is namely as expanded industrial estate area having 68 acres area. For this region the 15 bore well points are selected which covers the whole area and located on westside of Ichalkaranji – Hatkanangale road. These two regions are purely industrial regions as zones and other two samples are selected in non – industrial areas for comparing the quality of water with respect to physical, chemical and biological parameters are set by Pollution Control Board, WHO, Indian Standards as per permissible limits. The waste from the textile industries of industrial estates area are discharges through a Municipal nallahs and then joined the Chandur nallah which is 10 Km away from the entire area and finally goes towards river Panchganga

As per the survey, the waste coming from the various industries of textile industries are not treated properly but directly discharges through nallahs and in some of the places directly spreads on the roads. As per present situation, the waste is spread up on road as well as improper construction of nallahs directly percolated into the ground which leads to contaminate the groundwater when it reaches to the water table of entire area and then finally causes the groundwater pollution and need to analyze and control the pollution by regularly monitoring the bore well water as well as well water.

The sewerage systems of Ichalkaranji with sample locations are shown in Fig.1,3 and The proposed project work also carried out in this region.

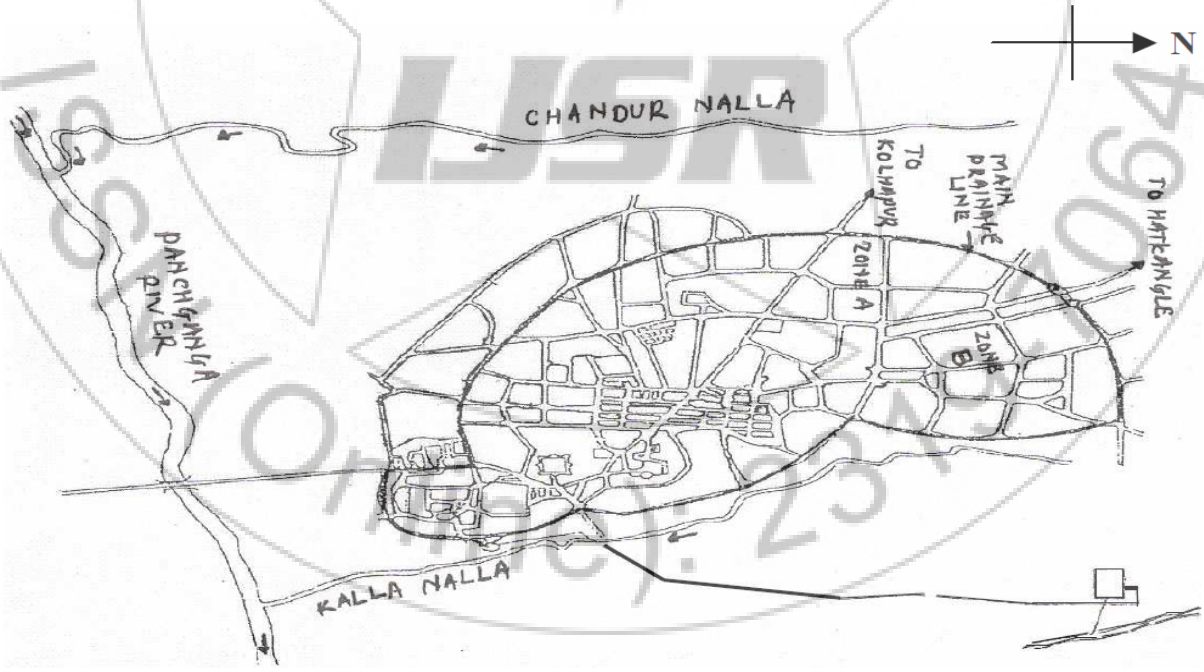

Figure 1: Sewerage system of Ichalkaranji City map

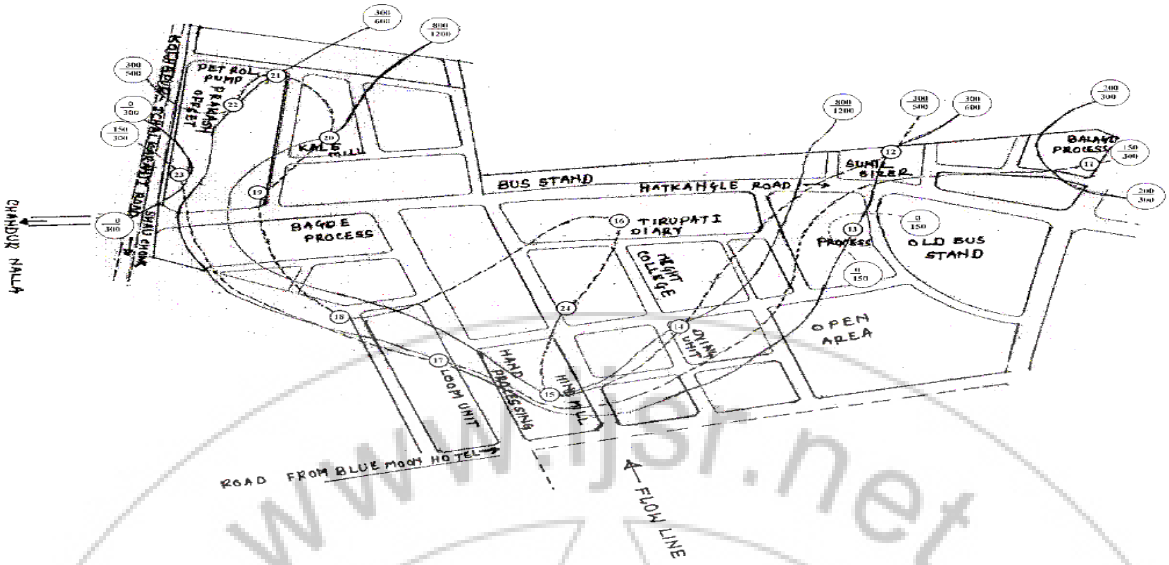

Figure 2: Isohytal map of Ichalkaranji city

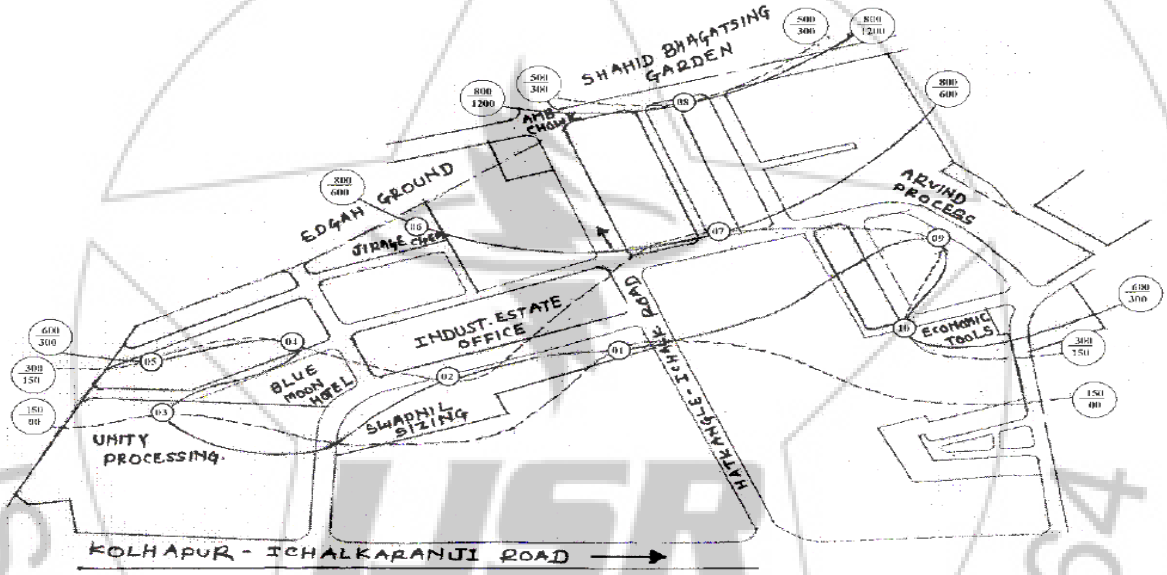

Figure 3: Topography map of Ichalkarnji city

The water pollution in Ichalkaranji Municipal limits is mainly caused due to discharge of sewage and industrial effluent. Total quantity of sewage generated is 37 MLD out of which 20 MLD is treated and the balance goes untreated into the river Panchganga thereby polluting the river. After Rui Dam, the Tilwani nallah and Chandur nallah join the river before the water is pumped to water treatment plant. The characteristics of groundwater in and around Ichalkaranji in the year of 2011 and 2012, also the characteristics of groundwater in industrial area, industrial residential mixed area, thick residential area and remote area shown in table.

2. Proposed Work

1) Zoning of Ichalkarangi city and establishing sample collection points.
2) Collection of samples for analysis pre-monsoon and post-monsoon sampling.
3) Determination of parameters

pH , Electrical Conductivity (EC),Total Dissolved Solids (TDS), Total Alkalinity (TA), Total Hardness (TH), Chloride (Cl^-),Fluoride (F^-), Sodium (Na^+), Dissolved Oxygen (DO), NO_3 – N

3. Literature Study

Shah, et al.,(2008)-Groundwater quality of Gandhinagar Analysis for physico-chemical and biological parameters. Conclusion-Poor quality for drinking purpose ,Purification treatment is necessary Quite good for irrigation purpose. Chandu, S.N.,et al (1995) – Suitability of ground water for domestic and irrigational purpose in some parts of Zansi district, UP.Conclusion- High content of salts and TDS in some parts. Water is quite good for drinking. Mohanty, S. K.,et al.,(2003) - Correlation study among ground water quality parameters near major industries in koraput. Conclusion- Positive correlation coefficient between EC and TDS - 0.998 BOD and COD - 0.985. Reddy ,K. M., (2003)-Ground Water Quality characterization In Wazirabad Damaracherla Area , Nalgonda District" Conclusion- Area is

dominated by bicarbonate and mixed type of ions. Good for irrigation purpose. Singh, O., et al.,(2005)- Water Quality Aspect of Some Wells, Springs and Rivers in parts of the Udhampur District (J& K) Conclusion- Higher concentration of TDS, Ca, Mg,Total Hardness, Fe, Mn, Cr.Low concentration of fluoride in some parts. Not fit for drinking. Patil, S.(2000)- Groundwater analysis for Sangli city. Conclusion- Groundwater quality is good for drinking in some area. Hardness -208 to 2780 mg/l in 60% area High chloride content (>600mg/l) Low S.A.R. (10) High EC (2259us/cm) Not suitable for irrigation purpose. MPCB Analysis of groundwater, Implementation of remedial measures Dept. of groundwater Survey & Deve., Analysis of groundwater

4. Material and Method

For selection of groundwater quality survey location the following criteria is considered: Drinking water bore wells; Bore wells closer to polluting sources like industries, urban wastewater drains, garbage dumpsites etc.; Bore wells suspected for natural contaminants like fluoride, iron, arsenic or such pollutants.

Samples collected from one of the following three types of Bore wells: Bore wells in use for domestic or irrigation water supply, Tube wells fitted with a hand pump or a power-driven pump for domestic water supply or irrigation; Hand Pumps, used for drinking. Bore wells, which are not in use or have been neglected, are not used for sampling. For collection of samples, a weighted sample bottle or sampler will be used to collect sample from an open well. Samples from the production tube collected after running the well for about 5 minutes. The samples collected from sources at various depths from extensively populated area, commercial, industrial, agricultural and residential colonies to obtain a good aerial and vertical representation. The hand pump continuously pumped prior to the sampling, to ensure that ground water to be sampled representative of ground water aquifer. All the samples stored in sampling kits maintained at 4^{o}C and bring to the laboratory for detailed chemical and bacteriological analysis. The standard methods (IS method) adopted for each parametric analysis of groundwater samples. The details of sampling locations and source and depth wise distribution given at each zone of city. The physico-chemical analysis will be performed by following standard methods. The brief details of analytical methods and equipment used in the study are given

Table 1: Parameters and method of analysis

Sr. No.	*Parameter*	*Method*	*Instruments/Equipment*
1.	pH	Electrometric	pH Meter
2.	Conductivity	Electrometric	Conductivity Meter
3.	TDS	Electrometric	Conductivity/TDS Meter
4.	Alkalinity	Titration by H_2SO_4	-
5.	Hardness	Titration by EDTA	-
6.	Chloride	Titration by $AgNO_3$	-
7	Fluoride	SPADNS	UV-VIS Spectrophotometer
8.	Sodium	Flame emission	Flame Photometer
9.	BOD	5 days incubation at 20^{o}C followed by titration	BOD Incubator
10.	COD	titrated with an excess of $K_2Cr_2O_7$	-
11.	Dissolved oxygen	Modified Winkler's method	-
12.	NO_3 - N	IS Method	Kjeldahl Apparatus

Table 3: Wastewater Characterization

LOCATION	pH	DO mg/L	COD mg/L	Cond. µmho/cm	TDS mg/L	TS mg/L	Cl^- mg/L	TA mg/L as $CaCO_3$	SO_4^+ mg/L	TH mg/L as $CaCO_3$
Panchganga Wastewater	6.31	Abs	106	1606	886	986	159.95	350	524.57	340
Confluence at nalla	6.46	5.9	55.12	1327	762	836	112.47	350	365.98	282
Before Confluence	7.06	7.2	34	1207	660	716	99.9.7	350	295.5	270
After Confluence	6.9	6.8	88.23	1110	710	794	84.97	330	104.91	284

Table 4: Average quality of Open Well samples

LOCATION	pH	DO mg/L	COD mg/L	Cond. µmho/cm	TDS mg/L	TS mg/L	Cl^- mg/L	TA mg/L as $CaCO_3$	SO_4^+ mg/L
Alte	6.38	6.6	61.44	1625	704	1236	167.5	392.5	48.01
Hatkanangle	6.18	5.9	33.92	1225	742	918	119	318	67.47
Kabnur	6.01	4.2	76.32	2636	2149	2182	325.5	301.25	307.4
Chandur	6.4	4.1	189.3	3784	2662	2822	739.8	276.25	484.9

Table 5: Average quality of Bore Well samples

LOCATION	pH	DO g/L	COD mg/L	Cond. µmho/cm	TDS mg/L	TS mg/L	Cl^- mg/L	TA mg/L as $CaCO_3$	SO_4^+ mg/L
Alte	6.26	6.6	57.89	1467	511	762	154.13	293	92.58
Hatkanangle	6.04	5.5	33.87	1193	614	685	89.97	327	94.34
Kabnur	5.97	4.2	92.22	2528	1655	2175	333.65	304	415.86
Chandur	5.06	2.9	251.3	5876	3986	4536	1184.6	251	797.03

Table 6: Average quality of Bore Well /open well samples

Sr. No.	Parameters	Industrial Area		Industrial & Resid. Mix Area		Thick Industrial Area		Remote Area		IS Norms for Drinking Water
		A	B	C	D	E	F	G	H	
1.	pH	7.4	7.6	8.1	8.0	7.3	7.8	6.9	7.1	6.5 – 8.5
2.	Total Hardness mg/l as $CaCO_3$	335	378	314	280	205	289	202	184	300
3.	Total Dissolved Solids	471	578	413	343	326	402	320	302	500
4.	Total Suspended Solids	12	19	07	09	11	09	05	05	-----
5.	Turbidity	2.5	4	06	04	2.7	2.8	02	2.2	10 UNIT
6.	Residual Chlorine	NIL	0.02	NIL	Traces	NIL	NIL	NIL	NIL	0.3 – 0.5
7.	Sulphates	51	66	78.5	65.2	64	79	45.5	35.5	150
8.	Chlorides	37	46	38.4	26.4	30	55	23.4	19.4	250
9.	Total Alkalinity	34	69	-----	-----	----	----	----	----	-----
10.	Iron as Fe	0.01	0.04	0.025	0.02	0.02	0.02	0.02	0.014	0.3
11.	Calcium	36	53	52.22	46.89	48	57	13.6	11.2	75
12.	Magnesium	13.4	19	16.9	14.8	18	22	8.2	6.8	30
13.	Silica	0.02	0.03	-----	0.02	0.03	----	----	----	----
14.	Most Potable Number (MPN)/100 ml	260	325	640	690	15	09	10	08	10

A: Night College D: Near Deccan Mill G: Awade Mala B: Bhone Mal
E: Narayan Mala Well H: Tilak Road C: Jawahar Nagar F: Rugge Mala.

Sr. No.	Parameters	Industrial Area		Industrial & Resid. Mix Area		Thick Industrial Area		Remote Area		IS Norms for Drinking Water
		A	B	C	D	E	F	G	H	
1.	pH	7.4	7.6	8.1	8.0	7.3	7.8	6.9	7.1	6.5 – 8.5
2.	Total Hardness mg/l as $CaCO_3$	340	370	325	300	215	296	200	175	300
3.	Total Dissolved Solids	480	565	415	350	320	430	305	310	500
4.	Total Suspended Solids	10	22	12	10	12	14	06	05	-----
5.	Turbidity	3.0	4.0	4.0	4.0	3.0	2.8	2.0	2.0	10 UNIT
6.	Residual Chlorine	NIL	NIL	NIL	Traces	NIL	NIL	NIL	NIL	0.3 – 0.5
7.	Sulphates	50	60	75	67	66	83	42	30	150
8.	Chlorides	41	49	42	25	27	60	25	20	250
9.	Total Alkalinity	35	71	-----	-----	----	----	----	----	-----
10.	Iron as Fe	0.01	0.04	0.025	0.02	0.02	0.02	0.02	0.014	0.3
11.	Calcium	40	55	51	49	48	34	15	12	75
12.	Magnesium	15	20	17	16	16	21	9	8.5	30
13.	Silica	0.02	0.03	-----	0.02	0.03	----	----	----	----
14.	Most Potable Number (MPN)/100 ml	280	315	695	695	25	10	20	10	10

A: Night College D: Near Deccan Mill G: Awade Mala B: Bhone Mal
E: Narayan Mala Well H: Tilak Road C: Jawahar Nagar F: Rugge Mala.

5. Result and Discussion

The electrical conductivity of all samples of bore well water are within the permissible limit as per WHO. The value of electrical conductivity is ranging from 0.3 to 1.98 micro mho/cm.

Spread of pollution:

The industrial estate area of Ichalkaranji is highly polluted due to the influence of textile industrial waste percolating through the nallahs at the time of disposing and finally it reaches to groundwater table and it contamination and to spread pollution I groundwater which impacts the health of mankind, if they are using for drinking.

The industrial estate area of Ichalkaranji is divided into two regions; one region of the area is located on the west side of Ichalkaranji – Hatkanangale road having 28 acres and 26 gunthas area. As per the test results, the pollution is going on increasing day by day due to influence of textile industry waste on the entire area.

The area nearer o the Dr. Ambedkar chowk is highly polluted and which represents high TDS value and high hardness showing the TDS value having a range of 800 – 1200 mg/l which is beyond the limit set by PCB. Also hardness values are more than 600 mg/l which indicates the water is very hard and it is not suitable for drinking.

But the Isoplyth map shows the area nearer to Ambedkar chowk is highly polluted and it lies under pollution zone which is spreading up to the area of Idgah ground and boundary of Arvind processing unit. The area nearer to Kolhapur road doesn't show any pollution and lying under safe zone.

The pollution of entire area is going on increasing as per topography (steep slope) and also decreases as per the topography (flat slope).

The second region of industrial estate area is having 68 acres area located on west side of Ichalkaranji – Hatkanangale road. The central area of this region is highly polluted due to the influence of textile industries locate along Ichalkaranji – Hatkanangale road and pollution decreases towards the direction of Chandur nallah. This polluted zone shows the TDS value ranging from 800 to 1200 mg/l and hardness value in the range of 300 – 500 mg/l. The groundwater in the entire area is not suitable for drinking as per Indian standards. The area, nearer to Blue moon hotel does not show any pollution which indicates safe zone. One more conclusion about this area can be drawn is that, at top level have a less pollution and at the low level flow line it goes on increasing along with flow.

The major two polluted parameters i.e. the TDS and hardness are mostly affecting the groundwater quality. parameters like COD, BOD influencing the groundwater quality. Such parameters are impacting on groundwater quality due to waste coming from the various textile processes such as bleaching, mercerizing, sizing, desizing etc. directly impairing into groundwater table through nallahs.

The major portion of industrial waste area is demarcated as polluted area and remaining area is also likely to be polluted in future. So the proper treatment is necessary to the

effluents coming from the various textile industries and their disposal to the municipal sewers etc.

6. Conclusion

The analysis of groundwater (bore and well water) is to be carried out with parameters like hardness, alkalinity, fluoride, nitrates, chlorides, sulphates, TDS, chromium, iron etc. to get the information about the influence of pollutants on its quality of entire area.

Based on the experimental results conclusions has been drawn:

1. All the parameters are well within permissible limits but only, TDS and hardness are showing higher values which indicate that the need for some kind of treatment for the removal of dissolved salts prior to its use for domestic purposes. Also due to hardness, there is need to soften the water. Some samples show the MPN value which reveals a quantitative and qualitative picture of pathogens which transmits the harmful diseases to human beings. The need is to conduct regular water quality analysis.
2. The industrial polluted zone is demarcated on Isoplyth map which shows the TDS and hardness values.
3. The various parameters signify that an immediate attention should be given to prevent pollution and curative measures should be adopted before it could be supplied to consumer.
4. The main source of groundwater pollution is caused due to the influence of textile industrial waste. So it should be properly treated before disposing it into municipal sewers.

7. Future Scope

The above research work further can be extended for solving problems of different kind of project for the betterment of society.

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Author Profile

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