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ASSESSMENT OF GROUND WATER QUALITY IN INDUSTRIAL AREA OF DHARUHERA, REWARI (HARYANA)

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ABSTRACT
Ground water quality of industrial area of Dharuhera, district Rewari was assessed for its suitability for drinking purposes. The various drinking water parameters viz., pH, alkalinity, Total Hardness, Fluoride, Chloride and sulphate concentration in ground water were analysed. Majority of the samples do not comply with Indian as well as WHO standards for most of the water quality parameters. Overall water quality was found unsatisfactory for drinking purposes. Fluoride content was higher than permissible limit in more than 20% samples and the chloride concentration also found higher than permissible limits in more than 40% sample. The fluoride concentration in the underground water samples were varied from 0.1- 3.4 mg/L and chloride concentration was varied from 24 – 680 mg/L.

KEYWORDS: Ground water Quality,   Industrial Area Dharuhera, Assessment

INTRODUCTION
Water is the most valuable resource given by the nature. It is also called matrix of life because life is originated from it and also exists in it (Anwar & Aggarwal 2014). It is used in agricultural, industrial, household, recreational and environmental activities. So. to fulfil the demand of these sectors ,the huge quantity of water is required but about 97% of the total earth water is present in ocean in unusable form and only 3% is fresh water, slightly over two third of this is frozen in glaciers and polar ice caps which makes difficult to fulfil the required fresh water demand. The unfrozen fresh water is found mainly as ground water. Groundwater is a good source of fresh water available on the earth due to its low susceptibility to pollution in comparison to surface water.

It is well known that human health and survival depends upon use of clean water for drinking and other purposes. Thus the availability of clean ground water is most essential, as it serves as the basic and critical component for human life and also for a large number of habitations. It is estimated that approximately one third of the world's population consume groundwater for drinking purposes and today more than half of the world's population depends upon groundwater for survival (Mohrir et.al. 2009 and Anwar & Aggarwal, 2014). Distribution of fresh water resources is uneven throughout the world so fresh water supply is limited for both growing population and diverse human activities. In the absence of fresh surface water resources, groundwater is exploited to meet the demand exerted by various sectors (Annapoorna & Janardhana 2015). The physico-chemical contaminants that adversely affected the quality of groundwater due to use of various agricultural chemicals and penetration of effluent from sewage treatment plants and ponds used for storage (Pathak 2012).

In India where ground water is used intensively for irrigation and industrial purposes, variety of land and water based human activities are causing ground water pollution. It contains wide varieties of dissolved   inorganic chemicals constituents in various concentration as a result of chemicals and biochemical interactions between water and geological materials which leads to deterioration of ground water quality. Groundwater quality has undergone a change to an extent that use of such water could be hazardous. The protection of ground water is important if ground water become polluted it is difficult to treat thus in light of the above discussion a study of ground water quality monitoring of industrial area of Dharuhera was undertaken.

MATERIAL AND METHODS
 The whole study was divided into two parts.
   1.   Sampling of ground water from industrial area of Dharuhera district Rewari, Haryana.

2. Physico- chemical Analysis of underground water Sample.

Water sampling: The samples were collected in pre cleaned sterilized bottles and stored in an icebox. A total of 30 water samples were collected from different sources, such as hand pumps, submersible pump and dug wells presented in table 3. It was ensured every time that bottles satisfied the following requirement i.e free from contamination and all samples are refrigerated at 4º C till complete analysis.

Physico Chemical Analysis
The pH of the water was determined on site using pH (Eutech- Instruments). Total alkalinity and total   hardness were measured by titration methods using standard sulphuric acid and standard EDTA solutions, respectively (APHA, 2005). Chloride was determined by argentometric titration method (APHA, 2005) and Fluoride by SPADNS method.

Sampling Area and Map of Dharuhera Industrial Area
 Dharuhera is a Municipal Committee (industrial   town) city in district of Rewari, Haryana. It lies between the 28° 05' 78" latitudes and 76° 60' 79" longitudes. It is well connected to Delhi by NH-8. According to 2011 census Dharuhera Municipal Committee had a population of 30,344 of which 16,414 are males while 13,930 are females.
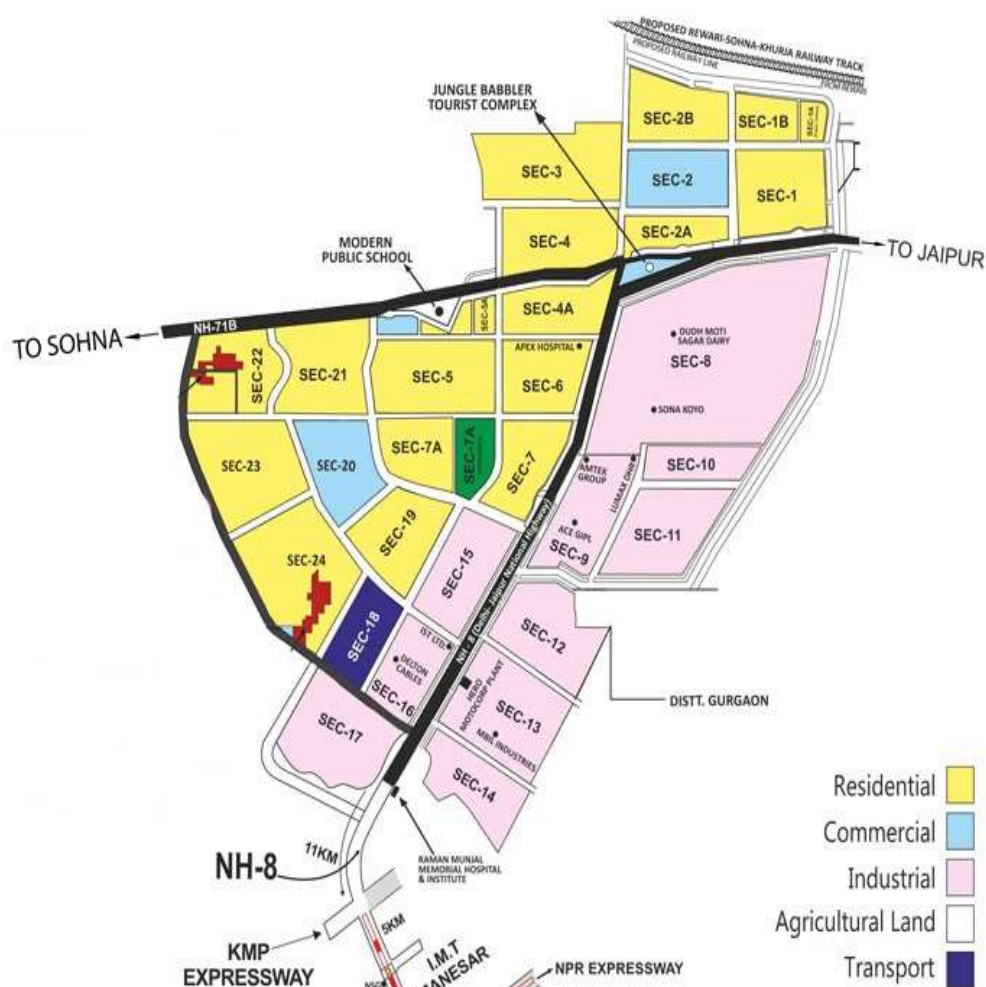

Fig-1 Location of Dharuhera Industrial Area in Haryana, India

RESULT AND   DISCUSSION
pH :- The pH of a solution is the negative logarithm of Hydrogen ion concentration. Its permissible limit in drinking water is 6.5 to 8.5 as prescribed by BIS. In the present study, it was varied from 6.8- 8.5 in the samples

collected from industrial area of Dharuhera district Rewari, Haryana (table 2) which is within the permissible limit as prescribed by BIS.

Total Hardness
Total hardness is a measure of the capacity of water to the concentration of calcium and magnesium in water and is usually expressed as the equivalent of $CaCO_3$ concentration. The hardness is caused due to the presence of excess of Ca, Mg and Fe salts (Kumar and Kumar, 2013). In the present study, the total hardness of the water samples ranges between 84 and 1140 mg/L. The analysis result of hardness is presented in figure 2 and table 2. About 86.6% of samples were found above the standard limit (200 mg/L) prescribed by BIS shown in table 1.

Calcium
Calcium is a major component of natural waters coming from rocks. Their presence in optimum concentration is also required to prevent cardiac disorders. The recommended limits for calcium in water are 75 mg/L prescribed by BIS shown in table 1. The Calcium concentrations are varied from 34 to 456 mg/L presented in table 2, 86.6% of samples were found above standard limit. Calcium in higher concentration is known to be responsible for the formation of stones in human beings.

Magnesium
The magnesium concentrations are varied from 3.0 to 145 mg/L shown in table 2, 40% samples were found above the standard limit (30 mg/L) prescribed by BIS shown in table 1.

Total Alkalinity
The constituents of alkalinity in natural system include carbonates, bicarbonates, hydroxides, phosphates and sulphides. These compounds result from dissolution of mineral substances in the soil and atmosphere. Highly alkaline water is unpalatable, excessive alkalinity is harmful for irrigation. Acceptable limit for alkalinity is 200 mg/L shown in table 1. In the present study alkalinity ranges from 32- 456 mg/L shown in table 2out of total 30 water samples only three (3) samples i.e. 10 % were found alkalinity beyond permissible limits.

Chloride
Chloride concentrations vary widely in ground water and it directly related to mineral content of the water. At concentration above 250 mg/l, water acquires salty taste which is objectionable. The chloride content of ground water of Dharuhera area ranges from 24-680 mg/L shown in table 2. This is found to exceed the desirable limit i.e (250 mg/L) prescribed by BIS shown in table 1. Out of total twelve (i.e.40**%)** samples were found exceeding the desirable limit.

Sulphate
It is naturally occurring anion found almost in all kinds of water bodies. Sulphate content more than 400 mg/L has purgative effects, the observed value of sulphate in studied samples of ground water of Dharuhera in the range of 24- 104 mg/L shown in table 2.. All the samples are in the permissible limit i.e. (200 mg/L) prescribed by BIS shown in table 1.

Nitrate
The recommended concentration of Nitrate in drinking water is 45 mg/L. Nitrate content in the sample of ground water of Dharuhera ranges from 0.1 to 12 mg/L presented in table 2. All the samples were found within the permissible limits i.e. BIS Standards limit 45.0 mg/l shown in table 1. Nitrate-nitrogen (NO3-N) in groundwater may result from point sources such as sewage disposal systems and non-point sources such as fertilized cropland.

Fluoride
Fluoride in the water is mainly due to the presence of fluorine in sedimentary rocks and igneous rocks. Water coming in contact, with these rocks may contain high concentration of fluoride. The permissible limit of fluoride is 1.0 mg/L as BIS standards shown in table 1.. The fluoride concentration in the ground water samples of Dharuhera is in range 0.1 to 3.4 mg/L shown in figure 3 and table 2. Fluoride is beneficial for human beings as a trace element, this protects tooth decay and enhances bone development, but excessive intake of fluoride in drinking-water, or in combination with exposure to fluoride from other sources can give rise to a number of adverse effect on human being (Suseela et.al. 1993; Khaiwal & Garg, 2006).

Table - 1: Comparison of ground water quality of Industrial area of Dharuhera with drinking water standards (Indian and WHO).

Parameters	Minimum	Maximum	Indian Standard As per BIS-10500: 2012	WHO
pH	7	8.5	6.5-8.5	6-9.2
Alkalinity(mg/lt)	32	456	200	200
Total hardness(mg/lt)	84	1140	200	500
Ca^{2+}(mg/lt)	34	456	75	500
Mg^{2+}(mg/lt)	3	145	30	50
Chloride(mg/lt)	24	680	250	259
Sulphate(mg/lt)	24	104	250	-
Nitrate(mg/lt)	0.1	12	45	45
Fluoride(mg/lt)	0.1	3.4	1.5	1

Table 2. Physico-chemical characteristics of the groundwater of the Dharuhera Industrial Area

Sample No	pH	Total Hardness(mg/lt)	Ca Hardness(mg/lt)	Mg Hardness(mg/lt)	Total Alkalinity(mg/lt)	Chloride(mg/lt)	Sulphate(mg/lt)	Nitrate(mg/lt)	Fluoride(mg/lt)
1	7.1	480	440	9.72	32	469	103	12	0.33
2	7.8	395	190	49.81	100	369	90	0.7	2.6
3	7.5	220	144	18.46	112	309	100	0.7	0.38
4	7.2	400	287	27.45	52	334	104	0.7	0.21
5	7.3	380	76	73.87	60	79	50	0.1	0.36
6	7.3	370	134	57.34	76	72	32	0.1	0.20
7	7.5	255	200	13.36	64	114	96	0.1	1.6
8	7.2	226	214	3.0	28	195	49	0.3	0.7
9	7.3	1140	540	145	40	319	43	4.2	0.10
10	7.6	305	60	59.93	256	145	77	3.6	0.30
11	7.8	108	20	21.38	456	185	82	2.2	1.2
12	7.6	400	240	38.88	160	387	79	10	0.31
13	7.2	372	220	37.00	88	380	70	6.8	0.50
14	7.2	328	280	11.66	72	332	73	1.3	1.4
15	8.0	436	334	24.78	60	139	62	5.0	0.85
16	8.4	270	239	7.53	104	271	67	7.2	0.4
17	8.2	212	96	28.18	152	39	67	0.1	0.15
18	8.1	192	88	25.27	168	59	46	8.4	0.38
19	7.7	388	324	15.55	64	375	70	6.5	1.8
20	7.8	292	138	37.42	96	320	57	0.1	0.38
21	7.4	280	72	50.54	80	215	46	0.1	0.58
22	8.1	132	80	12.60	88	80	35	7.0	2.4
23	8.1	212	128	20.40	104	60	39	1.1	0.37
24	7.8	268	132	33.00	40	72	24	0.2	1.8

25	8.3	340	194	35.40	208	160	60	0.1	2.1
26	7.4	480	456	5.83	80	680	89	0.7	0.5
27	6.8	396	308	21.30	52	100	102	2.7	0.1
28	8.2	544	434	26.70	176	146	90	6.2	0.5
29	8.5	200	70	31.50	88	40	53	8.4	0.5
30	7.4	84	34	12.15	160	24	57	2.8	3.4

Table 3 Details of sampling location and Source

| Sample No.	Location	Source	Depth (Feet)
1	Saheed Bhagat Singh Chowk, Dharuhera	Handpump	200
2	Amtek Auto Ltd.	Tubewell	220
3	Kool Breweries Ltd.	Tubewell	280
4	Oriented Carbon Ltd.	Tubewell	250
5	Lumax Industries Ltd.	Tubewell	300
6	RT Packing Ltd	Tubewell	300
7	Lifelong Pvt. Ltd.	Tubewell	320
8	Shiv Mandir	Tubewell	182
9	Amartex Shooping World	Tubewell	270
10	Shiv Mandir Housing Colony	Handpump	120
11	House Nearby Industrial Area	Handpump	80
12	Green Belt HUDA	Tubewell	200
13	Dharuhera Pharma Ltd.	Tubewell	220
14	Hanuman Mandir	Tubewell	230
15	PMI Coaches Pvt. Ltd	Tubewell	300
16	Logwell Forge Ltd	Tubewell	280
17	GKN Drive line	Tubewell	240
18	Sandchem Ltd.	Tubewell	270
19	Oswal Polyrubber Ltd.	Tubewell	260
20	Modern Coir Ltd.	Tubewell	290
21	Vibewell Technik Ltd	Tubewell	320
22	Kryton Pvt. Ltd	Tubewell	280
23	House Nearby Industrial Area	Handpump	110
24	Evershine Moulders Ltd.	Tubewell	310
25	AGRT Steel Strip Pvt. Ltd.	Tubewell	300
26	Metzbr Ltd.	Tubewell	260
27	Unimet Profile Pvt. Ltd.	Tubewell	240
28	House Neary Industrial Area	Handpump	120
29	Nearby Industrial Area	Tubewell	320
30	Open well Nearby Industrial Area	Borewell	220
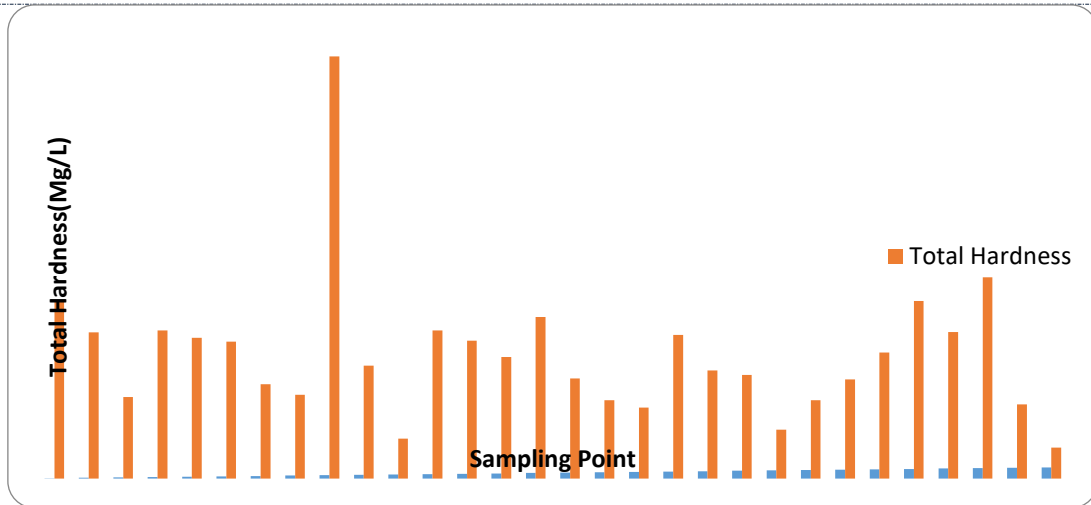
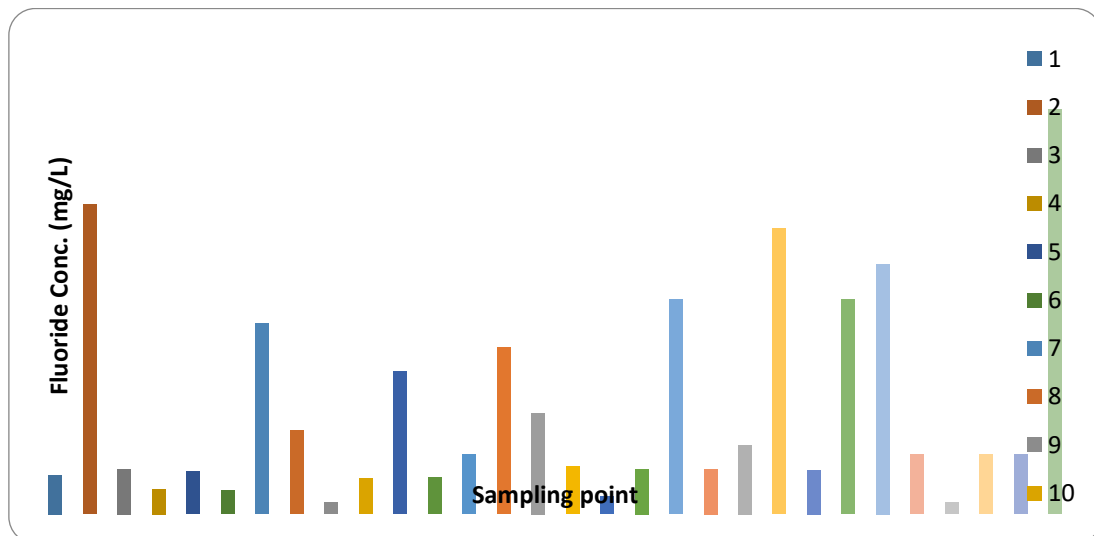*Fig 2: Variation of Total Hardness*

Fig 3: Variation of Fluoride Concentration

CONCLUSION

On the basis of physicochemical analysis of the ground water sources of industrial area of Dharuhera   Rewari district (Haryana), it has been concluded that the groundwater quality varied spatially. Water at most of the locations is not suitable for drinking purposes as per BIS guidelines. The analytical results shows concentration of Total hardness in 86.6% sample, Magnesium hardness in 40% sample, Calcium hardness in 86.6 samples and Chloride in 40% samples higher than the permissible limit of BIS as well as WHO, which indicates signs of water quality deterioration in industrial area of Dharuhera   Rewari district (Haryana)..

REFERENCES

[1] A.K. Susheela, A. Kumar, M. Bhatnagar and M. Bahadur, "Prevalence of endemic fluorosis with gastro intestinal manifestations in people living in some north Indian villages.Fluoride," 1993, Vol. 26, pp 97-104.

[2] APHA (2005). Standard Methods for the Examination of Water and Wastewater. 21th edn, APHA, AWWA, WPCF, Washington DC, USA.

[3] Bureau of Indian Standards (BIS), Indian standard specification for drinking water, second revision Bahadur Shah Zafar Marg New Delhi, (2012).

[4] K.M. Anwar and V. Aggarwal, "Analysis of Groundwater Quality of Aligarh City, (India):Using Water Quality Index," Current World Environment 2014, Vol. 9(3), pp 851-857.

[5] Kumar, M., and Kumar, R, "Assessment of Physico-Chemical Properties of Ground Water in Granite Mining Areas in Goramachia, Jhansi, UP, India," International Research Journal of Environment Sciences. 2013 2 (1) pp 19-24.

[6] Mohrir, D.S. Ramteke, ,Moghe, C.A. and R. Sarin, "Surface and Groundwater Quality Assessment in Binaregion", IJEP, 2009, 9; 22.

[7] Pathak, H, Assessment of Physico-Chemical Quality of Groundwater by Multivariate Analysis in some Populated Villages nearby Sagar City, MP, India," J Environ Anal Toxicol, 2012,

[8] R. Khaiwal, and V.K. Garg, "Distribution of fluoride in groundwater and its suitability assessment for drinking purpose," Int. J. Environ. Hlth. Res.2006, vol. 16, pp -163-166

[9] World Health Organization (WHO), Guideline for drinking water quality, 2nd ed., Vol 2 Health criteria and other supporting information,World Health organization, Geneva, 1997, pp 940-949.