

# Study on Physico-Chemical Characteristic and Suitability of Underground Drinking Water under Bhagalpur Municipal Corporation

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**Abstracts:** *Bhagalpur is one of the oldest district and presently old division of Bihar situated on the bank of holy River Ganga having total population of 399282 ref.yr.2011 to be covered under safe and hygienic drinking able water Source. At present city dweller has only two Water sources either from River Ganga or from their own/govt underground deep tube well water supply unit is located at Barari has about 0.01% supplying capacity. The status of drinking water its physical and chemical studies was the plan of our study. Bhagalpur is a part of Gangetic plains. The ground water of Ganga occurs under confined condition and underground water level is going rapidly in down trends. Presently one has to pump out water from 350feet bgl to 450 feet bgl having 60 water pumps run by BMC/PHED and 16 number of drains operative in BMC, discharge waste water into Ganga River. The present study is concerned with the measurement of its temp, PH, TH, TDS, EC,[Na<sup>+</sup>],[K<sup>+</sup>],[Cl<sup>-</sup>],[F<sup>-</sup>] and compare the value obtained from standard BIS, WHO and MIC corresponding reference and to justify at what level it is causing health hazard to the innocent people.*

**Keywords:** phonetic, hygienic, presidency redresses, inhabitants.

## 1. Introduction

Chemically, water is a compound of hydrogen and oxygen but it is highly complicated and incompletely studied. In Vedas water referred as matritamah means “most maternal”, in the Holy Koran saying is “We have created every living thing from water”, Assyro-Babylonian says “Tiamat” (salt water) and “Apsu” (sweet water) are divine things that made all beings. Chinese mythology takes water as “Thousands lives on those who ref drink it, ref.-Pon Lai” in Judaeo-Christian God is called “the fountain of life” where as scientists take it as “abnormal liquid. Whatever may be the truth water or pure water is penultimate need for our survival. In the present study we are going to explore the purity of drinking water in the Municipal corporation of Bihar namely Bhagalpur which is phonetic distorted form of Bhagatpuram means city of luck during Anga kingdom. BMC records 3.72% population growth from 2006 and onwards .The city has to be prepared for their water demands Bhagalpur was referred to as one of the biggest trade centres in Eastern India by the 7th century ref. by Huan-t-sang and Fa-Hien the prominent Chinese travellers. The City had a big Harbour on River Ganga at a place Champanagar now called Champanala that flows on the western entry of the City The existence of harbour means there were enough water discharge in the river Ganga in that period .This fact is also supported by the story of Naag (the king snake) and Naagin (the snake Queen) being worshiped in Champanagar in their temple called Bisahri-Temple. Snake charmer offer milk to them from this story we inferred that place was inhabitant of snakes they are safe and have favourable echo system for their growth naturally there must have water flow all along the seasons. Bhagalpur is one of the historical, ethical/literary/silk cities of the republic India. It is one of the oldest district of Bengal Presidency, presently in Bihar. It is 414km west of Kolkata and 225km east of its capital Patna situated at the height of 141ft from

sea level at latitude of 25°15'N and longitude 87°01'E. Its population is 399282 ref yr 2011 in 64192 Holdings. With daily solid waste 300MT/day. The whole city constitute one assemble constituency. Entire city is non-agro base population presently it is famous for silk industry but has been defamed for 1989 communal riots.

Out of 51 wards of the city no deep well boring is supplying soft water hygienic and safe for human consumption. Affordable people use supply water for other house work than to be drunk, but lower class people bound to drink such water. When Ganga was not polluted nearby dweller use to collect Ganga water for their daily consumption. Through this study we are trying out pest to bring in light the factual status of drinking water in the city so that attempts may be made in the coming plan for its redresses.

## Drinking Water Source in the BMC

Bhagalpur city has only two sources of drinking water either from holy but highly polluted River Ganga or underground water obtained from deep bore pumped from 300 feet bgl to 450feet bgl and it is moving fast in down ward direction.

## 2. Collection Sampling and Methodology

The present investigation was involved with study of water samples collected from 20 out of 51 wards of the municipal corporation as shown in by their number in the map of Bhagalpur with the purpose of characterised physico-chemical properties of drinking water either supplied or pumped by individual. The ground water sample was collected in Borosil glass pre sterilized bottle for the purpose of analyzing their different characteristics like PH, TH, [Na<sup>+</sup>], [K<sup>+</sup>] as per method reported in APHA standard method for examination of water and waste water, 20<sup>th</sup> edn-

1981(145) and the result so obtained was tabulated in Tables for further investigation

Table

Sl. No.	PH	TDS Mg/L	EC	Nitrate	Chloride	Sodium	K	F(-J)	Ca(II)	Mg(II)	Turb	TH
BMC.01	7.00	240	454	20	147	132	0.9	0.18	14	12	2.8	160
BMC.02	7.1	228	1220	26	58	136	1.1	0.11	29	09	2.7	199
BMC.03	6.8	550	900	29	136	120	0.8	0.13	46	10	1.7	190
BMC.04	6.9	330	756	16	120	108	0.3	0.09	48	11	0.6	160
BMC.05	6.8	598	1150	20	140	26	0.4	0.12	96	13	0.8	260
BMC.06	7.3	688	1230	30	60	38	0.4	0.26	78	14	1.9	256
BMC.07	7.2	892	770	19	46	29	12	0.17	72	27	3.9	360
BMC.08	7.1	742	854	30	137	60	0.2	0.37	105	35	3.5	209
BMC.09	7.2	781	940	10	141	40	0.5	0.30	98	41	4.3	210
BMC.10	6.8	785	1130	07	131	107	0.6	0.15	120	22	1.9	230
BMC.11	6.9	840	658	08	133	22	0.5	0.12	146	36	2.3	270
BMC.12	7.2	707	944	20	90	53	0.4	0.89	136	42	5.2	285
BMC.13	7.3	690	710	16	70	54	0.3	0.62	85	51	3.8	700
BMC.14	7.11	584	880	20	72	56	0.3	0.70	71	54	3.0	305
BMC.15	7.1	590	835	14	79	41	0.7	0.65	104	08	4.8	86
BMC.16	6.9	625	920	22	86	45	1.2	0.10	127	12	6.3	88
BMC.17	7.0	320	680	10	135	130	0.4	0.36	114	13	0.8	49
BMC.18	7.1	300	912	12	152	35	0.3	0.64	127	10	1.9	54
BMC.19	7.2	630	1160	08	86	112	1.2	1.02	146	16	3.7	82
BMC.20	7.4	840	1370	11	95	146	1.6	1.01	167	14	2.9	93

Mean	7.07	598	923.65	17.4	105.7	73.2	0.69	0.4395	96.5	23	2.94	212.3
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### Collection & Sampling and Methodology

Out of 51 BMC ward samples were collected from 20 different location and they were symbolised as.

Sample No	Location under BMC	Sample No.	Location under BMC
BMC-01	University Campus	BMC-11	Manik Sarkar Chowk
BMC-02	Mahashay Deodi Champanagar	BMC-12	Muslim High School Campus
BMC-03	Company Bagah	BMC-13	Kalabganj School
BMC-04	R.E.O Campus Adampur	BMC-14	Maulana Chak
BMC-05	Govt. School Barari	BMC-15	Mirzan Hat School
BMC-06	Abir Mishra lane Nathnagar	BMC-16	Mugalpora
BMC-07	Opposite BMC office	BMC-17	Aliganj
BMC-08	Teacher Training College Campur	BMC-18	Agro market Bagbari
BMC-09	Anandgarh Colony	BMC-19	Barahpura
WS-10	Chunihari Tola	WS-20	Akashwani Office

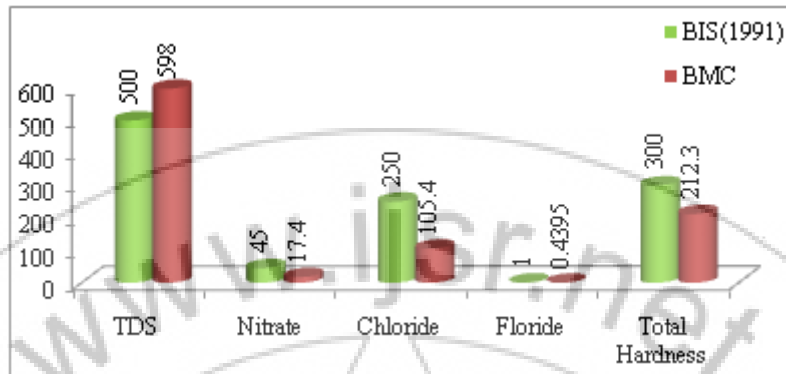
### 3. Results and Discussion

The variation in temperature of source for collecting sample was in the range of  $32 \pm 3$  and value ranges from 305K to 308K, pH value were from 6.8 to 7.4 showing slightly acidic to alkaline. Whereas BIS and MCI reference is 0.5 to 8.5 for human consumption. Total Dissolved Solid(TDS) value vary from 228mg/L to 892mg/L with average value 598mg/L The public value of TDS is that lower value provides good taste to drink BIS, MCI and WHO advise that TDS 500mg/L is palatable and above 1200mg/L as unsafe for human consumption and declared unpalatable. The turbidity value was measured in the unit of Nephelometric Turbidity Unit (NTU). Low turbidity value is the signal for high water clarity, where as its high value is the signal for lower water clarity the value of turbidity is indication of high clarity at all resource in the city. The total hardness [TH] of all the water sample was found in the range of 49mg/L to 700mg/L having mean value 212.3 mg/L hardness level >500mg/L are considered to nondrinking water and even in domestic use .

The electrical conductivity (EC) measured by conduct metric set was found to use in the range from 454.µs/cm to 1370.µs/cm the BIS limit is 600µ/cm. the (Cl<sup>-</sup>) was in between 46mg/L to 152mg/L and the mean value was 105.7.mg/L. WHO guide line for drinkable water quality must have an aesthetic objective (AO)<250mg/L. The [Cl<sup>-</sup>] up to 250mg/L is best suited for Agro-use [Na<sup>+</sup>] in all the sample was in the range of 26.mg/L to 147.mg/L which is found to be much lower than BIS,MCI and W.H.O recommended land mark of 200mg/L. No doubt Na<sup>+</sup> is essential for human life and daily intake limit should not exceed 120to 400m/L is sufficient to meet the demand of our body but an adult should minimize the value as advised by WHO as it may soot up B.P.Value. The value of [NO<sub>3</sub><sup>-</sup>] have limit in Bhagalpur like drinking water form 7.0.mg/L to 30.0.mg/L and mean[NO<sub>3</sub><sup>-</sup>]17.4.mg/L the [F<sup>-</sup>] in different water sample was 0.4395.mg/L (mean value). Its standard recommendation is 1.0mg/L. The [K<sup>+</sup>] was analyzed for all the 20 sample and result was recorded in the table has range from 0.2mg/L to 1.2mg/L.

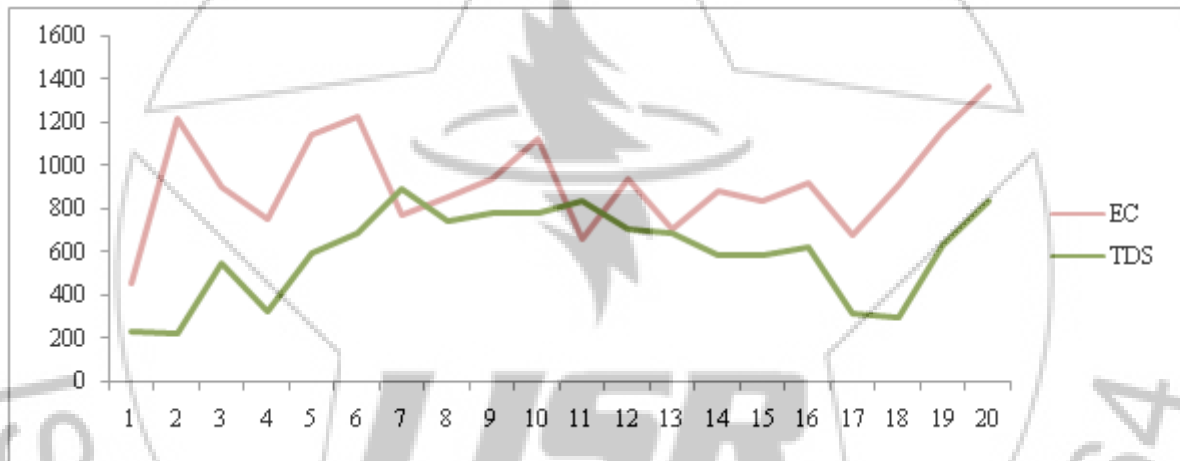
Whatever my Conc. of different ions and other parameters consuming community of each locality said that water is not better in test any how we do this all such are of high TDS.

**4. Physico Chemical properties (Mean) of BMC were compared to BIS as under**

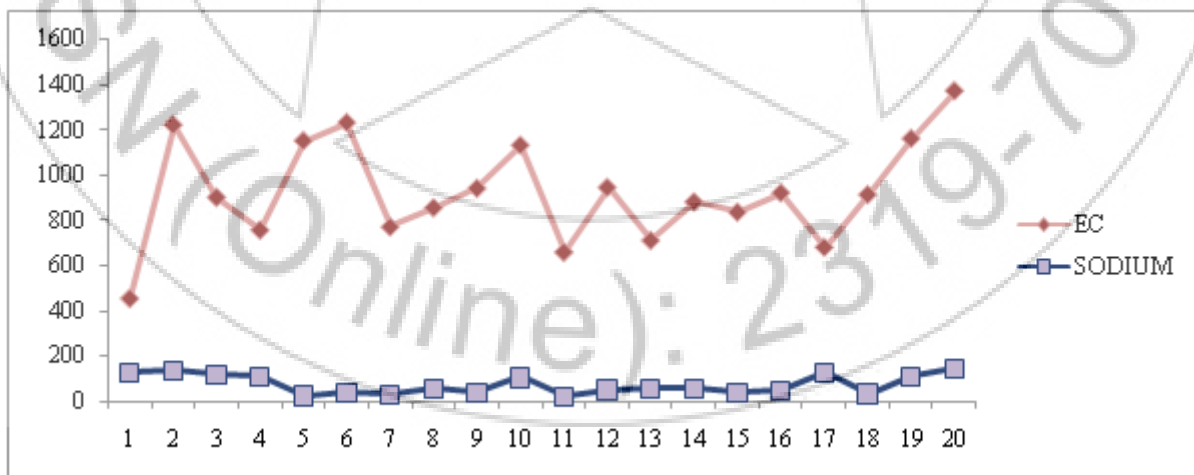


BIS-Indian standard of Drinking water-specification (BIS)  
 BMC-Bhagalpur Municipal Corporation

**Figure 2:** The Mean value of different parameters obtained from BMC and compared with BIS(1991)



**Figure 3:** The relation between Electrical Conductivity (EC) and TDS are shown graphically.



**Figure 4:** Graphical variation in [Na (I)] and Conductivity are shown

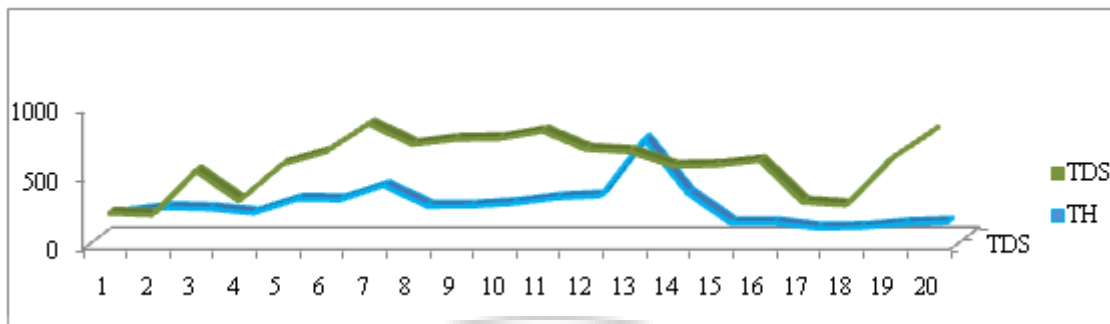


Figure 5: The relation between TDS and TH (Total Hardness) are shown graphically

The mean values of all the properties of 20-BMC water

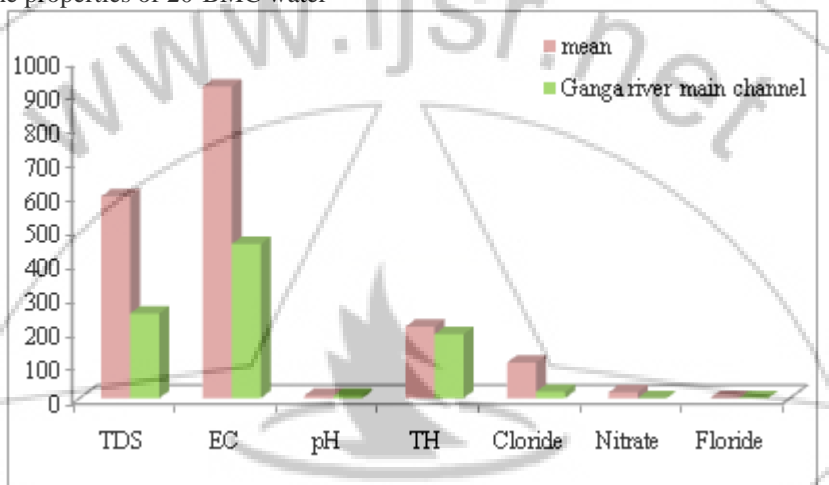


Figure 6: Mean value of some characteristics in BMC underground water and main channel Ganga Water at Bhagalpur

(Source-EIA-Bhagalpur water supply)

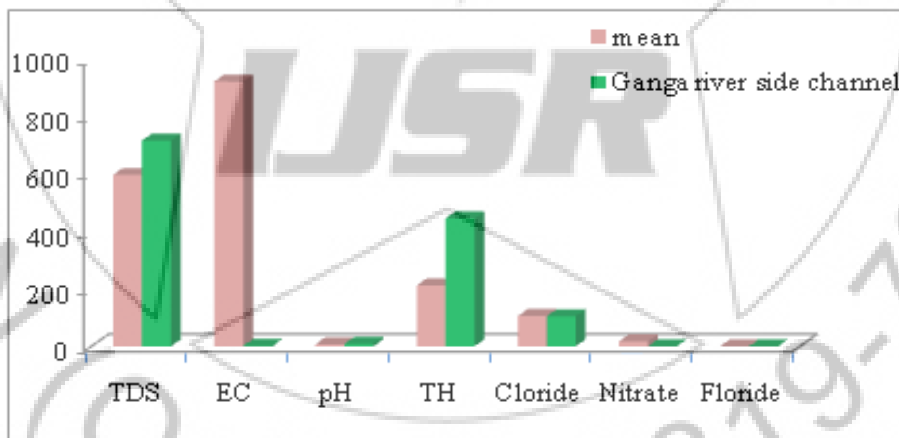


Figure 7: Mean value of some characteristics in BMC underground water and side channel Ganga water at Bhagalpur

(Source-EIA-Bhagalpur water supply)

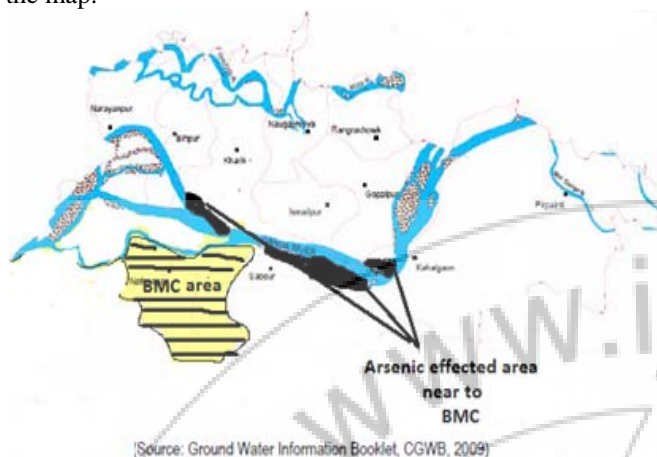
### 5. Conclusion

Bhagalpur city is entirely situated on the bank of holy River Ganga but not a single deep well pumped out tasty and hygienic water. So far local pollution of River Ganga in concerned, there is neither major industry in the city that may discharge waste in the river only human water waster coming from all the 16 drainages in the city as the polluting sources of contamination of drinking water. Although time to time attempts were made by state government to bring sivergse system operative but all became in vain. The result is that inhabitants of this city is bound to drink unhygienic

water particularly people of lower income group, middle and high income group and either issuing package water or have installed water purifier in his house hold. It is unfortunate for country like India where the great philosopher/ teacher/ hydrologist like Varamihir, Kautilya have given water as one of the three gems of the earth.

Prithibiyam trini ratnani jalam annam subhashitam |  
Mudhai pashan khandeshu ratna sangya vidhiyate ||  
Kautilya Niti-14.01

We are bound to get artificial gem in the name of polluted or contaminated drinking water. Recently adjoining area of the BMC is under Arsenic attack in drinking water as shown in the map.



But it has been found that Arsenic is contaminated only in those water which is pumped out from the depth of 12m bgl to 40m bgl, there is drastic decline in Arsenic concentration when water is pumped out below 40m bgl, all municipal and most of the private deep well are more than 100m bgl hence for the time being BMC area are free from Arsenic contamination. As reported in by Central Underground Water Agency, BMC is under high potential Zone and have enough water supplying strength. Pre monsoon water level data reveals that the depth of water level goes to 1.35m bgl to 4.3m bgl. **“If Water is Life, Sanitation, Surely is Way of Life”.**

## 6. Recommendations

Although number of drainages are only 16 under BMC, but highly dreadful, last year in one of the drainage in Adampur Ward no. 22 during medium rainfall one student washed to death with his bike on main road hardly 300 meter from the BMC H.O. in mid day. Arsenic attack has reached in the rural area of the district. Under this situation we may hope BMC and PHED of Bihar government will take serious note of this study before red alert.

## 7. Acknowledgement

The authors acknowledge Dr. A. K. Jha, Head Department of Chemistry, G. B. College Naugachhia, and T. M. Bhagalpur University for providing lab facilities to this work. I also acknowledge my husband Tathagat Priyadarshi for Information Technology and Computing support and my only three years old son in maintaining himself for peace as well as my mother-in-law for her continuous support and blessing during the whole research work.

## References

[1] Mariappan V., Prabakaran P., Rajan M.R. and Ravichandran A.D., A Systematic study of water quality index among the physico-chemical characteristics of groundwater in and around Thanjavur Town, Ind. J. Env. Protect., 25, 551- 555 (2005)

- [2] Jameel, Evaluation of drinking water quality in Thiruchirapalli, Ind. J. Env. prot., 44(2), 108-112 (2002)
- [3] Rajmohan N., Elango L., Ramachandran S. and Natarajan, Major ion correlation in groundwater of Kancheepuram region, South India, Ind. J. Env. Health, 45(1), 1-5 (2002)
- [4] Meenakshi and Maheshwari R.C., Fluoride in drinking water and its removal, J.Hazard.Mater., 137, 456 – 463 (2006)
- [5] Zoeteman C.J., Overview of contaminants in groundwater. In: Ground water quality (Eds.) Ward, C. H., W. Giger and P. L. Mc Carty. Wiley - Interscience publications, 28 (1985)
- [6] Saxena M.M., Environmental Analysis – water, soil and air, Agro Botanical Publishers (India), 2nd Edition, 4-86, 121-125 (1994)
- [7] American Public Health Association: Standard Methods for the examination of water and waste water, 17th edition., Washington, DC 1989
- [8] Bureau of Indian Standards, (IS 10500:1991), Edition 2.1. (1993)
- [9] Nirmala B. and Ranjitha N.J., Physico-chemical analysis of ground water of selected areas of Mysore city, Karnataka, India, World Rur. Obser., 3(3), 88-91 (2011)
- [10] Patil V.T. and Patil P.R., Physio-chemical analysis of selected ground water of Amalner Town on Jalgaon District, Maharashtra, India, E J. Chem., 7(1), 111-116 (2007)
- [11] Durfor C.N. and Becker E., Public water supplies of the 100 largest cities in the United States, U.S. Geological Survey Water-Supply Paper, 1812, 364 (1964)
- [12] Ranjana A., Physical-chemical analysis of some ground water sample of Kotputli Town Jaipur, Rajasthan, International Journal of chemical, environmental and pharmaceutical research., 1(2), 111-113 (2010)
- [13] Mittal S.K., Rao sikh, R.L. and Kumar, Groundwater quality of some areas in Patiala city, Indian J Environ Hlth., 36, 51-53 (1994)
- [14] Gopalkrushna M.H., Assessment of physico-chemical status of ground water samples in Akot city., Res. J. Chem. Sci., 1(4), 117-124 (2010)
- [15] Devi S. and R. Premkumar, Physico-chemical analysis of ground water sample near Industrial area, Cuddalore district, Tamilnadu, India, Int. J. ChemTech Res., 4(1), 29-34 (2012)

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