

PHYSICO CHEMICAL ANALYSIS OF GROUND WATER NEAR MUNICIPAL SOLID WASTE DUMPING SITES IN COIMBATORE CITY

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ABSTRACT: The water is essential for both animal and plant kingdom and also for industrial and agricultural needs. Nowadays, the available surface water is not fulfilling the needs of human beings. Hence they are going for the subsurface water. In Coimbatore people mainly depend on the groundwater for their daily uses. The quality of groundwater is as important as its quantity. The quality was assessed in terms of physicochemical parameters. The usual and the most neglected cause of water pollution are uncontrolled dumping of Municipal Solid waste. Infiltration of water by rainfall, water already present in the waste or water generated by biodegradation, cause the leachate to leave the dumping ground laterally or vertically and find its way into the groundwater thereby causing contamination. Ten groundwater samples collected during the rainy season 2011 from the study region and the samples were analysed for various physical and chemical properties. During the study it was found that Total Dissolved Solids varies from 565 mg/l to 912 mg/l and compared with permissible limits. Therefore, the best accepted option is to avoid the possibility of polluting the groundwater resources.

Keywords: Municipal solid waste, Groundwater, Pollution, Contamination

1. INTRODUCTION

Due to rapid increase in population in India have resulted in a drastic increase in the generation of Municipal Solid Waste (MSW). It includes domestic as well as commercial waste that accounts for a relatively small part of the total solid waste stream in developed countries. Accumulation of a large amount of waste may create several problems to inhabiting populations. Population growth has been contributing to increase the quantity and variety of waste. Collection, transportation and handling of the waste must also be properly dealt with, if not, the waste creates a number of problems, many of which are related to human health and environment (Dhere et.al., and Fadel et.al.). The major part of MSW management was direct disposal open dumps and observed that developing countries where the waste is dumped directly in unscientific and uncontrolled manners can be detrimental to the urban environment. MSW leachate contains variety of chemicals like inorganic chemicals, detergents and complex organic chemicals and metals (Cocchi.et.al.)

During infiltration of water by rainfall, water already present in the waste cause the leachate to leave the dumping ground laterally or vertically and find its way into the ground water thereby causing contamination (Badmus et.al., and Iqbal et.al.). In recent times, the impact of leachate on groundwater and other water resources has

attracted a lot of attention because of its overwhelming environmental significance. Leachate migration from landfills and release of pollutants from sediments pose a high risk to groundwater resource if not adequately managed (Ikem et.al.)

The recent research in Coimbatore concluded that it is high rate of exploitation of ground water that its recharging, inappropriate dumping of solid and liquid wastes are the main causes of deterioration of ground water quality. Thus, there is needed to look for some indicators both Physical and chemical which can be used to monitor both drinking water operation and performance. The present study deals with the assessment of ground water quality near Municipal Solid Waste dumping sites in Coimbatore city.

2. MATERIALS AND METHODS

A. Survey and Sample Collection

Survey was conducted during the months of June, July, August (rainy season) of the year 2011 of the dumping sites all around Coimbatore. All the samples were collected from near the MSW dumping sites and stored at 4°C until used for analysis.

B. Physico-Chemical Analysis

All the samples were analyzed for the following physicochemical parameters; pH, temperature, turbidity, Electrical Conductivity (EC), Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Total Solids(TS), Total Alkalinity(TA), Chloride, Total Hardness(TH), Ca hardness, Mg hardness, Dissolved Oxygen(DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand(COD), Nitrate, Nitrite, Fluoride, Ammonia and Sulfate. The physicochemical analysis of water samples were carried out in accordance to standard analytical methods (APHA).

3. RESULTS AND DISCUSSION

The data obtained from the current study showed in table no.1 which was followed.

PH

The pH of the groundwater samples were about neutral, the ranges from 7.03 to 7.89.

Temperature

The temperature of groundwater sample slightly varies from 25.12 to 27.18.

Turbidity

Turbidity of groundwater samples obtained from 2.0 to 6.2 which showed limits under the CPCB.

Electrical Conductivity

Electrical Conductivity is a measure of total salt content in water. It is a determination of levels of inorganic constituents in water. Electrical Conductivity ranges between 512 $\mu\text{s/cm}$ to 951 $\mu\text{s/cm}$.

Total Dissolved Solids

Total dissolved solids are a measure of total inorganic substances dissolved in water. Total Dissolved Solids indicates the general nature of water quality or salinity. During the study Total Dissolved Solids is found between 545 mg/l to 996 mg/l. The Total Dissolved Solids concentration was found to be above the permissible limit may be due to the leaching of various pollutants into the ground water which can decrease the potability and may cause gastrointestinal irritation in human and may also have laxative effect particularly upon transits. Similar results also reported by Olaniya and Saxena.

Total Suspended Solids

Total Suspended Solids minimum value is found to be 35 mg/l and maximum value of 76 mg/l from sample no. 4 and 3 respectively might be due to the presence of several suspended particles. The total suspended solids are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of Ca, Mg, Na, K, Mn organic matter, salt and other particles. The effect of presence of total suspended solids is the

turbidity due to silt and organic matter. When the concentration of suspended solids is high it

may be aesthetically unsatisfactory for bathing (APHA).

Table 1: Physico-Chemical Parameters of the groundwater samples from MSW dumping sites at Coimbatore

S.No.	Parameters	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
1.	pH	7.25	7.12	7.27	7.14	7.11	7.03	7.77	7.46	7.89	7.37
2.	Temperature	25.12	25.15	26.32	27.18	25.16	25.78	26.47	25.27	27.11	26.89
3.	Turbidity (NTU)	5.8	6.0	2.0	5.6	2.1	4.8	3.8	6.2	2.7	4.5
4.	EC ($\mu\text{s}/\text{cm}$)	841	951	856	912	512	765	854	943	868	904
5.	TDS (mg/l)	754	896	768	832	786	862	545	790	863	845
6.	TSS (mg/l)	68	53	76	35	47	69	54	72	68	56
7.	TS (mg/l)	854	962	868	937	524	783	879	965	872	923
8.	TA(mg/l)	162	178	135	96	78	126	145	187	134	112
9.	Cl(mg/l)	156	264	208	114	138	173	172	246	287	218
10.	TH (mg/l)	280	305	276	277	149	189	192	258	278	217
11.	Ca(mg/l)	108	264	135	246	101	156	134	198	204	179
12.	Mg (mg/l)	54	46	38	46	65	42	36	67	56	34
13.	DO (mg/l)	4.14	3.78	4.03	3.92	5.16	4.78	6.35	6.43	4.68	4.12
14.	BOD (mg/l)	1.5	1.8	1.6	2.3	3.7	2.6	1.2	1.4	1.1	3.2
15.	COD (mg/l)	9.4	6.2	2.6	10.8	11.3	22.5	13.2	9.5	12.2	11.8
16.	NO ₃ ⁻ (mg/l)	2.8	12.5	ND	20.1	ND	5.6	5.4	ND	6.8	1.2
17.	NO ₂ ⁻ (mg/l)	0.45	ND	ND	0.04	ND	0.56	0.09	ND	ND	0.32
18.	F ⁻ (mg/l)	1.2	0.3	0.1	ND	0.5	0.7	ND	0,3	ND	0.9
19.	NH ₄ ⁺ (mg/l)	1.2	ND	0.2	2.4	4.3	1.2	0.8	0.5	1.6	1.8
20.	SO ₄ ⁻ (mg/l)	10.8	5.9	3.4	8.2	1.5	78	64	48	120	83

*GW- Groundwater. ND: Not Detectable

Total Solids

The value of Total Solids in this study was found minimum 524 mg/l and maximum 965 mg/l in sample no. 5 & 8 respectively.

Alkalinity

The total alkalinity was found to be in the range of 78 to 187 mg/l in ground water samples which are caused mainly due to OH, CO₃, HCO₃ ions.

Chlorides

The value of chlorides was found to be in the range of 114 mg/l to 287 mg/l as presented in table which is further compared

with the standard values 250 mg/l. Department of National Health and Welfare, Canada reported that chloride in ground water may result from both natural and anthropogenic sources such as run-off containing salts, the use of inorganic fertilizers, landfill leachates, septic tank effluents, animal feeds, industrial effluents, irrigation drainage and seawater intrusion in coastal areas. Chloride is not harmful to human at low concentration but could alter the taste of water at concentration above 250 mg/l (Hauser).

Total Hardness

The total hardness of ground water samples were found to be in the range of 149 mg/l to 305 mg/l which is further compared with the standard value ranged 300 mg/l. Water hardness is usually due to the multivalent metal

ions, which comes from minerals dissolved in the water.

Calcium and Magnesium hardness

Calcium and Magnesium hardness of groundwater samples were found maximum of 264 mg/l and 67 in sample no. 2 and 8 and minimum of 101 mg/l and 34 mg/l in sample no. 5 and 10 respectively which are further compared with the standard values of CPCB.

Dissolved Oxygen

Dissolved Oxygen of ground water samples were found in the range of 3.78 mg/l to 6.43 mg/l due to the capacity of water to hold oxygen.

Biological Oxygen Demand

The BOD value ranges from 1.1 mg/l to 3.7 mg/l which represent the amount of oxygen that microbes need to stabilize biologically oxidizable matter.

Chemical Oxygen Demand

The chemical oxygen demand value ranges from 2.6 mg/l to 22.5 mg/l. The test is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water, making COD a useful measure of water quality (Clair N Sawyer).

Nitrate

The concentration of nitrate was found in water sample up to 20.1 mg/l.

Nitrite

The concentration of nitrite was found up to 0.56 mg/l. Nitrites reacts directly with hemoglobin in human blood to produce methemoglobin, which destroys the ability of blood cells to transport oxygen. It can also cause methemoglobinemia or “blue baby” disease. Water with nitrite levels exceeding 1.0 mg/l

should not be consumed by humans let alone given to babies (Akinbile).

Fluoride

The concentration of fluoride in the studied water samples ranged from 0.1 mg/l to 1.2 mg/l. The concentration of fluoride at low concentration in ground water has been considered beneficial but high concentration may causes dental fluorosis (tooth mottling) and more seriously skeletal fluorosis. (Ravindra.K)

Ammonia

The ammonia (NH₄) concentration in the samples ranged from ND to 4.3 mg/l and likely indicates its origin from leachate of MSW.

Sulfate

Concentration of sulfate in water sample ranged from 1.5 mg/l to 120 mg/l. Sulfate is a nontoxic anion but ailment like catharsis, dehydration and gastrointestinal irritation have been linked with it when concentration is high (Bertram, J.et.al.,)

4. CONCLUSION

On the basis of current study we can conclude that the ground water near the MSW dumping areas most of the under permissible limit of CPCB but some of the achieving near permissible limit, so far there we can follow the safety recommend the following. The study assessed the evolution of water quality in ground water of Coimbatore near MSW. A comparative study of ground water i.e. bore well and hand pump water carried out by taking certain important parameters like pH, TSS, TDS, TS, TA, COD, Nitrate, Cl⁻, F⁻ etc. In this present study it was found that the maximum parameters were not at the level of pollution except few parameters like nitrate, TDS, TSS, TS and TH in ground water. So both type of ground water satisfy the requirement for the use in.

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