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Physicochemical Analysis of Ground Water near Municipal Solid Waste Dumping Sites in Rewa (M.P.) India

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Abstract - 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 2015 from the study region and the samples were analyzed for various physical and chemical properties. During the study it was found that Total Dissolved Solids varies from 546 mg/L to 907 mg/L and compared with permissible limits. Therefore, the best accepted option is to avoid the possibility of polluting the groundwater resources.

Key words- Municipal solid waste, Groundwater, Pollution, Leachate, Contamination Rewa.

I. INTRODUCTION

Rapid increase in population and change in life style in India have resulted in a dramatic 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 quality 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.*, 2008).

The major part of MSW management was direct disposal open dumps. It is unfortunately 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 detergents, inorganic chemicals and complex organic chemicals and metals (Cocchi and Scagliarini, 2005). These components are themselves very much toxic for the environment and additionally uncontrolled microbial action may result in release of more toxic elements which were not present in a free or reactive form in the waste (Abbasi and Vinithan, 1999). During 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 ground water thereby causing contamination (Badmus, 2001, Iqbal and Gupta, 2009). 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 wastes sites or landfills and the release of pollutants from sediments (under certain condition) pose a high risk to groundwater resource if not adequately managed (Ikem, *et al.* 2002).

Groundwater is an important water resource in both the urban and rural areas of India but in the cities, pipe borne water is also available. Rural dwellers rely basically on hand-dig wells for potable water supply as the streams usually dry up in summer season. This useful resource is under threat of pollution from human life style manifested by the low level of hygiene practiced in the developing nations (Punmia and Jain, 1998, Akujieze, *et al.*, 2003 and Bresline, 2007, Mishra, *et al.* 2009, Tewari, *et al.* 2010, Sirajudeen, *et al.*2014, Kumar and Kumar 2015). Protection of groundwater is a major environmental issue since the importance of water quality on human health has attracted a great deal of interest lately (Al-Sabahi, *et al.*, 2009, Longe and Balogun, 2010, Jothivenkatachalam, *et al.* 2010, Todd, 1980 and Rasheed, 2012). The recent research in Jabalpur (India) concluded that it is the high rate of exploitation of groundwater than 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 useful indicators, both chemical and physical, which can be used to monitor both drinking water operation and performance. Therefore, the present investigation deals with assessment of

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groundwater (drinking water) quality near municipal solid waste dumping sites at Rewa.

II. MATERIALS AND METHODS

A. Survey and Sample Collection

Survey was conducted during the months of August, September, October (rainy season) of year 2015 of the ten dumping sites all around Rewa. All the samples were collected from near the MSW dumping sites and stored at 4oC 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, Phosphate, Sulfate, Ammonia and Iron. The physicochemical analysis of water samples were carried out in accordance to standard analytical methods (APHA, 2005).

III. RESULTS AND DISCUSSION

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

A. Temperature

The temperature of groundwater sample slightly varied ranged from 25.11 to 27.31.

B. pH

The pH of the groundwater samples were about neutral, the ranged from 7.02 to 7.85.

C. Turbidity

Turbidity of groundwater samples obtained from 2.1 to 6.2 which showed limits under the CPCB.

D. EC

EC is a measure of total salt content in water (Morrison, *et al.*, 2001). It's a determination of levels of inorganic constituents in water (Awofolu, *et al.*, 2007). EC ranged between 571 µs/cm to 959 µs/cm.

E. TDS

Total dissolved solids are a measure of total inorganic substances dissolved in water (ANZECC, 2000). TDS indicates the general nature of water quality or salinity. During the study TDS is found between ranged 546 mg/l to 907 mg/l. The TDS 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 (WHO, 1997). Similar results also reported by Olaniya and Saxena, 1997.

F. TSS

In sample the minimum value was found 31 mg/l and maximum value 75 mg/l from sample no. 4 and 1 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, 2002).

G. TS

The value of TS in this study was found minimum 587 mg/l and maximum 978 mg/l in sample no. 5 & 6 respectively.

H. Alkalinity

The total alkalinity was found to be in the range of 76 to 198 mg/l in ground water samples which are caused mainly due to OH, CO_3, HCO_3 ions.

I. Chlorides

The value of chloride obtained 121 to 285 mg/l as presented in table which is further compared with the standard values 250 mg/l.

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Department of National Health and Welfare, Canada (DNHW, 1978) 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, 2001).

J. Total Hardness

The total hardness of ground water samples were found in the range of 150 up to 307 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. However, (Dzik, 1989) has reported an inverse relationship between water hardness and cardiovascular disease.

K. Calcium and Magnesium Hardness

Calcium and Magnesium hardness of groundwater samples were found maximum in sample no. 2 and 7 and minimum in sample no. 5 and 6 respectively which are further compared with the standard value of CPCB.

L. Dissolved Oxygen

DO of ground water samples were found in the range of 4.22 to 5.74 mg/l. due to the capacity of water to hold oxygen.

Biological Oxygen Demand

The BOD ranges values from 1.4 to 3.8 mg/l. which represent the amount of oxygen that microbes need to stabilize biologically oxidizable matter.

M. Chemical Oxygen Demand

The chemical oxygen demand ranged from 2.9 to 34.2 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, 2003).

N. Nitrate

The concentration of nitrate was found in water sample up to 54 mg/l. Although only one sample no. 6 exceeds the permissible limit but it shows a moderately high concentration. Jawad *et al*, 1998 have also reported increase in nitrate concentration in ground water due to waste water dumped at the disposal site and likely indicate the impact of leachate (Taiwo, *et al*. 2011).

O. Nitrite

The concentration of nitrite was found up to 0.51 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 and Yusoff, 2011).

P. Fluoride

The concentration of fluoride in the studied water samples ranged from 0.01 to 1.1 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 and Garg, 2005).

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

S.No.	Parameters	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
1.	Temp.	25.42	25.21	27.13	26.39	25.11	25.89	26.89	26.81	27.31	26.18
2.	pH	7.81	7.02	7.85	7.61	7.23	7.11	7.43	7.59	7.68	7.77
3.	Turbidity (NTU)	6.0	4.2	5.9	3.2	2.1	5.7	4.1	6.2	5.7	5.2
4.	EC (µs/cm)	952	814	865	902	571	912	794	959	802	903
5.	TDS (mg/L)	896	790	837	879	546	874	756	907	751	869
6.	TSS (mg/L)	75	36	42	31	41	69	47	71	65	52
7.	TS (mg/L)	971	826	979	910	587	943	803	978	816	921
8.	TA (mg/L)	189	167	121	98	76	101	113	198	129	106

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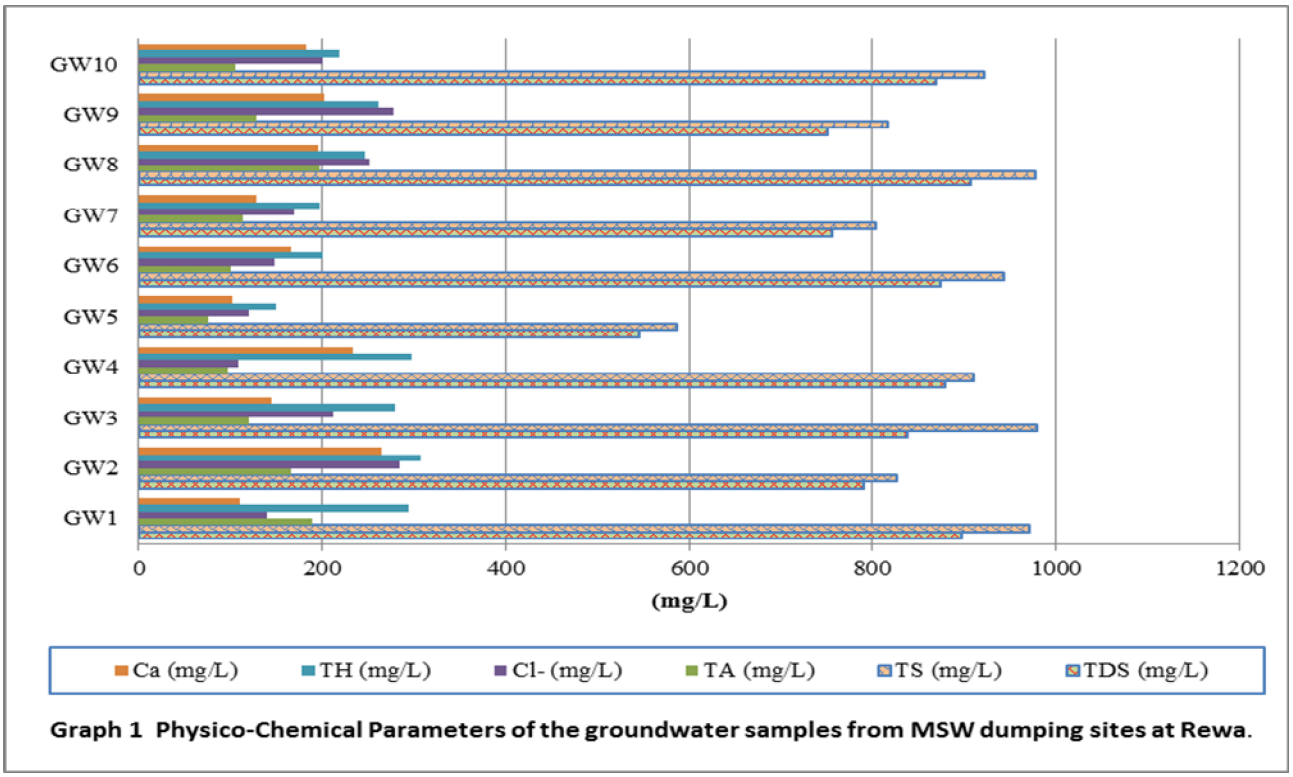
9.	Cl^- (mg/L)	140	285	213	109	121	148	169	252	278	201
10.	TH (mg/L)	295	307	280	298	150	200	197	247	261	219
11.	Ca (mg/L)	110	265	145	234	102	167	129	196	202	182
12.	Mg (mg/L)	58	42	35	64	48	33	68	51	59	37
13.	DO (mg/L)	4.12	3.9	4.01	3.91	5.13	4.97	6.29	6.23	4.57	4.08
14.	BOD (mg/L)	1.3	1.9	1.7	2.1	3.8	2.3	1.4	1.2	1.1	3.6
15.	COD (mg/L)	9.2	5.7	2.8	11.6	9.4	23.6	12.3	8.9	13.7	12.4
16.	NO_3^-(mg/L)	2.1	ND	ND	22.1	6.9	5.4	ND	7.8	0.1	4.7
17.	NO_2^- (mg/L)	0.51	ND	ND	0.02	0.08	0.46	ND	ND	ND	0.03
18.	F^- (mg/L)	1.1	0.2	0.1	0.5	ND	ND	0.7	ND	0.2	0.9
19.	PO_4^{3-} (mg/L)	0.01	ND	ND	0.01	0.05	ND	ND	0.07	ND	0.02
20.	SO_4^- (mg/L)	11.2	6.0	2.9	8.1	12.7	12.2	4.6	17.1	4.9	7.8
21.	NH_4^+(mg/L)	ND	1.2	0.1	2.7	0.8	4.3	1.6	1.8	0.5	1.7
22.	Fe^{++} (mg/L)	0.1	ND	ND	0.1	ND	0.3	0.2	0.1	ND	ND

*GW- Groundwater. ND: Not Detectable

Q.



Graph 1 Physico-Chemical Parameters of the groundwater samples from MSW dumping sites at Rewa.

Phosphate

Phosphate concentration showed under the permissible limit varied up to 0.05 mg/l.

R. Sulfate

Concentration of sulfate in water sample ranged from 2.9 mg/l to 171 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 and Balance, 1996).

S. Ammonia

The ammonia (NH_4^+) concentration in the samples ranged from ND to 4.3 mg/l and likely indicates its origin from leachate of MSW.

T. Iron

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Iron concentration showed under the permissible limit varied up to 0.2 mg/l.

IV. CONCLUSION

On the basis of current investigation 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 Rewa 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^-, PO_4^-, F^- etc. In this present investigation 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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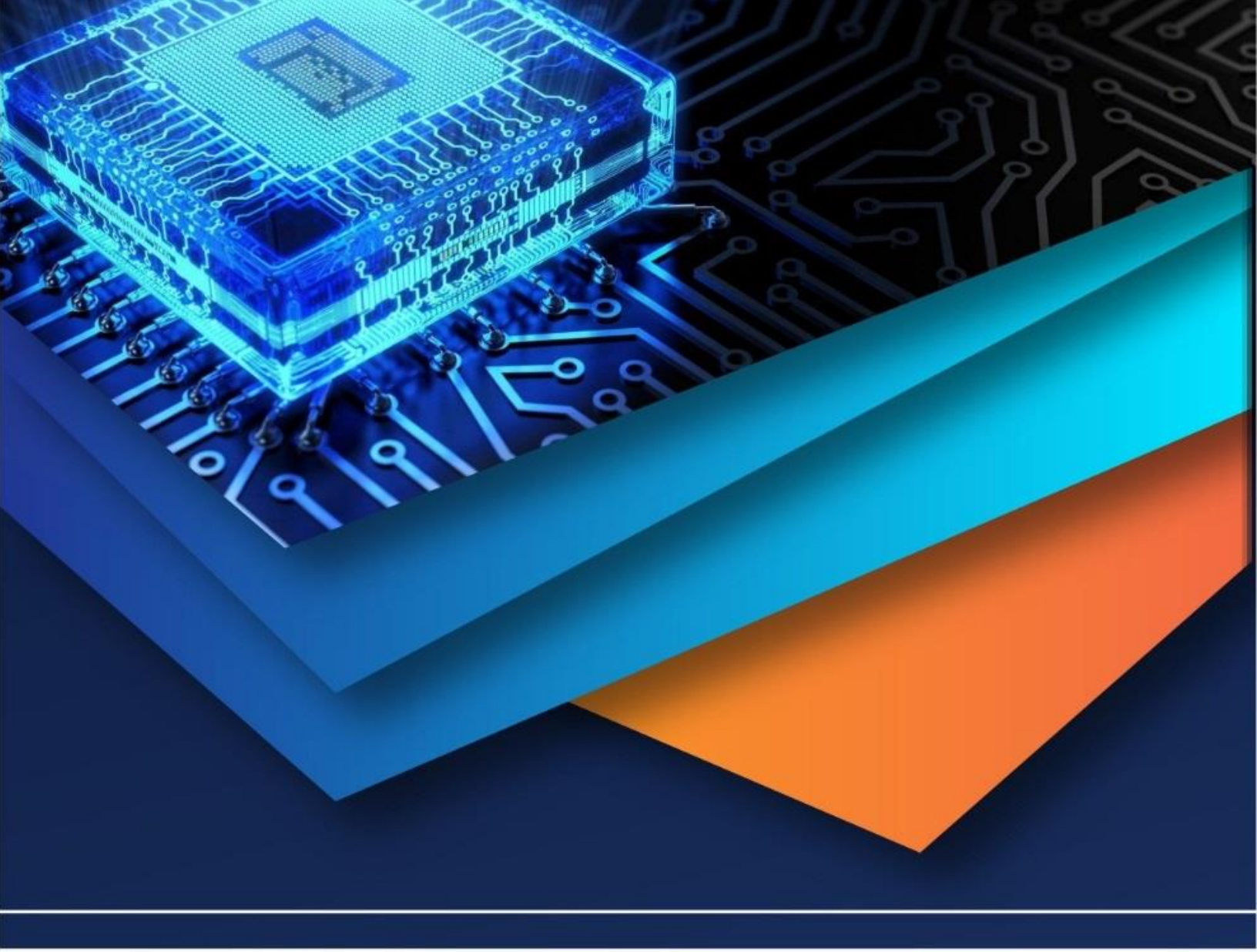

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