ORIGINAL RESEARCH PAPER

Environmental Science

ASSESSEMENT OF GROUND WATER QUALITY NEAR MUNICIPAL SOLID WASTE DUMP SITE AT SAMASTIPUR- A CASE STUDY

KEY WORDS: Municipal Solid Waste Dump Site, Groundwater, Samastipur.

Manoj Kumar Mishra* Department Of Chemistry, R.N.A.R College, Samastipur-848101, Bihar *Corresponding Author

Surendra Prasad Department Of Chemistry, R.N.A.R College, Samastipur-848101, Bihar

A. M. Jha U.R. College, Rosera-848210, Bihar

ABSTRACT

The present study was carried out to assess the impact of domestic waste disposal on groundwater quality at Samastipur, Bihar, India. The samples of ground water were collected from hand pumps in and around the waste disposal site. The samples were analyzed for various physico-chemical parameters viz. pH, electrical conductivity (EC), total hardness (TH), total dissolve solid (TDS), nitrate and phosphate. The results showed that water samples of many hand pumps were contaminated. Therefore, dumping of municipal solid waste is posing a serious threat for the groundwater quality. Thus, there is a need for Groundwater analysis around the dumpsite to know to what extent it is contaminated due to disposal of municipal solid waste.

INTRODUCTION:

Samastipur city, the headquarters of Samastipur District, is located on the bank of Budhi Gandak River in Bihar state. It lies between 25° 51'39" N latitudes and 85° 46' 56" E longitudes with an area of 2905 km^2. People in this city totally depend on the groundwater resources for their domestic, agricultural and industrial needs. Samastipur town has seen a steady growth in its population. The decadal growth rate is 25.33% (2001-2011). With the increase in population, the amount of waste generated has also gradually increased. Apart from this the establishment of commercial areas has augmented the waste generation. Due to lack of planning and proper facilities for treatment and disposal of solid waste, it is causing a serious health hazards. Samastipur town is generating about 65-70 tons of solid waste per day which increases up to 80 ton at the time of festivals and celebration. The waste is thrown in the dust bins provided at different places by Municipal Corporation. The waste from the dust bins is carried and disposed to the disposal area in most unscientific manner. The solid waste collected and dumped is of heterogeneous nature. Due to unplanned dumping of the MSW, their longer degradation and retention time increase the chances of movement of leachate down the ground to reach the groundwater sources and contaminating them. During the past decades, widespread reports of groundwater contamination have increased public concern about drinking water quality. The water quality characteristic is assessed in terms of physical parameters like pH, Electrical conductivity (EC) etc. Chemical parameters like Calcium hardness (CaH), Magnesium hardness (MgH), Total Hardness (TH), Alkalinity, Nitrate and Phosphate, Sulphate etc. and indicator parameters like COD and BOD etc. A number of papers dealing with contamination of groundwater due to solid waste dump from different parts of India have been published recently [1-10].

Keeping above in view the above facts present investigation was conducted to assess the impact of solid waste disposal on ground water quality in and around municipal solid waste dumping site at Samastipur, Bihar, India.

MATERIALS AND METHODS:

The area selected for sampling of groundwater was of about 2 km radius from the solid waste dumping site. The sampling sites were divided in core zone (approx 1km) and buffer zone (1km area after the core zone). Sampling was done in the morning and the water samples were collected in 1L polythene bottles and 1 ml of $HgCl_2$ solution (preservative) was added to each sample. All samples were tested in the laboratory within 24 hours from the time of collection. Water samples were collected from 16 tube wells (8 tube wells were situated in the radius of core zone and 8 tube wells were situated in the radius of buffer zone). Potable water supplied by PHED in municipal area was also collected during the period for comparing its quality with the groundwater collected from sampling sites.

The physico-Chemical parameters selected for analyses were pH, Electric Conductivity (EC), Total dissolved solid (TDS), Calcium hardness (CaH), Magnesium hardness (MgH), Total hardness (TH), Total alkalinity (TA), Nitrate (NO_3^-), Phosphate (PO_4^+), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) as per standard procedures. The quality of ground water has been assessed by comparing each parameter with the standard desirable limit of that parameter in drinking water as prescribed by ISO 10500:2012 [11].

RESULT AND DISCUSSION:

The result of the physico-chemical parameters of ground water samples are presented in Table 1. pH value of the groundwater samples collected from core zone and buffer zone were within desirable limits. The EC (Electrical conductivity) represents the presence of ions in the water. In many cases conductivity is linked directly to the total dissolved solids (TDS). The presence of salt and contamination with waste water increases the conductivity of water and the increase in the conductivity of water indicates addition of some pollutants to it. The EC value of the tap water samples was 542.36μmhos/cm while higher EC values were recorded for all the water samples analyzed. The high conductivity values of the water samples indicate the effect of solid waste on groundwater quality in the form of leachate outcome and inorganic pollution at this specific site.

Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. As per IS 10500:2012 the acceptable limits of calcium and magnesium in drinking water are 75mg/l and 30mg/l, respectively and permissible limit is 200mg/l and 100mg/l, respectively (BSI, 2012). The CaH and MgH values of water samples collected from core and buffer zones were above the acceptable limit but below the permissible limit except S1, S2 and S3 of core zone in which the CaH exceeded the permissible limit. The acceptable and permissible limit of total hardness of water is 200 and 600 mg/l, respectively. The total hardness (TH) value of the water samples collected from core and buffer zones were above the acceptable limit but below the permissible limit. The alkalinity of groundwater samples collected from core and buffer zones was also higher than the acceptable

limit (200mg/l) but below the permissible limit (600mg/l).

TDS (Total dissolved solid) is a measure of total inorganic substances dissolved in water. Total dissolves solid indicate the general nature of water quality or its salinity. Water containing more than 500 mg/L of TDS is not considered suitable for drinking, however, in unavoidable cases 1500 mg/L is also allowed. The TDS values of the water samples collected from core and buffer zones were much higher than the acceptable limit. High values of TDS in drinking water are generally not considered harmful to human beings. Continuous use of water with high TDS might cause weakness, scouring, bone degeneration and may affect the persons suffering from kidney and heart diseases. Water containing high solid may cause laxative or constipation effects.

In the groundwater as well as surface water the level of nitrate is normally low but its level may increase if, there is leaching or runoff from agricultural fertilizers or contamination from human and animal faeces. If, its concentration exceeds the desirable limit (45mg/l), it causes fatal effect on infants. In the present study nitrate content in the water samples of core and buffer zones were below the acceptable limit except in one sample (51.2mg/l). The minimum and maximum phosphate content in the core zone water samples, respectively, was 0.54 and 0.78mg/l. In the buffer zone water samples the minimum and maximum phosphate content, respectively, was 0.30 and 0.64mg/l.

The acceptable limits of BOD and COD of drinling water as mentioned in ISO 10500:2012 are 5mg/l and 10mg/l, respectively. In the present case the BOD and COD values of groundwater samples collected from both core and buffer zones were higher than the acceptable limits. A higher COD value indicates presence of higher amount of oxidizable matter in the water samples and this will reduce the DO levels. The ISO10500:2012 standard values and mean of CaH, MgH, TH, Alkalinity, TDS, BOD and COD recorded in the groundwater samples collected from core and buffer zones have been compared and presented in Fig. 1. It is apparent from the data shown that the mean value of all the tested water quality parameters of water samples collected from both core and buffer zones were higher than the ISO10500:2012 standard value for drinking water. However, the mean values of all these parameters were lower for the water samples collected from the buffer zone as compared to that of core zone.

CONCLUSIONS

On the basis of analysis of obtained data it is pertinent to conclude that the dumping of untreated municipal solid waste constitute a serious threat with regards to water quality parameters studied in the present case. Water samples with higher values of EC, TH, TDS, alkalinity, BOD and COD than the prescribe limits for these parameters are the indicators of ground water pollution. The overall picture that emerges out of the present study warrants certain remedial measures to check the rising trend of ground water pollution due to unauthorized and unscientific disposal of solid wastes.

Table 1: Physicochemical analysis of groundwater samples from MSW dumping site.

Source	Sample	pH	EC	CaH	MgH	TH	Alk	TDS	NO_3	PO_4	BOD	COD
Tap water	S0	7.5	542.36	60.42	40.62	202.3	130.42	310.6	0.3	0.10	2.600	5
CORE ZONE	S1	8.4	1184.9	240.64	54.26	438.42	370.64	990.6	51.2	0.76	8.80	100
	S2	8.8	1870.08	258.12	56.36	420.55	308.26	1045.5	47.8	0.74	8.60	102
	S3	8.2	1680.64	222.36	62.44	430.6	320.48	987.6	46.6	0.78	8.00	94
	S4	7.4	1740.2	188.54	66.58	410.39	316.27	922.7	47.0	0.66	8.20	96
	S5	7.4	1300.12	170.48	65.26	406.78	352.7	1025.6	45.2	0.76	7.80	88
	S6	7.2	1662.7	178.26	68.58	408.12	320.28	1028.7	45.0	0.66	8.00	90
	S7	7.6	1604.06	150.58	60.72	350.08	316.34	922.6	43.4	0.54	7.40	86
	S8	7.4	1750.28	140.4	54.80	320.26	300.25	990.7	40.2	0.54	7.00	94
BUFFER ZONE	S9	7.2	1422.42	82.22	50.33	294.28	312.06	845.6	38.4	0.34	6.00	82
	S10	7.3	1250.34	86.38	44.52	288.36	288.18	825.7	36.0	0.30	6.60	74
	S11	8.0	1100.72	88.56	52.74	306.58	270.26	952.7	36.0	0.64	5.00	68
	S12	7.4	1080.66	92.7	42.28	286.61	274.46	848.6	32.8	0.36	5.40	72
	S13	7.6	1900.4	88.55	40.49	290.56	280.74	954.8	30.2	0.38	5.20	64
	S14	7.2	1755.38	82.4	44.56	300.38	276.26	926.5	22.1	0.32	5.00	52
	S15	7.8	1846.5	84.32	46.76	292.5	250.12	878.2	24.4	0.36	4.80	54
	S16	7.4	1820.55	80.66	48.35	288.42	274.64	845.6	22.6	0.40	5.00	46
Mean		7.62	1560.62	139.70	53.69	345.81	302.00	936.98	38.06	33.8	0.53	6.68	78.88
Standard Error			0.12	72.45	15.73	2.25	15.28	7.91	18.00	2.35	0.05	0.37	4.49
Standard Deviation			0.50	289.79	62.93	9.01	61.13	31.65	72.02	9.42	0.18	1.46	17.95
Sample Variance			0.25	83975.9	3960.46	81.13	3736.33	1001.46	5186.74	88.73	0.03	2.14	322.12
% CV			6.5	18.6	45.0	16.8	17.7	10.5	7.7	24.8	33.8	21.9	22.8

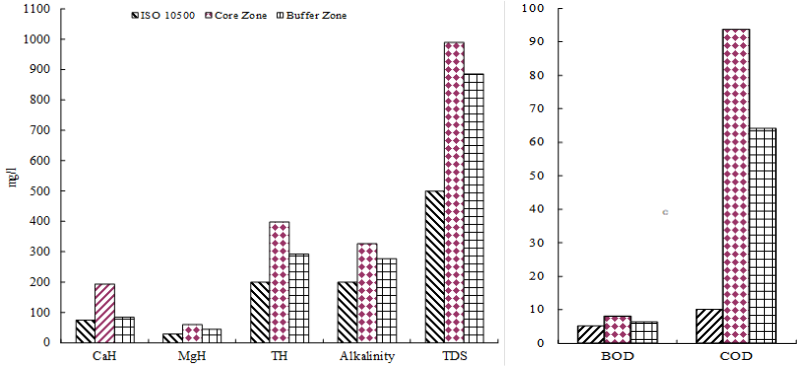

Fig. 1: Comparison of values of different water quality parameters of water samples collected from core and buffer zone at MSW dumping site.

REFERENCES:

1. Shenbagarani S. Analysis of Groundwater Quality near the Solid Waste Dumping Site. IOSR Journal Of Environmental Science, Toxicology And Food Technology (IOSR-JESTFT) 2010; 4 (2): 1-5.
2. Tiwari R. N. Assessment of groundwater quality and pollution potential of Jawa Block Rewa District, Madhya Pradesh, India. Proceedings of the International Academy of Ecology and Environmental Sciences 2011; 1 (3-4): 202-12.
3. Kalra N., Kumar R., Yadav S. S. and Singh, R. T. Physico-chemical analysis of ground water taken from five blocks (Udwantnagar, Tarari, Charpokhar, Piro, Sahar) of southern Bhojpur (Bihar). Journal of Chemical and Pharmaceutical Research 2012; 4 (3):1827-32.
4. Nagarajan R.,Thirumalsaisamy S and Lakshumanan E. (2012). Impact of leachate on groundwater pollution due to non-engineered municipal solid waste landfill sites of Erode city Tamilnadu, India. Iranian Journal of Environmental Health Science and Engineering 2012; 9(1): 35-46.
5. Noorjahan A., Dhanakumar S., Mohanraj R. and Ravichandran M. (2012). Status of heavy metals distribution in municipal solid waste in Tiruchirappalli City, India. Int. J. Appl. Biol. Pharm. Technol. 2012; 3 (3): 252–58.
6. Kamboj Nitin and Choudhary Mohrana (2013). Impact of solid waste disposal on ground water quality near Gazipur dumping site, Delhi, India, Journal of Applied and Natural Science 2013; 5 (2): 306-12.
7. Pande G., Sinha A. and Agrawal S. Impacts of Leachate Percolation on Groundwater Quality: A Case Study of Dhanbad City. Global NEST Journal 2015; 17 (1): 162-74.
8. Eshanthini P. and Padmini T. K. Impact of Leachate On Ground Water Quality Near Kodungaiyur Dumping Site, Chennai, Tamil Nadu, India. International Journal of Pharm Tech Research 2015; 8 (10): 171-79,
9. Mageswari S., Iyappan L., Aravind S., Mohammed Sameer N., Vignesh R. and Vinoth Kumar P. (2017). Contamination of Groundwater Quality Due to Municipal Solid Waste Disposal – A GIS Based Study in Perungudi Dump Yard. International Research Journal of Engineering and Technology (IRJET) 2017; 4 (5): 952-64.
10. Mishra Sachin, Tiwary Dhanesh, Ohri Anurag and Agnihotri Ashwani K. Spatial Analysis of Groundwater Quality Around MSW Landfill Site. Nature Environment and Pollution Technology 2018; 17 (3): 963-71.
11. Buraeu of Indian Standards. Indian Standard: Drinking Water - Specification (Second Revision); Buraeu of Indian Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi-110002; May 2012.