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Investigation of Heavy Metal Contaminations in Groundwater around Landfill Site in Bhopal City, MP

Dr. Manisha Singh

Govt. Motilal Vigyan Mahavidyalaya, Bhopal (M.P.) 462008

Corres. author: Manisha.msingh@yahoo.com

Abstract – Bhopal, the capital city of central Indian state of Madhya Pradesh, with an area of over 550 km^2 and a population of 1.4 million, is a city still expanding.

According to the latest available estimates, it produces over 1,200 metric tons of municipal and post-consumer solid waste on a daily basis (ESR 2006). The exponential growth in the Bhopal city during the last decade (in terms of area industry population and living standards) has put immense pressures on solid waste management system of the local municipal body. These solid waste sites generate highly contaminated leachate and pollute the groundwater resources in their vicinities. ground water samples were collected from 24 sampling stations around the landfill and were analyzed after standard procedure for 10 heavy metals including Al, Cd, Cr, Cu, Co, Fe, Mn, Ni, Pb and Zn were determined by using AAS. The results show that the near landfill sites the values were higher as comparative to other sites.

Keywords: Contamination, groundwater, heavy metal, landfill, Bhopal.

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INTRODUCTION

Bhopal, the capital city of central Indian state of Madhya Pradesh, with an area of over 550 km^2 and a population of 1.4 million, is a city still expanding.

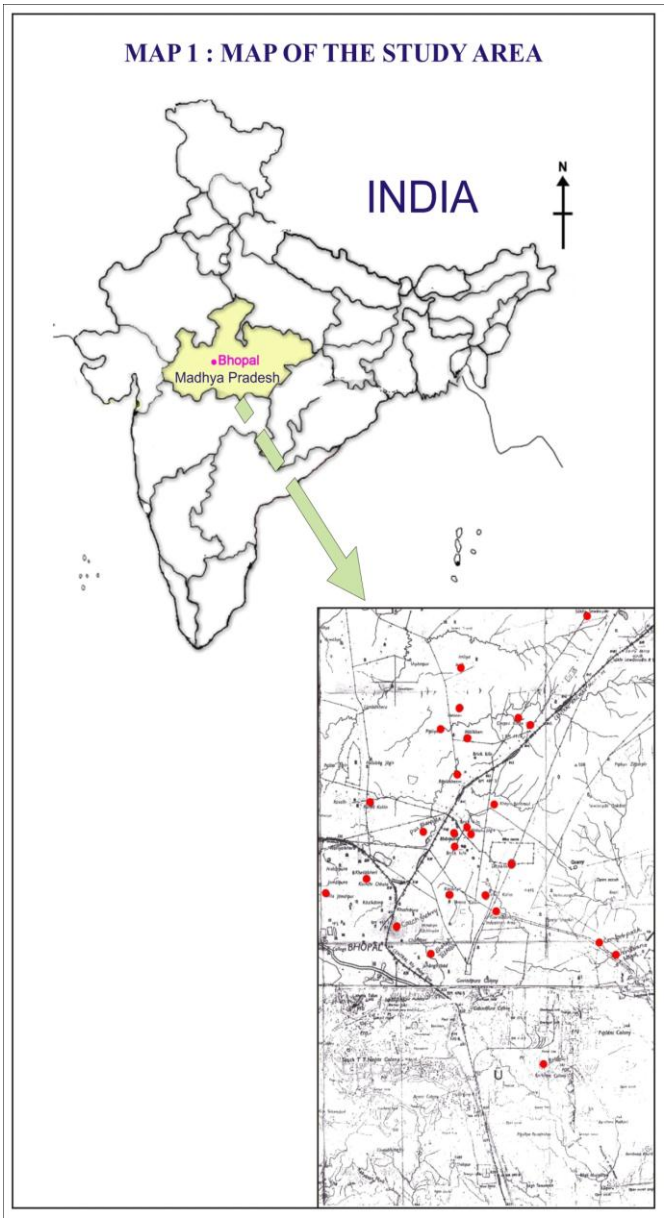
The site under review was previously an abandoned stone quarry, which later braved as a dumping site for MSW, with improper leached collection system. Presently, it looks like a hillock (15-20 m height) with even increasing heap of MSWs. The general composition of waste is as follows : Organic matter 63% proper 7 % plastic, rubber, leather, and synthetic 8 %, metal 5 % inert matter 9 % and glass 8 % (BMC 2003 year), out of which organic matter produces large amount of leachates.Consequently, the leachate production is high organically complex in nature and continously growing. The instant effects of MSW decomposition are a foul and stinking smell felt from a distance and breeding of houseflies, vermin and pathogens besides a very unpleasant sprawl " Pur Bhanpura and Rasal kheri are the two villages in this area severely affected due to leachate contamination in soil and ground water, unhygienic drinking water and garbage induced diseases, like dysentery, cholera, and hepatitis, are frequently reported in their villages during monsoon season. Therefore, the present work on the geochemistry of leachate as well as groundwater from the study area were conducted.

The exponential growth in population (particularly after the establishment of BHEL in 1950), industry, urbanization and living standards has put immense pressures on the solid waste management system of the local municipal body. As a common waste disposal practices in many metropolises, strucks from different parts of Bhopal collect and bring solid wastes to the outskirt areas and unload in an irregular fashion. These solid waste sites generate highly contaminated leachate and pollute the groundwater resources in their vicinities. The proposed study attempts to evaluate the present geochemical status of groundwater in and around Bhopal city with an emphasis on the impact of landfill sites on water quality. The planned study is important in successful water resource management and prevention of health hazards.

3. Study Area :

The study area lies between latitude 23°10'-23°22'N and longitude 77°15'-77°30' E on the survey of India Toposheet Nos 55E/7and 55E/8 covering an area of about 550 Km^2. The study area is occupied by Vindhyan forming hill ranges and the Deccan Traps occupying the valley. A number of hills surround the upper Lake, out of which singarcholi hill, near Lal Ghati is highest an elevation of 625 m above mean sea level (MSL) Climate in this area is semi-arid with an average annual rainfall of 240 mm. June to September in the period of rainy season with

occasional heavy rainfall events. This leads to depression of leachates in the surrounding low lying areas. The total area available for MSW dumping site is about 75 acre



4. Sampling of Groundwater :

In an effort to study the extent of groundwater contamination, 24 (Twenty five) Sampling points were selected within 500 km of landfill site from where the groundwater samples were taken (Figure 2) Detail of the sampling points are presented in Map no. 1 & 2. The samples were collected in 1 litre capacity pre-cleaned polyethylene container after the extraction of water either from a hand pump, a dugwell or a tube-well at the beginning of the May 2012. The water was left to run from the source for about 4 min. to equate the minimum number of well volume and to stabilize the electrical conductivity (Mor *et al.*, 2006) The samples for organic pollutant were aseptically taken in 50 ml sterlize universal containers.

Table 2 : Heavy metal analysis of sampling station in premonsoon 2012

S. No		Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1	GW1	0.01	ND	0.11	0.32	0.01	ND	0.10	0.03	0.16
2	GW2	0.02	ND	0.02	0.31	1.01	ND	0.01	0.03	0.12
3	GW3	0.01	0.01	ND	0.13	0.12	ND	0.01	0.03	0.18
4	GW4	ND	ND	ND	0.14	ND	ND	ND	0.03	0.13
5	GW5	ND	0.01	ND	ND	0.10	ND	ND	0.03	ND
6	GW6	ND	ND	ND	ND	0.02	ND	0.12	0.03	0.01
7	GW7	0.03	0.01	0.01	0.32	ND	ND	0.13	0.02	0.01
8	GW8	0.02	0.01	ND	0.11	0.13	ND	0.12	0.02	0.02
9	GW9	0.01	0.01	0.02	0.13	1.13	ND	ND	0.01	0.03
10	GW10	0.01	0.01	0.11	0.16	ND	ND	ND	0.02	ND
11	GW11	0.03	0.01	ND	0.18	1.01	ND	ND	0.01	ND
12	GW12	0.02	ND	0.09	0.11	0.13	ND	ND	0.02	ND
13	GW13	0.01	ND	0.04	ND	0.16	ND	0.01	0.02	ND
14	GW14	0.01	ND	ND	ND	ND	ND	ND	0.02	ND
15	GW15	0.01	ND	ND	ND	ND	ND	0.14	0.02	ND
16	GW16	ND	ND	0.01	0.11	0.32	ND	0.13	ND	ND
17	GW17	0.01	0.01	0.01	0.12	0.11	ND	0.13	ND	0.01
18	GW18	0.02	ND	ND	ND	ND	ND	ND	0.01	ND
19	GW19	0.02	ND	0.02	ND	ND	ND	0.01	0.01	0.06
20	GW20	ND	0.01	0.01	0.13	0.12	ND	0.01	0.01	0.16
21	GW21	ND	0.02	ND	0.11	ND	ND	ND	0.01	0.02
22	GW22	0.03	0.11	ND	0.13	0.13	ND	0.41	0.01	ND
23	GW23	0.02	ND	0.01	0.12	0.14	ND	0.32	0.01	ND
24	GW24	0.11	ND	0.01	ND	ND	ND	0.11	0.01	0.32

All values are in mg/l

Table 4 : Heavy metal analysis of sampling station in postmonsoon 2011

S. No		Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1	GW1	ND	ND	ND	0.01	0.01	ND	0.02	0.01	0.01
2	GW2	ND	ND	ND	0.02	0.01	ND	0.02	0.02	0.02
3	GW3	ND	ND	ND	0.01	0.01	ND	ND	0.01	0.02
4	GW4	ND	ND	ND	0.01	0.01	ND	ND	0.01	0.01
5	GW5	ND	ND	ND	ND	ND	ND	0.01	0.02	0.02
6	GW6	ND	ND	ND	ND	ND	ND	0.01	0.02	0.01
7	GW7	ND	ND	ND	0.01	ND	ND	0.01	0.02	0.01
8	GW8	ND	ND	ND	0.01	0.01	ND	0.02	ND	0.01
9	GW9	ND	ND	ND	0.01	0.01	ND	0.01	ND	0.01
10	GW10	ND	ND	ND	ND	0.02	ND	ND	0.02	0.01
11	GW11	ND	ND	ND	ND	0.03	ND	ND	0.01	0.02
12	GW12	ND	ND	ND	ND	0.01	ND	ND	0.01	ND
13	GW13	ND	ND	ND	ND	ND	ND	ND	ND	ND
14	GW14	ND	ND	ND	ND	ND	ND	ND	0.02	ND
15	GW15	ND	ND	ND	ND	ND	ND	0.01	0.02	ND
16	GW16	ND	ND	ND	ND	0.01	ND	ND	ND	ND
17	GW17	ND	ND	ND	ND	0.02	ND	0.0	ND	0.01
18	GW18	ND	ND	ND	ND	0.01	ND	0.0	ND	0.01
19	GW19	ND	ND	ND	ND	ND	ND	0.0	0.01	0.01
20	GW20	ND	ND	ND	ND	ND	ND	0.0	0.01	0.01
21	GW21	ND	ND	ND	ND	0.02	ND	ND	0.01	0.01
22	GW22	ND	ND	ND	ND	0.01	ND	0.0	0.00	0.01
23	GW23	ND	ND	ND	ND	0.01	ND	0.0	0.00	0.01
24	GW24	ND	ND	ND	ND	ND	ND	ND	0.00	0.01

Fig. 9 : Heavy metal analysis of sampling station in premonsoon 2012

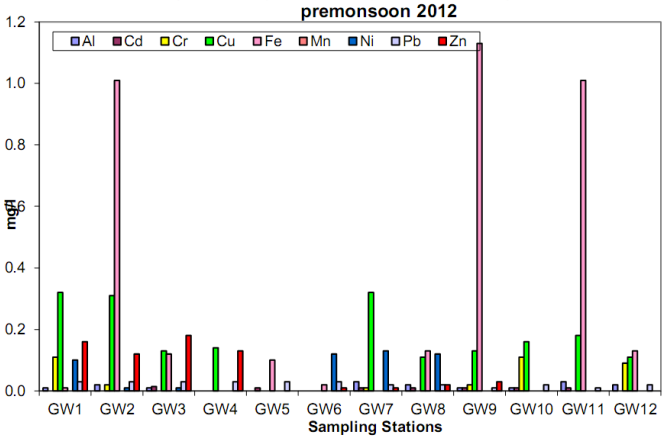


Fig. 11 : Heavy metal analysis of sampling station in postmonsoon 2012

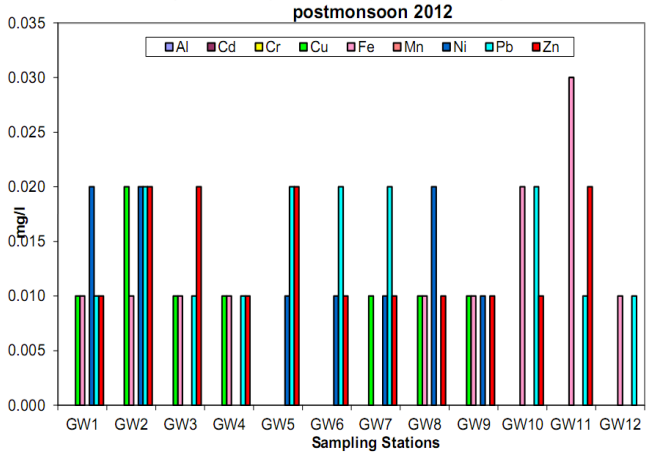
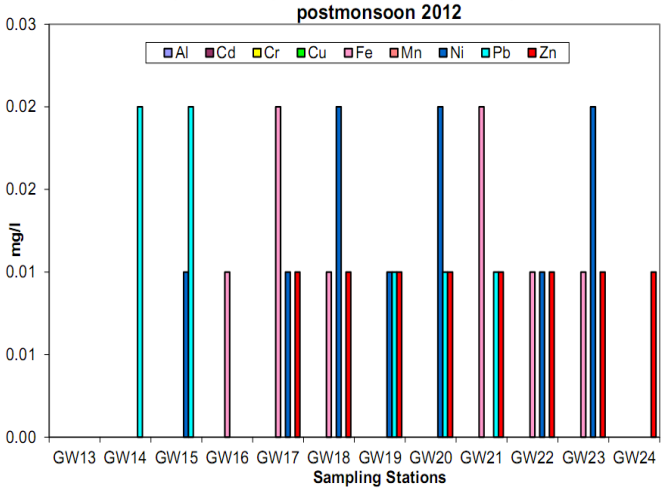


Fig. 12 : Heavy metal analysis of sampling station in postmonsoon 2012



Heavy metals : The heavy metals analyzed are Al, Cd, Cr, Cu, Co, Fe, Mn, Ni, Pb and Zn (Table no 2 & 4). High concentration of Pb, Ni and Zn suggest that the waste are mainly of municipal arising containing refused batteries, paints product, metallic items and fluorescents lamps. The Al concentrations are results of electronic waste and aluminum foils. The high range of iron is an indicative of the dumping of metal scarp and tin based garbage at the dumping site. The dark brown colour of the leachate in attributable to the oxidation of ferrous to ferric from and the formation of ferric hydroxide colloide and complexes with fluvic and humic substance (Chu and Cheung 1994). All values are in ppm, except pH, EC (in ms/cm) and BOD/COD

CONCLUSION:

The present study has indicated that the presence of heavy metals around the landfill site were higher concentration compared to other site. The water of this area is not fit for drinking as well as agriculture practices. The overall implications of this study call for the management of water resources to check these waste and management practices with planned study important in successful water resource management and prevention of health hazards.

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