J. Ecophysiol. Occup. Hlth. 12 (2012) 35-42

Study on ambient air quality of municipal solid waste dumping site district Satna (M.P.), India

Vandna Pathak and *B.P. Kushwaha

Department of Physical Sciences

Faculty of Science and Environment,

Mahatma Gandhi Chitrakoot Gramodaya Vishwvidyalaya, Chitrakoot, Satna (M.P.)

Abstract:*The unscientific disposal of municipal solid waste (MSW) creates air, water and soil pollution. This study reveals the problems of air pollution caused due to unscientific disposal of MSW found at Satna, Maihar, Nagod and Birsinghpur municipalities of district Satna (M.P.). The seasonal mean values of SPM and RSPM were in exceeding limit in all the seasons except monsoon season. The values of SO_2 and NO_2 were observed within the norms in all the season as set by Ministry of Environment and Forest Government of India. It is observed that the garbage collected from Satna, Maihar, Nagod and Birsinghpur municipalities is being dumped indiscriminately on open land. The dumping sites are not proper by designed and operated as per Municipal Solid Waste (Management and Handling) Rules 2000. Results suggest that adequate measures must be taken for the scientific disposal of municipal solid waste to control increasing levels of pollution and its dispersion from MSW dumping site to nearby area through wind flow.*

Key Words: MSW, Dumping site, Disposal, Air quality, SGPT, SGOT, ACP, ALP, Arsenic, Albino rat, Hepatopathology.

Introduction

The municipal refuge is referred to as any waste that is generated by domestic and industrial sectors in municipalities. The MSW is heterogeneous in nature and contains paper, plastic, glass, metal, sand and fine earth and compostable matter. Scrap material, dead animals, discarded chemicals, pints, agricultural residues comes under MSW. The Bio-medical waste (BMW), Industrial waste, Electronic waste (E-Waste), Batteries waste, should not be disposed with MSW but wastes of the Indian municipalities disposes such type of waste along with MSW (Dhare et al., 2008). Most of the municipalities having no proper waste disposal facilities; whereas Ministry of Environment and Forest (MOEF) Govt. of India issued separate management and handling rules for proper disposal of MSW, BMW, E-Waste, Hazardous waste and Batteries waste etc. There are specific rules and regulations in India but proper implementation of these rules are not being done causing several types of environmental, pollution and health problems. The Municipal Solid Waste (Management and Handling) Rules 2000 emphasized integrated solid waste management right from house-to-house collection to processing of organic waste and scientific disposal of inert waste (CPCB and CECB, 2007). Under this rule, air quality standard for land fill site and air quality monitoring frequency has also been prescribed by MOEF but these rules are not being implemented in most of the municipalities.

The monitoring of Air quality parameters like SPM, RSPM, SO_2 and NO_2 is one of the important works to assess the air quality at MSW dumping areas. The main sources of air pollution at the MSW dumping site are fugitive emission from open dumping, exhaust from trucks/dumpers, dust generation from waste dumps due to wind erosion and fugitive emission due to trucks movement in open and unpaved road, open burning of MSW heaps (Sinha and Shreekesh, 2002; Pathak and Kushwaha, 2012a).

* Email : Bhola.Kushwaha@gmrgroup.in

Present study has been carried out to determine the effect of unscientific MSW disposal on Ambient Air Quality of Satna, Maihar, Nagod and Birsinghpur municipalities of district Satna (M.P). Assessment of air quality was done as a part of "Study of municipal solid waste and its disposal and management strategies of district Satna" to prepare proper environment management plan for MSW dumping site.

Sampling site:

The Locations of MSW dumping sites of study areas are as given below in table-1 and shown in figure -1.

Table -1 : Location of MSW dumping site in studied municipality

SN	Name of municipality	Sampling Site / Existing MSW Dumping Site
01	Satna	Near Hawai Patti Satna
02	Maihar	Behind Gola Math Mandir, Village Arkandi
03	Nagod	Near Forest Naka , Satna Road
04	Birsinghpur	Beside Bus stand

Fig. 1 : Location of Study area shown in the figure

Materials and Methods

The air samples were collected four times in a year (for 2008-09) in different seasons Sep – Nov (Post monsoon Season), Dec – Feb (Winter season), Mar – May (Pre monsoon season) and Jun – Aug (Monsoon Season) from MSW dumping site of Satna, Maihar, Nagod and Birsinghpur. Parallels of four samples in four directions were taken in each site in every season and analysis of total 64 samples of each parameter were carried out according to standard method (Srivastava, 2002; CPCB, 2003; Lokeshwari et al., 2006; Kushwaha et al., 2008). Respirable dust samplers Envirotech Model APM 460, NL 411 were used for air sampling. The RSPM concentration was measured using Glass fibre filter paper (Whatman GF/A).Sulphur dioxide (SO_2) and Nitrogen dioxide (NO_2) Concentration by spectrophotometer. Air samples were simultaneously collected from all the four municipalities' in all the four directions that is North-East, South-East, South-West and North-West around the MSW dumping site. Monitoring location had been fixed according to direction of wind flow. Distance and height of sampling station have been considered as per the guideline of national ambient air quality monitoring standards issued by CPCB Govt. of India.

Results and discussion

The analysis of Ambient Air samples at surrounding areas of MSW dumping site were done in all the four season in year 2008-09. The maximum, minimum and mean values of monitored parameter for all the four season are given in Table 2 to 5. Standards of Ambient Air Quality for landfills sites as prescribed by Ministry of Environment and Forest, Government of India are given in Table 6.

Satna Municipality

The mean values of SPM in the ambient air at Satna MSW dumping sites are 522, 616, 578 and 245.5 µg /m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. Similarly the mean values of RSPM are 182, 251.5, 233.5 and 87.5 µg/m^3 during post-monsoon, winter, pre monsoon and monsoon season respectively. The Seasonal mean value of SPM and RSPM were found more than permissible limit in post-monsoon season, winter season and pre-monsoon season. The mean values of SO_2 in the ambient air at Satna MSW dumping sites are 16.1, 20.8, 24.0 and 14.8 µg/m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. Similarly the mean values of NO_2 are 19.2, 27.8, 29.1 and 18.5 µg/m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. The SO_2 and NO_2 values were well within permissible limit.

Maihar Municipality

The mean values of SPM in the ambient air at Maihar MSW dumping sites are 502,564.5, 538 and 243.5 µg/m^3 during post-monsoon, winter, pre- monsoon and monsoon season respectively. Similarly the mean values of RSPM are 137, 246, 230.5 and 90.5 µg /m^3 during post-monsoon, winter, pre monsoon and monsoon season respectively. The seasonal mean values of SPM were found more than permissible limit in post-monsoon, winter and pre-monsoon season. Similarly the RSPM values were found in exceeding limits in winter and pre-monsoon season. The mean values of SO_2 in the ambient air at Maihar MSW dumping sites are 17.0, 19.2, 21.6 and 13.9 µg/m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. Similarly the mean values of NO_2 are 21.5, 24.6, 26.4 and 17.5 µg/m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. The SO_2 and NO_2 values were found in permissible limit.

Nagod Municipality

The mean values of SPM in the ambient air at Nagod MSW dumping sites are 508.5,559, 546.5 and 246.5 µg/m^3 during post-monsoon, winter, pre- monsoon and monsoon season respectively. Similarly the mean values of RSPM were 161.75, 225.5, 213 and 85 µg /m^3 during post-monsoon, winter, pre monsoon and monsoon season respectively. The SPM and RSPM value in the post-monsoon, winter and pre-monsoon were found beyond the limit as set by MOEF. The mean values of SO_2 in the ambient air at Nagod MSW dumping sites were 15.4, 16.3, 18.8 and 13.7 µg/m^3 during post-

monsoon, winter, pre-monsoon and monsoon season respectively. Similarly the mean values of NO_2 are18.4, 21.1, 23.9 and 18.3 µg/m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. The SO_2 and NO_2 values were found in permissible limit.

Birsinghpur Municipality

The mean values of SPM in the ambient air at Birsinghpur MSW dumping sites were 475,530.25, 515.5 and 226 µg/m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. Similarly the mean values of RSPM were 120, 233.5, 226.5 and 73 µg/m^3 during post-monsoon, winter, pre monsoon and monsoon season respectively. The values of SPM and RSPM found beyond the permissible limit in winter and pre-monsoon season. The mean values of SO_2 in the ambient air at Birsinghpur MSW dumping sites were 9.5, 11.9, 12.6 and 9.1 µg/m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. Similarly the mean values of NO_2 are 12.3, 14.7, 16.0 and 11.7 µg/m^3 during post-monsoon, winter, pre-monsoon and monsoon season respectively. The SO_2 and NO_2 values were found well within the permissible limit.

The monitoring values were compared with the standard prescribed by Ministry of Environment and Forest Govt. of India (MOEF, 2000). The average annual emissions of SO_2 and NO_2 in all the sites during all the season were found well within the limit as set by the MOEF; whereas MSW generation at Satna, Maihar, Nagod and Birsinghpur are 61.67, 10.128, 4.498 and 2.269 MT per day respectively. The value of SO_2 and NO_2 at municipalities of Satna district may be increased after some year when waste generation quantity was increased, resulting in possibility of vehicle movement and burning of waste heaps was increased.

The maximum value of SPM (884) was observed in winter season at Satna Municipality and minimum value of SPM (208) was observed in monsoon season at Birsinghpur Site. Similarly Maximum value of RSPM (342) was observed in winter season and minimum value of RSPM (58) in monsoon season at Birsinghpur site. Similar pattern have been observed for SO_2 and NO_2 concentration also.

It is found that the monsoon season is comparatively cleaner period in the year. This may be due to repeated rains which settle down the air borne particulate matter and various pollutants generated and dispersed from the source. The winter season of the year is relatively more calm than other seasons. The prevailing calm conditions facilitate more stability to atmosphere and consequently slow dispersion of generated pollutants occur resulting as a trapping or accumulation of all ambient air pollutants near the ground level during winter season (Gujral *et al.*, 2001; CPCB, 2003; Singh *et al.*, 2006; Kushwaha *et al.*, 2008; Pathak and Kushwaha, 2012b).

The particulate matter enters the human body through inhalation and they give rise to many of the diseases (Asthma, Cold, Cough) related to lung and if the concentration is crossing the permissible limits it may cause eye dieses, cancer, headache, blood pressure. It was reported that effect of SPM in human depends on particle size, concentration and exposure time (Singh *et al.*, 2006, PopeII, 2000; WHO, 2000).The human nostrils filter out 99% of the inhaled large and medium sized particles. The rest may enter the windpipe and lung where some inhalable particulates cling to protective mucous are removed. Some of smallest particles (RSPM) may tend to slow down the exchange of oxygen with carbon dioxide in the blood, causing compensate for oxygen loss. Usually, people most sensitive to these conditions have respiratory diseases like emphysema, bronchitis, asthma or heart problems. Particles themselves may be poisonous if inhaled, damaging remote organs like the kidney or liver. Swallowed mucous that is laden with hazardous particulate matter may damage the stomach. In addition, particulates may be the carriers of hazardous liquid or gaseous substances (CPCB, 2001).

The results of present study clearly suggest that adequate measures should be taken for the scientific disposal of municipal solid waste. A Comprehensive Environmental Management Plan should be prepared and implemented to control air pollution at MSW dumping site.

Table - 2. Measurement of SPM, RSPM, SO_2 and NO_2 in Air Samples near MSW Dumping Sites of all the four sampling stations of Post Monsoon Season Year - 2008-09

Ambient Air Value	MSW Dumping Sites (Values in µg/m3)															
	Satna				Maihar				Nagod				Birsinghpur			
	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2
Min	458	144	14.6	18.2	428	102	14.6	18.2	384	146	14.2	16.4	412	108	8.2	10.6
Max	684	248	18.6	21.0	644	168	20.2	24.8	698	188	18.4	20.0	542	132	10.8	14.0
Mean	522	182	16.1	19.2	502	137	17.0	21.5	508.5	161.75	15.4	18.4	475	120	9.5	12.3

Table - 3. Measurement of SPM, RSPM, SO_2 and NO_2 in Air Samples near MSW Dumping Sites of all the four sampling stations of Winter Season Year - 2008-09

Ambient Air Value	MSW Dumping Sites (Values in µg/m3)															
	Satna				Maihar				Nagod				Birsinghpur			
	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2
Min	454	184	15.2	19.2	412	164	12.6	15.0	448	176	12.0	15.0	422	182	10.2	12.8
Max	884	342	28.8	36.8	846	324	26.4	34.6	778	272	24.2	28.6	725	294	14.2	16.2
Mean	616	251.5	20.8	27.8	564.5	246	19.2	24.6	559	225.5	16.3	21.1	530.25	233.5	11.9	14.7

Table - 4. Measurement of SPM, RSPM, SO_2 and NO_2 in Air Samples near MSW Dumping Sites of all the four sampling stations of Pre-monsoon Season Year - 2008-09

Ambient Air Value	MSW Dumping Sites (Values in µg/m3)															
	Satna				Maihar				Nagod				Birsinghpur			
	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2
Min	424	154	18.6	24.8	346	132	12.6	16.4	412	160	15.4	20.2	422	168	10.2	14.2
Max	838	342	34.6	38.8	812	320	32.6	38.4	758	254	24.5	28.6	622	268	15.2	18.2
Mean	578	233.5	24.0	29.1	538	230.5	21.6	26.4	546.5	213	18.8	23.9	515.5	226.5	12.6	16.0

Table - 5. Measurement of SPM, RSPM, SO_2 and NO_2 in Air Samples near MSW Dumping Sites of all the four sampling stations of Monsoon Season Year - 2008-09

Ambient Air Value	MSW Dumping Sites (Values in µg/m3)															
	Satna				Maihar				Nagod				Birsinghpur			
	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2	SPM	RSPM	SO_2	NO_2
Min	224	80	12.8	16.4	224	80	12.2	15.0	208	62	12.0	14.2	208	58	8.2	10.0
Max	284	98	16.4	20.2	268	104	16.4	20.2	298	118	16.0	20.4	248	92	10.2	14.6
Mean	245.5	87.5	14.8	18.5	243.5	90.5	13.9	17.5	246.5	85	13.7	18.3	226	73	9.1	11.7

Table -6. Air Quality Standards for MSW disposal site (MOEF, 2000)

Pollutant	Time Weighted Average	Concentration in Ambient Air
SO_2 µg/m^3	Annual*	80
	24 hours**	120
NO_2 µg/m^3	Annual*	80
	24 hours**	120
SPM µg/m^3	Annual*	360
	24 hours**	500
RSPM µg/m^3	Annual*	120
	24 hours**	150

* Annual Arithmetic means of minimum 104 measurements in a year twice a week 24 hourly at uniform interval.

** 24 Hourly/8 hourly values should be met 98 % of time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

Acknowledgement

The Authors are thankful to the Dr. Rahul Dwivedi, Jr. Scientist, M.P. Pollution Control Board, Regional office Satna (M.P.) and Mr. G. R. Telang, Assistant Manager (Environment), Monnet Ispat and Energy Limited Raipur for providing necessary monitoring equipment and valuable support for smooth running of research work.

References

CPCB (2001) Air pollution and human health. Central Pollution Control Board, Ministry of Environment and Forest, Government of India. *Parivesh*, **9**, 10-14

CPCB (2003) Guideline for Ambient Air quality Monitoring. Central Pollution Control Board, Ministry of Environment and Forest, Government of India. *National ambient air monitoring series,* 17-130

CPCB and CECB (2007) Two-day's workshop cum training programme on Municipal Solid Waste and Plastic Waste at Raipur. Organized by *HRD Foundation Lodhi Road New Delhi*

Dhare, A. M., Chandrasekhar, B., Pawar, P. S., Pardeshi, B. and Patil, D. (2008) Municipal solid waste disposal in Pune City – An analysis of air and ground water pollution. *Curr. Sci.,* **95**, 773-777.

Gujral, S., Sharma, V., Rani, A. (2001) Assessment of dispersion of ambient suspended particulate matter and meteorological conditions near Kota Thermal Power Station. *Indian I. of Environmental Protection* **3**, 238- 249**.**

Kushwaha, S. K., Singh, R., Kushwah, B. P., Pathak, V., Rai, O. P. and Duvedi, R. (2008) A study of air quality and human health of certain villages of industrial area Raigarh. *Indian I. of Environmental Protection* **28** , 709-713.

Lokeshwari, H., Ramkrishnaia, H. and Chandrappa, G. T. (2006) Concentration of heavy metals in urban airborne respirable suspended particulate matter (PM_{10}) of Banglore city. *Ind.J. Air Poll.C ontrol*. **6**, 15-21.

MOEF (2000) Municipal solid waste (management and handling) rules. Ministry of environment and forest, Govt. of India. *Gazette Notification*.

Pathak, V. and Kushwaha, B. P. (2012a) Study of air pollution by municipal solid waste dumping site Satna (Madhya Pradesh), India. *J. Environ. Biol..* (In press)

Pathak, V. and Kushwaha, B. P. (2012b) Study on ambient air quality at selected few municipal solid waste dumping sides of district Satna (M.P.), India. *National J. Life Sci.* (in press)

PopeII, C. A. (2000) Review: Epidemiology of fine particulate air pollution and human health: Biological Mechanism and who risk? *Indian I. of Environmental Protection Hlth. Persp,* **108**, 713-723

Srivastava, A. K. (2002) Level of air contaminants in Jhansi City. *Indian I. of Environmental Protection* **22**, 327-328

Sinha, S. and Shreekesh, S. (2002) Air quality status and management options for the mining belt of Goa. *Indian I. of Environmental Protection* **22**, 241-253.

Singh, R., Chaurasia, S., Dwivedi, R. and Kushwaha, B. P. (2006) Air quality and human health around Satna Cement Satna (M.P.). *Indian I. of Environmental Protection* **268**, 748-751.

WHO (2000) Guideline for air quality. WHO/SDE/OEH/.02, World health organization Geneva, Switzerland.