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INTERACTION OF HOUSEHOLD WASTE WITH MUNICIPAL SOLID WASTE: STUDY OF OPEN DUMPSITES

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Abstract: There is evidence that hazardous compounds are finding their way to safe landfills meant only for non-toxic municipal solid wastes (MSW). The source of this contamination could be household hazardous waste (HHW), which often contains a wide variety of highly toxic ingredients like solvents, heavy metals, acids, bases, oxidizers, reactive chemicals etc. Many of these compounds do not degrade with time and enter the food chain spontaneously and are responsible for a variety of health issues such as hormone disruption, reproductive disorders, learning disabilities, heart diseases etc. This paper reviews various issues related to MSW and its possible impact on the environment. Several literatures, cited reveal that there is policy and institutional failures in managing the MSW sustainably. There are hazardous substances mixed with MSW which are subsequently getting dumped in secured landfills. These hazardous substances later not only degrade the SLF but also pollute the surrounding environment. Contaminated leachates often take various pathways, like air, soil, water and vegetation and find their way into food chain. This review recommends few alternate measures to strengthen the policy. Organizing campaigns, strengthening the segregation system at household scale and establishment of temporary collection points/centers, application of spatial database and analysis tool to integrate various spatial attributes related to soil, water, natural vegetation, proximity to habitation etc. for establishing an SLF.
Keywords: Household hazardous waste, environment, toxic substances, municipal solid waste.
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INTRODUCTION

Waste management has become a priority for the developing world. Advancing population growth accompanied with rapid urbanization and industrialization has resulted in dramatic upswing in the volumes of waste generated by modern societies. Changing lifestyles generate a massive volume of domestic waste which creates a critical problem in the domain of waste management (Palmer, 1998). Also nowadays human activities produce many by-products which are commonly viewed as useless and are discarded as waste which eventually find their way into the groundwater and air every year (Arms, 1991; Palmer, 1998; Day, 1998). It is seen that lavish consumption lifestyles in many countries have extreme effects on the amount of domestic waste produced by modern high-technology, while little effort is made to bring the same technology to bear on waste management and disposal (Palmer, 1998). Disposal of solid waste is a major problem nowadays due to the non-availability of land, appropriate technology and acceptance by the local community. Proper understanding of the nature of waste generation, source, and disposal mechanism is required. Also a rethinking is needed that calls for waste to become wealth, refuse to become resource and trash to become cash.

Waste management in India

In India, Municipal Solid Waste (MSW) Rules, 2000 provides the basis for waste management in our country. They are

applicable to every municipal authority, making them responsible for collection, segregation, storage, transportation, processing and disposal of municipal solids. Also according to the rules, waste has to be segregated and treated and also the biodegradable material should not be deposited in landfills. The policy is well written but the implementation and monitoring of the same is inadequate. As reported by 2011 census, the population of India was 1.21 billion, of which 31% live in the cities. It was further projected that by 2050 half of India's population will live in cities. Thousands of tons of Municipal Solid Waste (MSW) are generated by cities daily which are expected to increase in the future as India strives to attain status of industrialized nation by 2020. According to Central Pollution Control Board (CPCB), 1,27,486 TPD (Tons per day) of Municipal waste was generated in India during 2011-12, with an average waste generation of 0.11 Kg per capita per day. The total MSW produced in the National Capital Territory of Delhi is around 7310 MT per day.

Global Scenario

Brown *et al.* (1991) investigated that leachate from municipal solid waste landfills is just as toxic as leachate from landfills in which residential and hazardous wastes were co disposed. Leachate from MSW landfills even contained many of the same hazardous constituents as found in hazardous waste landfills. In addition, several researchers have found leachate to be quite toxic to rainbow trout and daphnia (Cameron and Koch, 1980; Atwater *et al.,* 1983) and to have some toxicological impact on laboratory mice (Raddi *et al.,* 1987). Landfills are connected to the environment. Rain, snow, and other precipitation reach the landfills and get mixed up with the landfill contents, including hazardous wastes. If the waste is water soluble, then it will be dissolved and carried wherever the water takes it. If it is not water soluble, it will probably remain intact and travel suspended in the water. This contaminated water (called leachate) moves down through the layers of trash and enters the environment if it does not encounter any type of barrier. Landfills with safety lining are not designed to treat hazardous waste. Some types of hazardous wastes can destroy the synthetic liner, making it ineffective (Faulcon, 1998). Leachate which is contaminated with hazardous waste cannot be completely cleaned at the wastewater treatment facilities. It is contaminated by hazardous waste that can potentially enter the water cycle. Landfill conditions influence what happens to household hazardous waste. The amount of oxygen and moisture in the landfill and the surrounding soil characteristics affect how fast household hazardous waste containers or metal battery casings will degrade. Water in a landfill may also react with different types of hazardous waste. For example, lithium, found in a type of dry cell battery, may react violently with water found in a landfill. Also Manufacturers sometimes use generic terms or vague language rather than revealing the specific chemical identity of their products thus misleading them (Faulcon, 1998).

According to Schwarzbauer *et al.* (2002) large number of degradation compounds like XOCs, BTEXs chlorinated aromatics; chlorinated/Non chlorinated hydrocarbons are identified quite often in landfill leachates. The amounts of various compounds differs in various landfills from very low concentration to high depending upon the age of the landfill, waste composition and its management processes. Many pharmaceutical drugs have also been reported in landfill leachates in Germany like propyphenazone, ibuprofen and clofibic acid, sulphonamides and barbiturates. Also phenazone (an analgesic) have also been detected (Schwarzbauer *et al.* 2002; Holm *et al.* 1995; Ahel and Jelice 2001). At least 40 different types of pesticides like N, N Diethyltoluamide (DEET), bentazon, MCPA are common and persistent in anaerobic landfill conditions have been detected in MSW landfill sites. (Schultz and Kjeldsen, 1986; Gintautas *et al.,* 1992; Lyngkilde and Christensen, 1992; Kjeldsen, 1993; Oman and Hynning, 1993; Christensen *et al.,* 2001; Kjeldsen *et al.,* 2002; Christensen *et al*. 2001 and Kjeldsen *et al.* 2002). It was observed that the amounts of Cd, Cu, Mn and Pb are in the ranges 0.1641–1.0372, 0.546–2.6886, 0.1605–1.7962, and

0.7655–5.1485 mg/L, respectively, for the collected leachate samples. The high level of Pb (5.1485 mg/L) in the leachate samples shows the presence of Pb batteries, chemicals for photograph processing, Pb-based paints and pipes at the landfill site (Moturi *et al.* 2004; Mor *et al.* 2005).

According to Grey *et al.* (2005) studied the way that people make use and abandon pesticides in the UK 93% of interviewed citizens stated that they had used at least one pesticide product over the last year in their household and approximately 95% replied that the containers had been discarded in municipal waste bins. The result was alike in USA, where a relevant survey revealed that about 88% of the interviewed participants responded that they disposed away pesticide containers with municipal waste. This study primarily focuses on the main landfills of the Community of Madrid (central Spain). It was observed that the soils and waters around landfills closed about 20 years ago still show the presence of heavy metals (Zn, Cu, Cr, Ni, Pb, Cd) in soils, and salts (sulphates, chlorides and nitrates) and high levels of organic pollutants in both soils and waters. The uses given to the landfills after their initial sealing, together with their particular characteristics pose difficulties both for the revegetation as well as remediation of these soils that show great differences in terms of the pollutants found, the density of nematodes (trophic groups) in the soil, and plant cover (Pastor and Hernández, 2012). Jensen (1999) also revealed that heavy metals are typically released by acidic pH and are found at moderate concentration levels in municipal landfill leachates.

Vassilis J. Inglezakis and Konstantinos Moustakas (2014) revealed that HHW constitutes a small fraction of municipal solid waste for which common knowledge has to be gained by the simple citizens. Citizens have to become sensitive of the issue of HHW and the potential risks through local information and educational initiatives and be able to identify the hazardous materials within the generated municipal waste in everyday life. The use of less hazardous materials in the manufacture and production of goods in the everyday life will also have a positive effect in dealing with the specific waste stream under investigation, since it will support the prevention process.

Concentration of heavy metals in a landfill is generally higher at earlier stages because of higher metal solubility as a result of low pH caused by production of organic acids. As a result of decreased pH at later stages, a decrease in metal solubility occurs resulting in rapid decrease in concentration of heavy metals except lead because lead is known to produce very heavy complex with humic acids (J. Harmsen, 1983). D. Kulikowska and E. Klimiuk, (2008) studied that heavy metals like Iron, Lead, Chromium, Cadmium, Copper, Zinc, Nickel and Arsenic are found in leachate at landfilling sites were in trace amount as the waste is domestic in nature. Most countries have certain procedures wherein the wastes are treated as per their content and then disposed accordingly. But in third world countries, there is no fixed management for these wastes and the general public is unaware of the hazards of these wastes. Presently, what is happening in India is that the household wastes are mixed with municipal solid wastes which are later dumped into landfills and open dumps. These cause further problems to the land and residents of communities living nearby (Toxics Link, 2008). Heavy metals have been found in leachate in very high concentrations particularly mercury and cadmium and lead but they are found in very little quantities. But zinc has been detected in very high quantities (Ehrig 1983; Kjeldsen et al 2002 and Robinson 1985). These metals could be a problem for drinking water as these are exceeding legislative permits in USA. Also particulate matters contaminated with these metals have been observed as one of the primary sources of heavy metal emissions from landfills (Parker *et al.,* 2002).

Landfills handling hazardous waste are designed with pollution control devices, including three impermeable liners, groundwater monitoring systems, and leachate collection systems. Even with these pollution controls in place, some are cynical about the potential of a lined landfill to control pollution.

Many hazardous wastes have been banned from landfills, including PCBs (polychlorinated biphenyls), dioxin, toxic metals, and most organic solvents (Faulcon, 1998). Since the chemical makeup is vastly different among the different types of household hazardous waste, one cannot make a general statement about what happens to household hazardous waste in a landfill environment. The long-term effects of household hazardous waste are still unknown (Faulcon, 1998). According to Dasgupta (2013) a wide variety of toxic and organic compounds can be found in Bhopal landfill (Bhanpura) leachate. However, the concentration of these constituents is generally in the order of micrograms per liter. Co-disposal of ash with MSW does not appear to adversely impact leachate quality. Concentrations of heavy metals, BOD, COD, and ammonia in leachate from co-disposal sites were not statistically higher than values reported for MSW sites. Chloride values were elevated in the ash leachate in the methanogenic phase because of the high chloride content of ash. Sara Ojeda-Benitez et al, (2013) described that the primary HHW generated in the three strata selected according to a socioeconomic stratum. It was observed that cleaning products, personal care and beauty products, comprising a total of 68% of the total HHW generated. With exception of two tests, it was statistically demonstrated that each stratum exhibits different characteristics with respect to HHW generation and composition.

Landfill is one of the cost effective approach is in practice since immemorial to dispose biodegradable solid wastes collected from the households. Wastes are collected from the households and collected and stored in a common place of the ward. As per the guideline, these wastes to be transported to landfills within 24 hours during wet months and maximum 48 hours during dry months, but the guidelines are not followed and trans-storage facilities making them also a source of hazardous waste. Further the ever growing population and increasing solid waste generation at household level has been affecting adversely the ecological, environmental quality aspects of the city (Raghav Chandra, 2013). Bhanpur landfill receives garbage from the entire city and with no recycling facility and has been making life miserable for locals for years. Residents of nearby areas rural and urban areas including Bhanpur, Raslakhedi, Khejda, Pipliya, Mahauli, Polua, Atal Nehru Nagar, Peoples group institutions, Shiv Nagar, Kalyan Nagar, Kararia, Karond and Meenal Residency are facing hazardous smoke and other impacts.

The current dumpsites are an environmental hazard, particularly to communities residing around the sites. This recently led to the National Green Tribunal asking the BMC to take immediate remedial measures to resolve this matter. Several issues in Bhopal connected to solid waste need attention given the number of lakes and green belt areas; hence there is an urgent need to safeguard its environment. We must understand that landfill sites should act as a 'safety net' in a good waste management system rather than a mere dumping yard. It should be managed out in a way such that future generations do not have to worry about it. Hence should be done in a sustainable way. The landfill approach should follow a systematic approach from solid waste generation *i.e.* at household level, segregation, trans-storage, transpiration, sterilization and finally dispose it at landfill. According to the MSW rules, 2000, the state garbage must be incinerated at a land fill site and not at a dumping site. Although since 1980, the un-segregated bio-degradable and non biodegradable solid waste is being burnt at the site, and is putting up an enormous health hazard for the habitation nearby. Continuous burning practiced should be stopped and primary medical facilities like hand gloves, drinking water, mask, proper light, toilet at dumping site should be provided for the workers (Times of India, 2013).

Due to the ignorance of the authority and apathy of the people, there is hazardous waste like hospital waste, chemical constituent wastes, corrosive material, inflammable and glass, including florescent bulb/ tubes, PVC constituted materials, etc. dumped in the

Bhanpur landfill site. This is being attracting various vectors, including garbage pickers, who pick-up recyclable materials from the dump site and litter the waste. The practice of the rag pickers are not hygienic and not using any safety measures. Thus the current practice (un-segregated dumping) put these rag pickers in great risk and disaster. Garbage accumulated at Bhanpur, has majorly impacted air and water quality of the surrounding area and life in nearby residential areas, and thus posing a grave danger/ hazard to nearby railway track which is barely 20 feet away from the dumping site. Due to the huge waste that lies at the site, cattle stray on to the railway track and, resulting into many incidents, there are reported cases of cattle death. Besides, due to air pollution, it is proving to be a big health risk to passengers who are travelling/ passing the area due in inhalation (Times of India, 2014).

Experimental work conducted in the area, reveals utmost of the specifications of the ground water in most of the sites located nearby this landfill area are not in accordance to the normal standards of portable ground water (Hassan *et al,* 2012). According to the people of the Bhanpur village, the MSW site is also being contaminated by hospital waste. The use of mosquito repellents is increasing and being practiced on daily basis. The residues of these are also contaminating the site (Tischler et al, 2013). This gives a clear indication of a possible contamination of toxic waste (hazardous) in the landfill site. As per the guideline the solid waste at landfill requires to be reduced through decomposition, but here it is burnt to reduce its amount. Carcasses are also burned in open and bio-medical waste is mixed freely at dumping site in large quantity, raising questions on the health of those living in the nearby areas. Rag picking is being practiced freely; the people working at this landfill site are not given any safety gear for protection, since it is an un-authorized activity. For earning an amount of Rs. 100 per day, they expose themselves to such toxic atmosphere, risking their lives, which puts a question mark on the management of such risk prone sites. It is an illegal act since many children below the age of 10 yrs are also involved in this activity and accounts for child labour. Also they are not providing them with the required protection gear while working at such hazardous site. The leachate being generated at the landfill site is polluting the soil, groundwater and affecting the productivity of the fields. Thus hazardous substances collected at the household level and its mixing with municipal solid waste at the landfill sites are creating various environmental problems.

CONCLUSION

The review recommends few alternate measures to strengthen the policy. Organizing campaigns in order to spread knowledge about the best practices for waste management in urban areas, strengthening the segregation system at household scale and establishment of temporary collection points/centers to monitor the level of segregation at the household scale, application of spatial database and analysis tool to integrate various spatial attributes related to soil, water, natural vegetation, proximity to habitation etc. for establishing SLF, collection of sample from soil, water and leachate from the SLF and its analysis and remedial measures to be taken based on case to case basis. Waste to energy initiatives to provide incentives to the community who participate in waste segregation would be another approach in sustainable solid waste management at municipal scale.

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REFERENCES

Ahel, M., Jelicic, I., (2001). Phenazone analgesics in soil and groundwater below a municipal solid waste landfill.Pharmaceuticals and personal care products in the environment scientific and regulatory issues. Washington DC7 American Chemical Society,100-115.

Atwater, J.W., Jasper, S., Mavinic, D.S.,and Koch, F.A. (1983). Experiments using daphnia to measure landfill leachate toxicity. Water Res, 17, 1855.

Brown, K.W., Schrab, G.E., and Donnelly, K.C. (1991). Acute and genetic toxicity of municipal landfill Leachate.TR-153, Texas Water Resources Institute, Texas AandM University.

Cameron, R.D., and Koch, F.A., (1980), The toxicity of landfill leachates. WPCF Journal, 52(4), 760.

Chandra, R., (2013). Solid Waste Management: Need, Innovations and Strategies: A case study of Christensen, T.H., Kjeldsen, P.,Bjerg, P.L., Jensen, D.L., Christensen,J.B., Baun, A., (2001). Biogeochemistry of landfill leachate plumes. Appl Geochem,16:659 – 718.

Dasgupta, T., (2013). Analysis of Bhanpur Landfill Leachates: Investigation and Recommendation. International Journal of Scientific Engineering and Technology 2(1), 1091-1094.

Faulcon Bowen, C., (1998). Household Hazardous Products and Hazardous Waste.A Summary for Consumers, College of Agricultural Sciences Agricultural Research and Cooperative Extension.

Gintautas, P.A., Danial, S.R., and Macalady, D.L., (1992). Phenoxyalkanoic acid herbicides in municipal landfill leachates. Environ Sci Technol, 26:517-521.

Harmsen, J., (1983). Identification of organic compounds in leachate from a waste tip. Journal of Water Research, 17(6), 699-705.

Hassan, I., Kumar, A., Khan, F., Saxena, S., and Iqbal, A., (2012). Evaluating the effect of landfill leachate on groundwater quality in relation to physicochemical and bacteriological characteristics. Journal of Chemical and Pharmaceutical Research, 4(12):5202-5214.

Holm, J.V., Rugge, K., Bjerg, P.L,and Christensen, T.H., (1995).Occurrence and distribution of pharmaceutical organic compounds in the groundwater downgradient of a landfill (Grinsted, Denmark). Environ Sc Technol, 29:1415-1420.

Jensen, D.L., Ledin, A., and Christensen, T.H., (1999). Speciation of heavy metals in landfill-leachate polluted groundwater. Water Res, 33:2642–2650.

Kjeldsen, P., Barlaz, M.A., Rooker, A.P., Baun, A., Ledin, A., Christensen, T.H., (2002). Present and long-term composition of MSW landfill leachate: a review. *Crit Rev Environ Sci Technol*, 32:297 – 336.

Kjeldsen,P.,(1993). Groundwater pollution source characterization of an old landfill. *J Hydrol*, 142:349-371.

Kulikowska, D., and Klimiuk, E., (2008). The effect of landfill age on municipal leachate, 99, 5981-5985.

Lyngkilde, J., and Christensen T.H., (1992). Fate of organic contaminants in the redox zones of a landfill leachate pollution plume (Vejen, Denmark). *J Contam Hydrol*,10:291 – 307.

Mor, S., Ravindra, K., Dahiya, R.P., and Chandra, A., (2005). Leachate characterization and assessment of groundwater pollution near municipal solid Waste landfill site. Environ Monit Assess, 118,435–456.

Moturi, M.C.Z., Rawat, M., and Subramanian, V., (2004).Distribution and fractionation of heavy metals in solid waste from selected sites in the industrial belt of Delhi, India. Environ Monit Assess, 95,183–199.

Oman, C., Hynning, P.(1993).Identification of organic compounds in municipal landfill leachates. Environ Pollut, 80:265 –271.

Palmer, J.A., (1998). Environmental Education in the 21st Century. Theory, Practice, Progress and Promise.Routledge, London and New York, 35-77.

Parker, T., Dottridge, J., and Kelly, S., (2002).Investigation of the composition and emissions of trace components in landfill gas. RandD Technical Report P1-438/TR. Environment Agency, Bristol, 145.

Pastor, J., and Hernández, A.J. (2012).Heavy metals, salts and organic residues in old solid urban waste landfills and surface waters in their discharge areas.Determinants for restoring their impact, Journal of Environmental Management 95, S42-S49.

Raddi, P., Panconesi A., Sumer S., (1987). Ilcipresso in Turchia.considerazioni di un viaggio di studi. Monti e Boschi 1:67-72.

Robinson, H.D., (1995). A Review of the Composition of Leachates from Domestic Wastes in Landfill Sites. UK7 Aspinwall and Company for the Department of the Environment, 511.

Sara Ojeda, B., Quetzalli Aguilar, V., Paul Taboada, G., and Samantha, E., Cruz, S. (2012). Household hazardous wastes as a potential source of pollution: A generation study, Waste Management and Research, 31(12), 1279–1284

Schultz, B., Kjeldsen, P. (1986). Screening of organic matter in leachates from sanitary landfills using gas chromatography combined with mass spectrometry. *Water Res,* 20: 965–70.

Schwarzbauer, J., Heim, S., Brinker, S., Littke, R. (2002).Occurrence and alteration of organic contaminants in seepage and leakage water from a waste deposit landfill. *Water Res*, 36:2275 – 87.

Slack, R., Gronow, J., and Voulvoulis N. (2004). Hazardous components of household waste. Critical Reviews in Environmental Science and Technology. 34:419–445.

Times of India (2013). Come clear on dumping site status, NGT to agencies: The Times of India, Oct 30, 2013.

Times of India (2014). Bhanpur burning waste a ticking time bomb: The Times of India, Nov 11, 2014.

Tischler, L., Buzby, M., Finan, D.S., Cunningham, V.L., (2013). Landfill disposal of unused medicines reduces surface water releases. *Integr Environ Assess Manag*. 9(1):142-54.

Vassilis, J. Inglezakis, and Konstantinos Moustakas (2014). Household hazardous waste management: A review, *Journal of Environmental Management*, 150:310-321.

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