

Management of Solid Waste in Jodhpur: Current Status and Innovative Approach

ROHIT CHOUDHARY

Department of Civil Engineering
JIET Universe (co-ed campus),
NH-65, Pali Road, Mogra,
Jodhpur (Rajasthan), INDIA
rohitchou20@yahoo.com

DAMINI VYAS

Department of Civil Engineering
JIET Universe (co-ed campus),
NH-65, Pali Road, Mogra,
Jodhpur (Rajasthan), INDIA
damainivyas93@gmail.com

RAMLAL RIYAR

Department of Civil Engineering
JIET Universe (co-ed campus),
NH-65, Pali Road, Mogra,
Jodhpur (Rajasthan), INDIA
riyarjiet2012@gmail.com

GARIMA GOSWAMI

Department of Applied Sciences
JIET Universe (co-ed campus),
NH-65, Pali Road, Mogra,
Jodhpur (Rajasthan), INDIA
garima.goswami@jietjodhpur.com

ABSTRACT

Jodhpur (geographical area of 22850 Km². The district stretches between 26°29' to 27°37' at north Latitude and between 72°55' to 73°52' at East Longitude) the second largest city in the state of Rajasthan. The city's population and density by the end of 2012 is 1,510,000 and 12,210/Km² respectively. The increase in generation of solid waste is only the result of the rapidly growing human population and the adopted modern life style; the substantial increase in the solid waste generation resulting into the contamination of air, water and land resources. Municipal solid wastes, commonly known as trash or garbage, are the solid wastes generated from different municipalities. Some of these wastes have been proved to be extremely toxic and infectious. The uncontrolled and unscientific dumping of such wastes has brought about a rising number of incidents of hazards to human health. Contamination of surface and ground water give rise to more serious human health risk. In this study we will deal with the current MSW in Jodhpur and its improvement for future. This paper aims at suggesting better and economic methods for Jodhpur Municipal Solid Waste (MSW).

KEYWORDS: solid waste, vermi compost, environment, ground water, water table, keru village, air quality.

I. INTRODUCTION

This district comes under arid zone of the Rajasthan state. It covers 11.60% of total area of arid zone of the state. Some of the area of Great Indian Desert THAR also comes within the district. Despite its arid climate, Jodhpur is blessed with a variety of flora and fauna.

Extreme of heat in summer and cold in winter is the characteristic of the desert. Jodhpur is no exception. The temperature varies from 49°C in summer to 01°C in winter. The Sandstorm (andhi) spectacle for people from other region of India. The rainy days are limited to maximum 15 in a year. The average rainfall is 302 mm.

The out-dated, inefficient, institutional weakness, shortage of working man-power, inadequate financial resources, improper choice of technologies, inadequate

Coverage of areas & poor short & long term waste management planning are few of the reasons why the MSW management system in India is lacking to desired level. The City Jodhpur is also facing these deficiencies in varying degrees and there is a need to make substantial improvement in the MSW practices prevailing in the city to raise the standards of health, sanitation and urban environment keeping pace with the rapid urbanization and growing population.

The adverse effects on environment due to the adverse effects on environment due to un-scientific management of waste disposal are well known. These are as follow:

- ❖ Ground and Surface water pollution
- ❖ Air pollution due to bad odour of the waste
- ❖ Green-house-gases i.e. Carbon dioxide
- ❖ Harmful effects of rats, stray animals, flies, mosquitoes, germs and other insects
- ❖ Increase in acidity of soil near the garbage heaps
- ❖ Probability of diseases and epidemics
- ❖ Health related problems for rag pickers

WHAT IS SOLID WASTE?

The simple solid waste emerging from houses or dwelling is not the problem. The real problem arises when one is confronted to transport and disposal of hazardous and biomedical waste. The main source of domestic waste is printing press, throwing out news paper, printed boxes, books and journals. In addition we have food waste, fly ash and plastic waste. The mentioned material namely plastic is real headache for disposal. One cannot get rid of it by incineration. This process will result in liberation of obnoxious gases which are injurious to health. The packaging industry has made phenomenal progress in designing very attractive containers. Many a times person is so personified with attractive packages that he buys it

just for its good appearance with no consideration of packed material. The second group of hazardous waste is composed of materials like pesticides, fertilizers. Such waste on indiscriminate disposal leads to serious health problems.

Many of the components are non-degradable. It also includes radioactive waste. Its disposal is a great problem in nuclear industry. The concept of the biomedical wastes is of recent origin. We have made spectacular progress in field of medicines with the starting of hospitals for health care. We have many super specialty experts in hospitals, such hospitals deal daily with human blood, culture, pathological waste, contaminated sharps like hypodermic syringe or old surgical instruments. The diseases producing bandages, lint's, plastic container is serious problem. As it stands in most of our small towns, biomedical waste is carelessly thrown along with usual solid waste to dumping ground. Such discarded biological waste is the breeding places for occupational diseases. One must not forget that all kinds of biomedical waste need disinfection before its disposal. Nowadays such bio waste is periodically collected by environmental conscience community from large hospitals and nursing homes; however the situation in small towns, cities and villages is far from satisfactory.

CHARACTERIZATION OF WASTE

Before we think of transportation and treatment of waste, we must consider the physical, chemical and biological properties of all kinds of solid waste. For characterization of solid (domestic) waste an analysis called proximate and ultimate analysis is carried out in order to know the contents of moisture, volatile matter, ash and compounds of carbon, nitrogen and sulphur. It is always necessary to know their specific gravity. The chemical characterization involves consideration of contents of metal, glass, cloth, garden waste, ash and plastic. The characterization of plastic is of vital importance. We may encounter high density, low density plastic or polymers. Polyethylene, polyvinyl chloride, polypropylene are the variety which cannot be easily degraded in soil.

In case of hazardous solid waste, it is necessary to study flammability, corrosiveness, toxicity, reactivity, infective and irritating property, with due consideration of bioactivity. In biomedical waste one is confronted with the problem dealing with blood, urine, biological fluids, bones, discarded parts of body after major surgery like amputation or transplant of liver, kidney and other vital organs. The contaminated sharps consist of injection vials and needles, syringes, scalp blades, disposable pipettes, capillaries, slides and broken pieces of glass. The diapers, wet dressing, drain tubes, catheters pose a serious problem for health. All kinds of these biomedical wastes need disinfection before its disposal.

II. PRESENT SCENARIO - JODHPUR CITY

Most of the population does not store the waste at source and instead dispose the waste into the municipal bins, streets, open spaces, drains, etc as and when waste is generated. Segregation of recyclable waste is not practiced. Most of the recyclable material is disposed of along with domestic and trade waste. Therefore, recyclable waste is generally found mixed with garbage on the streets, into the municipal bins and at the dumpsites from where part of this waste is picked up by the rag pickers. There is no system of door-to-door collection of waste except in few housing societies earlier in year 2012 M/s Kanak Resource Management, Jodhpur was given a tender for the door-to-door collection but the groups worked only for one year and stopped to do it

further due to some financial crisis. Street sweeping is thus the only method of primary collection of waste.

Jodhpur, being a heritage and tourist city, there are many hotels and restaurants in the city. Arrangements of primary collection of waste from hotels and restaurants are not yet made. These establishments, therefore, dispose of their waste on the nearby open space or into the municipal bins.

Adequate storage facilities were not provided in the main vegetable, fruits and fish markets. The market wastes thrown in open space leading to unhygienic conditions and unbearable odour.

Near the waste processing site, Keru village, a private operator is transporting & incinerating the waste to common biomedical waste treatment facility, where proper disposal of waste is being done as per the guidelines. Some pathology labs, small nursing homes, dental clinics, clinics and dispensaries were disposing their waste along with municipal solid waste.

1. COLLECTION OF MUNICIPAL SOLID WASTE

The storage of MSW at the source is substantially lacking throughout the Jodhpur city. The bins are common for both decomposable and non-decomposable waste (no segregation of waste is performed). Storage bins classified as movable bins and fixed bins. The movable bins are flexible in transportation but lacking in durability, while the fixed bins are more durable but their positions cannot be changed once they have been constructed. A sweeper who sweeps the roads manually is allotted a specific area. The sweepers put the road wastes into a wheelbarrow and then transfer the waste to dustbins or collection points.

Very poor storage and collection practice was seen in the city. It was seen that sweepers are not doing their road sweeping duties regularly and sincerely also peoples of Jodhpur were also found less awarded to through the waste into the fixed or movable bins. The mixed waste was seen inside & outside the bins states that segregation of waste is not being done seriously. The stray animals were also seen around the bins as the waste was not also throwing outside the bins. The conditions of plastic & cemented bins were very bad as all were broken. Out of the 15 lakhs of population total generation of municipal waste is 300-350 MT/day. Out of that only 100 MT/day is being collected through trucks, tractors deputed by municipality. The received 100 MT/day of waste at processing site is being used for composting the rest is being disposed to the backyard of site.

2. TRANSPORTATION OF MUNICIPAL SOLID WASTE

Transportation of waste is done through a variety of vehicles such as three-wheelers, tractors and trucks. The transport vehicles are loaded manually and these are used for two-three shifts in a day. Inadequate number of transport vehicles is a major problem. The transportation system also does not synchronize with the system of primary collection and bulk waste storage facilities. Multiple manual handling of waste becomes necessary. During the study period, it was observed that vehicles transporting waste were not covered with the tarpaulin/plastic sheets.

3. MUNICIPAL SOLID WASTEPROCESS PLANT

Municipal Solid waste treatment & processing plant(Plant area 48 Acres)at village Keru, Jodhpur30 Kms away from the Ratanada, Airport operating by M/s U P L Environmental Engineers Ltd. The processing plant is the result of Central Government scheme of establishment of Municipal Solid Waste processing plant in the Air-based town. The Detailed Project Report (DPR) for Jodhpur was submitted by National Buildings Construction Corporation (NBCC) under Solid Waste management scheme for mitigation of bird hit menace to Indian Air Force (IAF) air craft's, Jodhpur and approved by the Central Public Health and Environmental Engineering Organization (CPHEEO), a department under the Ministry of Urban Development (MoUD) and the fund was sanctioned for implementation. The processing unit at Keru village of 200 MT/daycapacity was commissioned on February, 2012. The receiving of waste started from November, 2012 for the compost &vermi-compost production. As the waste received is only about 100MT/day in that after screening of the waste is being use for composting and bio-composting. The received waste contains polythene, rubber, stones, iron, sand, cloth, wood, foam, leather and vegetables. The processing unit is making compost with two brand names i.e. PhosGold, Godavarysold to Sikandarabad and Apna Star Compostsold locally. 10-15 MT/day is the production of compost selling at the price of 1-2 Rs/Kg. The windrow technology is being used for the compost manufacturing. Water spraying on the waste is done for three times a week. To compost the waste first it is segregated properly and moisture is to be maintained. After this the segregated waste for the compost is being fed to 35 mm , 16mm trommle machine respectively, the reject of these machine is sent to landfill area (spread in 20 acres area). After curing (maintain the moisture to 15%) the waste for compost fed into Refinement (Sieve of 6mm, 4mm & 2mm) & metal separator sections. The compost after 40 days of process is ready to mix with rock phosphate in ratio of (630 gmsCompost: 370gms Rock phosphate) and the final product is being packed and sold in the market with a trade name.

Vermi-composting of organic waste is also being done at this processing plant. There are total 68 huts provided for the same. Moisture is maintained through timely water spraying & earthworms are being fed in the organic waste-cum-animal dung. Only 10 huts are in operation due to less amount of received organic waste. Total 1 to 3 MT/monthly is the production of vermi-compost sold at the rate of 2-3 Rs/Kg of vermi-compost.

On site fire in the land filled waste was seen, it was also informed that this happens many times a month. 50 KL of water tank is provided to cop up with the fire-incident & municipality fire-brigade is also being informed for the same.

Fencing was done around the boundary of plant area whereas broken at some places due to animal movements in night. About 1000 tress are planted e.g. Babool, Ashoka, Neemand,Kaneralong with the flower garden.

Just near to the waste processing plant a Carcass plant to make the Murgi-Daana from the dead animals flesh. The dead animals are being thrown in front of the Carcass plant causing severe air pollution along with the unbearable smell. The birds like Vulchers are very common here to result in any Air crashes.

It was informed by RSPCB; Jodhpur that the MSW processing site is not working properly and after repeated renewal notices from RSPCB no serious action was taken by the unit's authorities.

4. DISPOSAL OF MUNICIPAL WASTE

The MSW of Jodhpur city was being dumped on unauthorized sites or was used to fill up the pits or low lying areas. Dumping site at Keru(15 KMaway from the city Jodhpur)where untreated 300-350tonnes of MSW was being dumped daily, was situated in catchment area of Kaylana water storage tank of Public Health and Engineering Department (PHED) and UmaidSagar of Irrigation Department, ignoring health hazards due to contamination of surface water being supplied to Jodhpur city for drinking. The waste processing site is also situated here & having its own municipal landfill site behind the plant in the area of 20 Acres. A Carcass plant to make the Murgi-Daana from dead animals flesh is also running near the site. Dead animals are being dumped in front of the Carcass plant causing serious environmental nuisance. It was also seen that municipality workers are even not disposing the waste to the approved landfill site and dumping the waste on the roadsides.

It was also informed that fire incidents are very much common here in the municipal waste. Fire-brigade is being informed immediately to cop-up with the fire incidences however a temporary arrangement is being done by the waste processing sites officials.

The leach ate tank is of HDPE liner to avoid ground water contamination. As the waste received from the city is normally dry, so leach ate generation quantity is very less.

III. RESULTS AND DISCUSSION

1. AMBIENT AIR QUALITY

The data of average concentrations of four air pollutants - Suspended Particulate Matter, Sulphur dioxide, Nitrogen dioxide and Ammonia during the study period is provided in Tables I.

The estimated SPM concentration in the ambient air of the three sampling sites varied between 82to 118 $\mu\text{g}/\text{m}^3$. The primary sources of dust are windblown soil /MSW materials (usually occur in the district) and processing plants activity.

SO₂ values were Below the Detectable Limits (BDL) at all the locations and the NO₂ concentrations were in the range of 09 to 18 $\mu\text{g}/\text{m}^3$. These concentrations were well within the acceptable limits. Ammonia (as NH₃) concentration in the ambient air varied between45and90 $\mu\text{g}/\text{m}^3$.

The biological and chemical processes that occur in open dumps produce strong odour, which contaminate the adjacent environment. Fires periodically break out in open dumps, generating smoke and high particulate matter in the region.

2. GROUND WATER QUALITY

The results of the physical-chemical parameters of ground water in and around the waste dumpsites are presented in Table -II. Three ground water samples were collected 09 December, 2013. The TDS of the water samples in the study area varied from 822to 1,136mg/L, indicating the ionic contamination of ground water due to garbage dumping higher at Carcass plant. Although there is no specific limit for conductivity, but it indicates the soluble ion concentration of the water. The electrical conductivity of water samples varied from 939 to 1,500 $\mu\text{S}/\text{cm}$. Maximum values of TDS and conductivity was observed at Carcass plant, ere un-scientific dumping of dead animals was continued from a long time.

The pH of ground water of the area varied from 7.3 to 8.5. In the present area, the chloride content of the water samples varied from 18 to 36 mg/L and the concentration of sulphates in ground water was detected up to 86 mg/L in the study area. All the concentrations are well within the prescribed limits of IS 10500:1991.

IV. GENERAL OBSERVATIONS

- (a) It was observed that very poor community garbage collection facility is in practice all over the Jodhpur city.
- (b) The cemented & plastic bins at many places of Jodhpur area were very dirty, overflowing and broken. People, often threw the garbage outside the bins. The nuisance of huge garbage on roads and sorting by the rag pickers or moving stray animals on the streets, present very ugly scene.
- (c) It was observed at many places in morning, thick black smoke spread over large areas on the roads due to burning of leaves, plastics and other wastes.
- (d) Most of the drains beside the road were found choked due to the indiscriminate dumping of garbage.
- (e) The use of commercial trucks with or without hydraulic tipping arrangement for waste transportation was very common in Jodhpur city. It has a carrying capacity of 3.5 to 8.0 MT waste at a time. Garbage from the roadside bins is lifted manually and hydraulically into the trucks. Besides this, tractor, dumper placer, mobile compactor etc. were also used to transport MSW to the dumping site.
- (f) Dumping of Municipal Solid waste on the unauthorized land is in regular practice. To stop this unauthorized dumping practice RSPCB has already made directions & notices, however action from Municipality is still awaited.
- (g) The un-scientific dumping of dead animals was unhygienically creating many problems in village Keru.
- (h) The vultures are common here in this dumping area.
- (i) Presently, Jodhpur has one dumping site at Keru village also the refused waste of processing plant is also being dumped backside the plant area where unscientific dumping is continued from a long time. Due to this, there was a possibility of percolation of heavy metals from garbage into the groundwater.
- (j) It was observed that records and documents related to the dumping of waste at each dumpsite were not maintained properly.
- (k) It is estimated that 300 to 350 MTD of solid waste is generated in the city through street sweeping and from the communal waste storage sites. Out of that only 100 MTD is accepted by processing plant and rest is sent to dumping site.
- (l) It was observed that proper fencing, approach road, light is being provided however the monitoring facility for pollution measures and pesticide spray to control flies etc. were not available at the dumping sites.

(m) Significant quantity of garbage was observed near the multi-storied buildings and big apartments due to the absence of the collection bins and closed campus system.

V. RECOMMENDATIONS

- (a) To direct Municipality of Jodhpur to authorize the dumping site as well as the dumping site of MSW processing plant for non-compliance.
- (b) To avoid any air-crashes nearby Carcass site, the dumping of the dead animals should be avoided.
- (c) To develop sanitary landfill sites as per guidelines of MoEF.
- (d) To provide sufficient community garbage storage facilities in the slum area is a pre-requisite to better management of MSW.
- (e) To stop and prevent open burning of tree leaves and other waste by sweepers on the roadside and direct them to take all the waste to the communal waste storage bins/sites only.
- (f) To avoid throwing waste in the open drains to prevent drain choking. To clean the drains in regular basis to permit free flow of wastewater.
- (g) To assess the pollution load, monitoring facility should be developed at processing plant area.
- (h) To store, transport and dispose industrial waste as per the guideline of SPCB. However, The JMC may act as catalyst by helping industries located in large & small industrial area to procure land and in the transport and dispose of non-hazardous industrial waste on cost recovery basis.
- (i) To spread mass awareness through messages like "Clean Jodhpur, Green Jodhpur" or "Keep your waste unmixed" etc. And cartoons related to MSW management can be painted on the JMC vehicles, Public buses or private buses for public awareness.
- (j) To spread awareness through cable TV and local channels as these are very powerful media to create awareness for public about solid waste management in the city. NGOs with good mass communication skills can develop good education programmes for the public on the new solid waste management strategies either through direct support or through use of JMC facilities.
- (k) To encourage Social Clubs to sponsor many events to keep the topic of Solid Waste Management in city alive and design programme every week or month. Ward committees should use their good offices for public involvement to make their wards litter free and clean. Healthy competitions among the wards may be organized by the JMC. Corporation may also announce rewards to the employees contributing to the cleanliness of city.

Table 1: Ambient Air Monitoring at MSW Site Keru Village, Jodhpur

S. NO.	TIME	Near weight bridge				Near compost plant			
		SO ₂	NO ₂	NH ₃	SPM	SO ₂	NO ₂	NH ₃	SPM
Sampling Date: 24.03.2013									
1	10 am-2pm	BDL	09	45	82	BDL	11	76	118
2	2 pm- 6pm	BDL	18	59		BDL	15	90	

All values are in $\mu\text{g}/\text{m}^3$

Table 2: Ground Water Analysis Report

S.No.	Locations	pH	Conductivity (μS)	TS	TDS	Cl ⁻	SO ₄ ⁻²
1	Carcass Plant	7.3	150	115	113	36	22
2	Vermi-compost Plant	8.5	1115	830	822	18	40
3	Bio-medical waste plant	7.7	939	933	914	21	86

All values are in mg/l, except pH and conductivity in μS

VI. REFERENCES

1. Shah K. L., Basics of solid and hazardous waste management technology, Prentice Hall Publication, New Jersey, USA (2000)
2. Bagchi A., Design construction and monitoring of Land fills, Wiley (1994)
3. Khopkar S. M., Environmental Pollution analysis, Second edition, New Age International Publishers (P) Ltd. (2012)
4. Khopkar S. M., Environmental pollution, monitoring and control, Second Edition, New Age International Publishers (P) Ltd. (In Press)