

# Municipal Solid Waste Management in KhoramAbad City and Experiences

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**Abstract**—This paper presents an overview of current municipal solid waste management in Khoram Abad city.

According to data collected by the local authorities, the waste generation rate is estimated to be 800 g/cap.d with density of 243 kg/m<sup>3</sup>. Solid waste is stored in different types of containers at the source of generation in different areas of the city.

Local Authority is responsible for waste collection, transportation. Municipality is responsible for waste collection, using private sector contracts.

At present, both mechanical and manual methods are used to collect residential waste. Manual methods of collection are the most commonly used for waste collection in most parts of the city.

Land filling is the main disposal method in this city. But it has some obvious problem and deficiencies

The current state of solid waste management has been improved slightly in the last decade. By more actions can reduce the human and environmental risks.

**Keywords**—Disposal, Landfill, management, solid waste.

## I. INTRODUCTION

SOLID waste management is a complex process because it involves many technologies and disciplines. These include technologies associated with the generation (including source reduction), on-site handling and storage, collection, transfer and transportation, processing, and disposal of solid wastes. All of these processes have to be carried out within existing legal, social, and environmental guidelines that protect the public health and the environment and are aesthetically and economically acceptable [1].

Rapid urbanization, population growth and changes in lifestyles in developing countries contribute to increasing the per capita municipal waste generation. Keeping pace with the requirements of rapid economic development and continuing population growth, and because of its critical role in protecting the environment and public health, accomplishing effective and efficient municipal solid waste (MSW) management should be a priority for cities in developing countries [2].

In appropriate waste handling, storage, collection and disposal practices pose environmental and public health

risks. In densely populated urban centers, for example, appropriate and safe MSW management is of utmost importance to create a healthy environment for the people. The collected waste is generally dumped on land in a more or less uncontrolled manner. [3].

Improper management of solid waste in most cities of developing countries leads to problems that impair human and animal health and ultimately result in economic, environmental and biological losses [4].

Solid waste management in developing countries must deal with many difficulties, including low technical experience and low financial resources which often cover only collection and transfer costs, leaving no resources for safe final disposal [5].

In general, there is a lack of organization and planning in waste management due to insufficient information about regulations and due to financial restrictions in many developing countries [6]. Due to resource limitations, increasing amounts of MSW are not accompanied with proper management practices. This situation poses serious public health risks and causes environmental degradation in many cities of the developing world [7]. Improper management of solid waste has been reported by several researchers in different cities of developing countries [4, 8, 9, 10].

Recently, some developing countries have realized that the SWM policies they follow do not serve the objectives of sustainable development, and there is a need for a paradigm shift in dealing with MSW management problems [11].

This paper presents an overview of current municipal solid waste (MSW) management in Khoram Abad city. In addition, the major issues involved with the management of solid waste in Khoram Abad are presented and discussed, applicable recommendations for system improvement is provided

This study may be useful for authorities and researchers of developing countries to work towards improving their present municipal solid waste management system.

## II. DESCRIPTION OF KHORAMABAD CITY

The city of Khoram Abad (center of Lorestan Province) is located in the western part of Iran (Fig. 1). The latitude and longitude of Khoram Abad are 33°, 29' N and 48°, 21' E, respectively. The area of the city is 6233 Km<sup>2</sup>. Its Attitude from free seas is 1134 m. The city located in a valley. It has been surrounded by mountains (Fig. 2). Buildings are mostly one or two floor.

Population of the city is about 355,000 with a population growth rate of 2.8 percent.

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Khoram Abad has a main municipality that is responsible for all aspects of solid waste management.



Fig. 1 The location of Lorestan province and Khoram Abad city in Iran



Fig. 2 A view of Khoram Abad city

### III. DATA COLLECTION

Necessary data and information for this study was collected from municipality information, direct observation, taking photography by the researchers, Interviewing with responsible persons. Also a questionnaire was planed (including questions about frequency of collection, time of collection, ...) that fill out by collection workers, people, recovery organization responsible.

### IV. GENERATION AND CHARACTERISTICS OF MSW

Waste production and composition depend on many factors, such as the stage of development; socio-economic, climatic and geographical conditions; and collection frequency [5, 12]. Data on quantity variation and generation are useful in planning for a collection and disposal system [4]. According to data collected by the local authorities, the waste generation rate is estimated to be 800 g/cap.d for KhoramAbad city. This amount is near to other Iranian cities [13, 14]. According to performed analysis, density of MSW is 243 kg/m<sup>3</sup> that vary from season to season. Total amount of municipal solid waste is currently about 240 tons/d with a variation during the year. A comparison of the average amounts of MSW components of Khoram Abad city in different years is reported in Table I.

TABLE I  
CHARACTERISTICS OF MSW IN KHORAM ABAD

Components	Percent by weight 1993 Health center	Components (%) 2001 recovery organization	Components (%) 2006 recovery organization	Components (%) 2007 recovery organization
Food wastes	80.5	64.5	76.1	76
Rubber & Plastic	4.3	5.5	2	5.5
Paper& cardboard	6.7	8	6	8.2
Glass	1.6	2.5	1.5	2.4
metals	2.4	2.3	1.3	2.5
Others	4.5	17.2	13.1	5.4
sum	100	100	100	100

In all studies, the physical analysis of MSW was accomplished using methods described by Omrani [15]. As shown, the percentage of organic wastes in the MSW of Khoram Abad city is usually high, mainly due to use of unprocessed foods in daily people diets. Although, the amount of organic wastes decreased from 80.5% in 1993 to about 76% in 2007 it's relatively high. This amount is almost near to that of many cities in developing countries such as Turkey (42–80%) [4], India (40–60%) ([4], Jordan (54–78%)[17], and Nigeria (52–65%) [8]. Derived structural formula for MSW in Khoramabas is  $C_{163} H_{22} O_{121} N_6 S_1$  and its heating value is 6596 kJ/kg.

In addition, there has been a big change in the percentage of plastics in the waste stream during the last few years mainly due to a change in the living style of the citizens. For example, increases in the consumption of bottled water and soft drinks, as well as fast foods, which have recently become more popular, have changed the MSW during recent years.

### V. WASTE STORAGE, HANDLING AND SEPARATION/PROCESSING AT SOURCE

Solid waste is stored in different types of containers at the source of generation in different areas of the city. Within the household, plastic bags are usually used for the storage of the solid waste generated (Fig. 3). These bags are thrown away near houses or in medium-sized containers, which are located near houses. Medium- and large-sized containers are mainly used in commercial locations on the road sides and in densely populated areas, fiberglass containers, of 220 lit capacity, or galvanized type are used for MSW storage in the areas accessible by the collection vehicles (Fig.4). Many containers in the some areas are in poor condition. Some are without wheels, which delay the process of unloading into the collection vehicles. In addition, movement of containers without wheels requires extra effort or handling by the workers, which results in severe injuries in some cases. Some containers are corroded and rusted, which leads to leachate spillage at the container site.



Fig. 3 Using plastic bags for transferring MSW in Khoram Abad



Fig. 4 Type of mechanical container for MSW collection in main streets and commercial areas, Khoram Abad

Like many other developing countries, scavenging plays a role in reducing the quantity of waste reaching the disposal site. Although scavenging activities reduce waste volume, they make waste collection much more difficult due to the opening of garbage bags. The valuable components of MSW, such as papers, plastics (PET, PP, PE, etc.), glass, metals and breads are collected by some people irregularly in the city, as well as at the disposal site. They sell the recovered materials to small recycling units.

Source separation of wastes (especially organic wastes) will not only bring economic benefit, but will also make the recycling of other components more efficient [18]. A systematic source separation program for solid wastes (including food waste, plastic, paper and board, metal and glass) was started in some parts of the city by recovery organization in 2007. In this program at the first step necessary information is given to citizens by posters, Pamphlets, books, and face to face education. Then special bags (in different colors) are delivered to citizens in order to separate MSW components. Some gift rewarded to people for more participation.

## VI. COLLECTION

Local Authority (KhoramAbad Municipality) is responsible for waste collection, transportation and street sweeping. Municipality is responsible for waste collection, using private sector contracts.



Fig. 5 Temporary terminal for collection solid waste

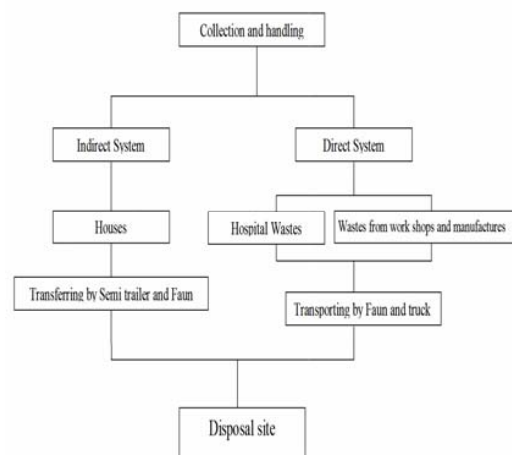


Fig. 6 Flowchart of MSW management in Khoram Abad city

At present, both mechanical and manual methods are used to collect residential waste. Manual methods of collection are the most commonly used for waste collection in most parts of the city.

Almost 54.4 % of the MSW is collected daily and transported to transfer stations or disposal sites. 27.3 % of MSW is collected every other day, 13.3% of MSW is collected once a week and 5 % without any certain schedule. About 48.6 % of collections are occurred at nights. 42.3% of MSW collections are occurred in the mornings (8 am to 12 am). And 9 % of MSW collections are occurred without certain schedule. Some of the residents near the bank of Central River flowing through the city throw different wastes in to the river.

Waste collection in Khoram Abad includes collection from residential places, hospital wastes and manufacture wastes. Main portion of MSW (80%) transported to disposal site directly the rest transferred to temporary terminals (Fig. 5) and final transport to main site. Whole MSW management in Khoram Abad city is illustrated in Fig. 6.

In the city the main collection scheme of MSW is based on that residents put their waste out of doors. Municipality workers collect it in trucks (or other light vehicles such as vans), take it directly to the disposal site. In some cases, where the containers are close to residences, the residents put the waste directly into the container. The containers are emptied into a rear loading compaction vehicle that has a special lifting device for collecting the solid waste.

The collection crew usually consists of two or three workers plus a driver. Each vehicle is assigned to collect the solid waste from one or more regions. Once the vehicle is filled, it leaves the collection route and travels to the landfill.

## VII. TRANSPORT AND TRANSFER

In recent years, the use of small transfer stations in different cities of Iran has become popular [13]. At present, there are two transfer stations in Khoram Abad city. The main reason for using a transfer station is special structure of streets and old alleys. The type of the transfer station in Khoram Abad is direct-load. The waste that is collected by small vehicles (e.g., vans) is discharged into an open top trailer to disposal site.

## VIII. FINAL DISPOSAL

Land filling is the main disposal method. All solid wastes are finally transferred to land fill site. With 35 hectares area that has been used from 1991.

The wastes (240 tons/d) are transported to a land fill site, which is located in the south- eastern part of the city (13 km distance from the center of the city). This site has been used from 1986. The land filling system is Ravin method.

Unfortunately, at the site, some people collect valuable components of MSW informally. In addition, different types of animals such as dogs and cows consume organic components of the waste. Such inadequate disposal practices lead to problems that impair human and animal health (Figs. 7, 8).



Fig. 7 View of uncontrolled dumping of wastes in landfill site



Fig. 8 Wastes disposal around the road and waste burning in landfill site

Some obvious problems of this site are as follows:

- Waste isn't covered daily.
- No action for waste reduction at site
- No action for run- off control.
- No action for generated gases.
- No sufficient action for hospital wastes.
- No restriction for light waste spreading around
- No sufficient fire controlling equipments at site
- Air pollution because of wastes burning
- Unfavorable odors at site
- No consideration for leachate control
- No restriction for animal entrance to site
- No action to control insects, rodents, and other vectors
- Lack of alarm and guide sign at site.

## IX. DISCUSSION

The solid waste quantities generated have been increasing due to a rise in the population and in the waste generation rate, especially during the last 20 years. It has increased from 165 ton/day in 1978 to 284 ton/day in 2006.

Inadequate funds, human resources and equipment: While

allocating resources, including financial resources, solid waste management is assigned a low priority compared to other municipal activities, resulting in inadequate funds. There are inadequate human resources mainly due to the absence of a trained staff. In addition, the equipment presently used in the collection system is old and inefficient.

Household hazardous waste, including paint, used batteries, and pesticide containers, are not collected separately.

Problems with plastic waste: Plastic wastes, especially thin plastics used as packaging materials and PET bottles, have become a nuisance in MSW management in almost all Iranian cities.

In most developing Asian countries, regulations have been enacted or are in the process of being drafted. However, there is a need for stringent control and an enforcement mechanism for successful enactment [19]. Iran also faces legal provisions regarding environmental issues, especially in solid waste management [13].

The operational efficiency of solid waste management depends upon the active participation of both the municipal agency and the citizens. Since the social status of solid waste management in most developing countries is low, there is strong apathy towards it, which can be seen from uncollected waste in many areas and the deterioration of aesthetic and environmental qualities at uncontrolled disposal sites [19]. Fortunately, public participation in Iran, especially related to municipal solid wastes, has improved due to NGO and media activities during the last 10 years [13].

#### X. CONCLUSION AND RECOMMENDATION

Because of population increasing and changes in lifestyle, the quantity and quality of MSW has changed. The current state of solid waste management in Khoram Abad city has been improved slightly in the last decade.

The waste analysis of Khoram Abad showed that the percentage of organic waste in the MSW is quite high, mainly due to the use of unprocessed foods in the daily diet of inhabitants.

Lack of resources, infrastructure, suitable planning, leadership, and public awareness are the main challenges in MSW management. Following recommendations can efficiently improve current problems of Khoram Abad MSW:

- Public education in order to increase public participation (Including waste reduction, Waste separation at source and so on.)
- Training program for the facility employees in identification of prohibited hazardous waste and prohibited waste containing PCBs
- Performance of land filling process with regard to all considerations
- Enforcement manufactures to produce higher quality products.
- Establishment of appropriate policies, legal frameworks and financial management for municipal waste management.
- Separation of household hazardous wastes such as used pesticide containers, paints and different type of used batteries

using special containers in different regions of the city.

-Improving the traditional waste collection system, such as upgrading vehicles, regular collection time and frequency.

-Preparation of any engineered structure, including landfill liners, leachate collection systems, run-on/run-off control systems, final covers, ground water monitoring systems, and gas collection systems.

-Fencing at the property or unit boundary or the use of other artificial or natural barriers to impede entry by the public and large animals.

-Weighing or estimating the tonnage of all incoming waste and recording the tonnage in the facility's operation

-Preparation of adequate fire protection to control any fires that may occur at the facility. This may be accomplished by on-site equipment or by arrangement made with the nearest fire department

-Controlling insects, rodents, and other vectors.

Also, allow no open burning and prohibit scavenging

#### REFERENCES

- [1] J. A. Salvato, N. L. Nemerow and J. Franklin, "Environmental Engineering", fifth edition, Edited by Agardy JohnWiley&Sons, Inc.,Hoboken, NewJersey. 2003.
- [2] J.Jin, Z.Wang and S. Ran, Solid waste management in Macao: practices and challenges. Waste Management, 2006, 26 (9), pp 1045–1051.
- [3] H. J. Mosler, S. Drescher, C. Zurbrugg, T. C. Rodriguez and O. G. Miranda, "Formulating waste management strategies based on waste management practices of households in Santiago de Cuba, Cuba", Habitat International, 2006. 30 (4), pp 849–862.
- [4] M. Sharholi, K. Ahmad, G. Mahmood and R.C Trivedi, "Municipal solid waste management in Indian cities – A review", Waste Management 2008, 28 (2), pp 459– 467.
- [5] C. Collivignarelli, S. Sorlini, and M. Vaccari, "Solid Wastes Management in Developing Countries", CD-ROM of ISWA 2004 World Congress, Rome, Italy October 17–21, 2004.
- [6] E. Tinmaz and I. Demir, "Research on solid waste management system: to improve existing situation in Corlu town of Turkey". Waste Management 2006, 26 (3), 307–314.
- [7] L.F Diaz, G.M Savage, and L.L Eggerth, "Overview of Solid Waste Management in Economically Developing Countries". In: Proceedings of Organic Recovery and Biological Treatment, ORBIT 99, Part 3, Rhombos, Berlin, 1999, pp. 759–765.
- [8] A. Imam, B. Mohammed, D. C Wilson and C. R Cheeseman, "Solid waste management in Abuja, Nigeria". Waste Management 2008, 28 (2), pp 468–472.
- [9] S.S Chung and W. H. L Carlos, "Local waste management constraints and waste administrators in China". Waste Management 2008, 28 (2), pp. 272–281.
- [10] M. Berkun, A. Eras, and S. Nemlioglu, "Disposal of solid waste in Istanbul and along the Black Sea coast of Turkey". Waste Management, 2005, 25, pp. 847–855.
- [11] P. Agamuthu, "Solid waste management in developing economies –need for a paradigm shift". Waste Management and Research, 2003 21, 487.
- [12] G. Tchobanoglous, H. Theison and A.S Vigil, "Integrated Solid Waste Management", McGraw-Hill International Edition, 1993.
- [13] M. R. Alavi Moghadam, N. Mokhtarani and, B. Mokhtarani, "Municipal solid waste management in Rasht City, Iran", Waste Management. 2008.
- [14] M. A Abdoli, "Disposal and recycling management of solid waste in Iran", Iran Municipalities Organization, In Persian. 2000
- [15] G. A. Omrani, "Solid waste-Management, Collection, Transportation, Sanitary Landfill and Composting", vol. 1. Scientific Publication Center of Islamic Azad University. In Persian. 1994



- [16] E. Metin, E. Ar.ztürk and C. Neyim, "Solid waste management practices and review of recovery and recycling operations in Turkey". Waste Management 2003, 23 (5), pp.425–432.
- [17] H. A. Abu Qdais, "Techno-economic assessment of municipal solid waste management in Jordan", Waste Management, 2007, 27 (11), pp. 1666–1672.
- [18] G. A. Aydin and G. Kocasoy, "Significance of Source Separation and Composting of Wastes of Istanbul: From Theory To Practice, CD-ROM of ISWA 2004 World Congress, Rome, Italy. October 17–21, 2004.
- [19] A.V. Shekdar and M. Tanaka, "Integrated Approach for Sustainable Solid Waste Management in Some Asian Countries", CD-ROM of ISWA 2004 World Congress, Rome, Italy October 17–21, 2004.