

Waste Source Separation Management for Urban Mining: A Change Strategy to Improve Quality

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Abstract : The aim of Urban Mines is to provide information, expert advice, support, direction and financial solutions to waste, energy, and climate change problems [1]. There are several effective ways of separating recyclable materials; one possible way is to separate it as mixed waste in suitable plants i.e. curbside, MRF (Material Recycling Facility) or landfill. It identifies, evaluates, analyzes past experiences and their compliance with new methods of solid waste management based on social, economic, technical, environmental and health considerations associated with the management concerns that have a positive and valuable effect in solving problems and optimization of source separation schemes in large cities. The aim of this study is to evaluate past experiences in Tehran, study positive and negative points of view of different methods and provide a model for source separation. On the basis of an experimental work and the merits of a new system, results suggested an "integrated waste source separation system" should be adopted. In preparing a new plan on the resolution of the problem previous experience in Tehran was examined, as well as the other metropolitan cities in Iran and similar projects that have been implemented in other countries.

Keywords - Waste management, Waste source separation, Urban mining

INTRODUCTION

The concept of Urban Mining challenges the status quo. Urban mining is the process of reclaiming compounds and elements from products, building and waste. This definition is based on the concept of Sustainable Development, the fact that our ecosystem is finite, non-growing and materially closed and uses industrial ecology, which examines materials and energy flows in products, processes, industrial sectors and economies [2]. Urban mining includes actions that can recover resources from waste as secondary materials or energy by separate collection or recovery of resources etc. [3, 4]. Most countries that have prepared reports on recycling household waste undertook them to assist those involved in the waste management services and recommended collection techniques required for the recovery of recyclable materials such as urban mining. The effectiveness of each regulatory schema studied and a brief review of some of many countries have shown that both source separation and resource recovery schemes need to have an active long-term role and a national strategy [5]. The results of the research for information on source separation could not answer the question as to whether source separation of mixed waste should be before or after collection, or whether both should be pursued in parallel. The results were based on very limited existing information and evidence [6].

The aim of the waste source separation of paper was gathering qualitative information on the waste collection experiences and planning new methods of source separation. Source separation schemes are a step in developing new environmental policy, the use of new technology and the development of social services. Now several local contractors pay for the cost of the selected material (bread and ferrous-metal) in Tehran. Markets for the sale of all recyclables should be secured - this is the first recovery strategy that has priority over other factors. Also it should be ensured that there are incentive laws for the products collected for use. Skills and equipment are effective factors for reduction or increase of the amount to be collected. If the income from this process does not cover the cost it will not find acceptance and the only choice will be collection as mix-waste. In the present study, the objective is to investigate points of strength and weakness in strategies adopted between the years 1997 to 2006 and from 2006 to 2010 in Tehran to help the local and regional managers to establish the best collection system for household waste. The study covers source separation in the residential area and not market issues.

I. MATERIAL AND METHODS

In Tehran, an average of 7,000 metric tons of waste are generated per day by each of the municipal regions. Currently, more than two and a half million tons of waste annually is generated in Tehran. According to the waste analysis that was carried out, 32% of dry material is recyclable. The promotion of source separation of recyclable materials will be of help in the recycling and prevention of environmental pollution and loss of national capital. Several waste source

separation trials have been conducted in Tehran in recent years and were divided into two groups which have been well documented.

a. Traditional strategies (1997 to 2006)

Resource recovery from mixed waste is the traditional method of separation that has been able to attract the most participation of people. The major obstacles to effective dry waste collection operations in each of these systems are examined. The implementation of better plans is considered separately in addition to traditional systems. Different ways of motivating and encouraging people to cooperate with the municipality is a necessary requirement of any strategy adopted. Waste pickers in the city collected waste door-to-door and purchased waste (bread and ferrous-metal) separated by citizens. Waste pickers in this system, especially those collecting paper and plastic recyclables from contaminated sources such as household garbage and hospital waste negatively affected the quality of recycled products collected. Equipment used in this method includes a wide range of handheld devices such as carts, as well as pickup trucks. In this program, citizens recycling material such as bread ,glass and ferrous-metal from home and then selling them for cash or exchanging them for other materials and separated recyclable materials in the following ways:

At source using specific recycling centers and stores; returning waste to the producers and institutions and advertising it for sale or free collection in newspapers; Taking it to storage sites and making use of collection and transportation services provided by itinerant workers and by pickup from the door ;Disposing of it through municipal refuse collection services at landfill sites.

b. Waste source separation strategies (2006 until 2010)

Tehran's waste management organization in most areas monitored performance of contractors in order to try to make the process more efficient. The separation process was originally done with the evaluation contractor. Activities carried out in this process included separation, collection and transportation. Scavengers often purchased goods from the citizen, and then transferred them to a collection center where they could sell them at a higher price. Contractors also offered these materials to other facilities at higher prices.

Between the years 2006 to 2010, several schemes were implemented for collecting recyclable materials by the Tehran waste management organization as a pilot in different areas of Tehran. Trialing a system before full-scale implementation is generally recommended. Short term trials were performed in Tehran as part of this scheme and were divided into four groups:

Improvement of traditional separating by existing contractors; Use of public service vehicles for collecting dry waste each day; Use of vehicles with towable containers for collecting wet and dry waste ; Use of public service vehicles for collecting dry waste at night .

The buyback center system, door-to-door services and curbside sorting are the source separation initiative undertaken in Tehran City. The area covered is 22 regions of the city. Buyback centers are the most common source separation system currently in operation in Tehran, and are the preferred approach for high-density communities. Buyback centers are privately operated. A standard one-ton recyclable materials collection pick-up truck with one driver and one container is used, from which the collected material is sorted at the buyback center. The citizens keep recyclable materials separated from other refuse, and can also deliver these materials to the buyback center during its hour's operation (5:00-7:00 p.m. in the afternoon). With the cooperation of the buyback center system, recyclable material is collected as co-mingled materials of paper, glass, metal, and plastic. Citizens who keep their recyclable materials separate and sell it to the center receive either promotional materials or a ticket for earn money, as described by the scheme in Figure 1.

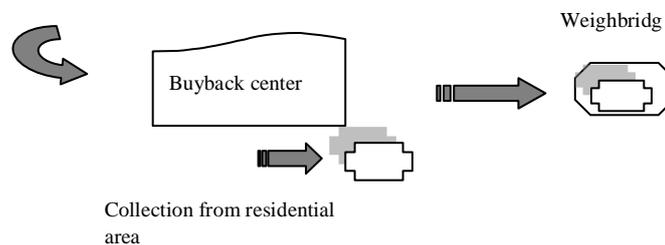


Figure 1: Source separation by the buyback centers

The curbside sorting collection is a reuse system undertaken in Tehran. Curbside collection is made daily. Curbside collection sorting of recyclable materials was started as a youth employment project over 40 years ago. Materials are left at the curbside in a co-mingled state. At the MRF plant, sorted material is separated into specific categories which can be sent directly for recycling. A motorized three-wheeled vehicle with one container is used for collecting recyclable material at the curbside, passing four times daily. In co-mingled collection, sorting will result in a quality product to sell to industry. In curbside co-mingled collection, all recyclable materials are collected except for bread, and

non-ferrous metal in the existing wheeled bins. Glass, because of the risk of breakage during due to both collection and storage and mixing with other refuse is often not collected in collection systems. The 22 areas of the city are divided into several posts per week, and the vehicles are assigned to these areas and their specific posts, as described by the scheme in Figure 2.

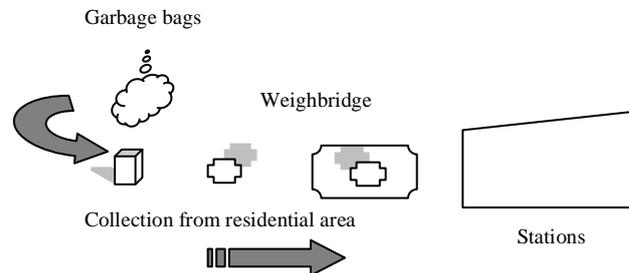


Figure 2: Curbside sorting

The door-to-door services collection system is a reduction system undertaken in Tehran; the coverage area is 22 regions of Tehran City. The collection vehicle is a 500 kg pickup truck; this vehicle has curbside loading and is unloaded by hand. The sorting position is available to the collector outside the body of the vehicle. Weekly loading is utilized. Citizens deliver recyclables using blue polyethylene bags, with recyclable materials separated as a co-mingled for the scavenger. For a building complex, a wheeled 60-, 120-, or 240-liter bin is preferred; these are used for the collection of co-mingled clean recyclables. The number of collections at each post is a two times daily. By undertaking this system, we can achieve separation of glass. The door-to-door system is supported by a private sector contractor chosen by regional municipalities, as described by the scheme in Figure 3.

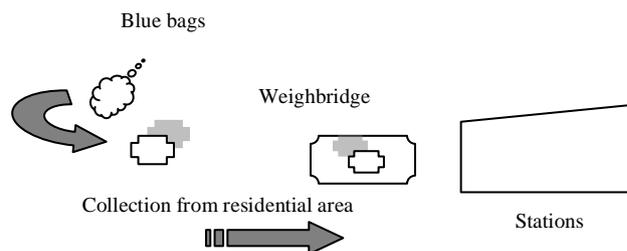


Figure 3: Source separation by the door-to-door services

At the MRF (Material Recovery Facility) plant, recyclable material is separated into specific categories which can be marketed directly. An MRF will be required to deal with the unsorted products of the collection system, and this has not yet been detailed or financially programmed. The ability to achieve realistic standards of products from a co-mingled collection is as yet unproven. Service stations located in urban areas and all mechanical devices belong to the waste management organization. Silos are located at an intermediate station for storage, and separation of collected recyclable materials has weighing and administrative locations divided by types of materials and machinery. More recyclable materials are collected by pickup track or three-wheeled vehicles that belong to the contractors than are collected and carried by truck to recycling facilities. More recyclable materials are discharged onto the platforms; then the mixed refuse is unloaded onto conveyors, where workers hand-pick some easy-to-remove items.

All waste separation is done by the workers immediately after they receive the recyclable materials at the station. Garbage bags are broken, and the refuse is separated into components using various combinations of magnetic separation and hand-sorting. Segregated materials include: PET, various plastics, ferrous and nonferrous metals, glass, paper, and cardboard. Funeral waste is discharged into semi-trailers and sent to landfills. Recyclable materials such as ferrous metal, cardboard, and aluminum cans are pressed and baled, then loaded onto trucks and transferred to recycling facilities. The MRF is operated by the solid waste management organization. The tonnages handled emanate from the curbside, door-to-door service, buyback center, and office paper collection rounds as well as the product, as described by the scheme in Figure 4.

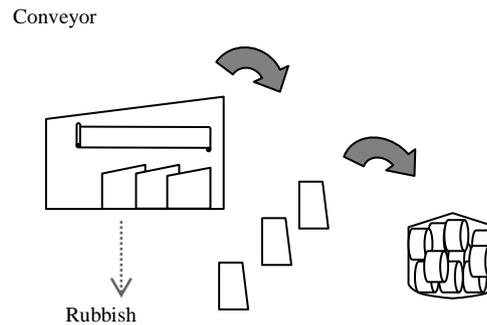


Figure 4: Separation at the MRF plant

II. RESULTS

Results in this paper show that carefully implemented waste collection systems should be successful, if they had high participation rates and were carefully managed. This paper identifies strengths and weaknesses of traditional and new schemes of waste collection in Tehran, and identifies matters required to implement a successful collection system. Identifying points of strength and weakness of the traditional approach help to ensure that the best way forward is found. Some reasons for failure in resolving the problems of traditional schemes implemented in Tehran before the summer of 2006 are:

- Lack of coordination between municipalities (22region) and the multiplicity of authorities involved in decision making
- Lack of clearly defined goals (short term and transient)
- Lack of a systematic approach to schemes and applying non-expert opinion in decision-making
- Lack of the necessary support to provide facilities, equipment and financial resources for the work involved

Local conditions in each country will affect the choice of the most viable waste collection system. Consideration of market issues is also an important factor in the choice of waste-collection systems. In the past there were not many differences between the buying and selling of recyclable materials. Now contractors offer their materials to recycling facilities and manufacturers at higher prices. The reasons for the success of traditional systems may be cited as follows:

- Lower costs and therefore a real and higher purchase price
- The direct purchase system of the people
- It was known as the native form, a very strong relationship with people and was usually punctual (true to one's promise)

III. DISCUSSION

In preparing a new plan on the resolution problem previous experience in Tehran has been considered and also plans from other metropolitan cities in Iran have been examined as well as the implementation of similar projects in other countries. Positive and negative points from all these examples were studied from social, economic, technical, environmental and health points of view. The performance of suitable methods of source separation were considered from different parameters such as the type of urban location, type of roads, as well as the social, cultural and economic levels of households. The recommended actions to be taken to solve the problem were divided in two ways: firstly, the effect on solid waste management system elements and secondly an emphasis on public awareness.

Eliminating the traditional system was possible, by attracting people to alternative clearing methods. This could include buying waste from them or incentivizing donations through the award of prizes or points that can be redeemed for goods and services; restrictions on waste disposal by the enforcement of local regulations using a more coercive approach that could involve financial penalties prescribed by a court of law; establishing area offices for recycling ; creating tax incentives for recycling and correct waste disposal ; creating cultural incentives that encourage the protection and preservation of the local environment and human health; creating awareness of ethical considerations; encouraging awareness of religious and moral requirements for cleanliness and correct disposal of waste; making it a matter of national pride. By using all the integrated and overlapping motivational techniques suggested here and promoting them through slogans, advertising and public service messages that can be combined to create the most powerful campaign that can win hearts and minds and create a social transformation. A solid waste management system was tried providing an "interim plan for the collection of dry and wet waste (through source separation)"; Recycling Offices would be established in 22 regions of the Tehran municipality; a "technical and performance manual for collecting dry waste" would be prepared; reform of "the technical and performing system of collecting dry waste" would take place; reform of "technical and performing system with a new approach to the integrated collection of dry waste" would also be designed.

IV. CONCLUSION

To achieve their aims the Tehran waste management organization should put more emphasis on the technical performance of each contractor by ranking them to create more motivation for effective collecting and separating of waste (based on tonnage). It also should create more incentives for private sector investment and participation. The municipality should provide systematic surveillance, and maximum participation by authorities in the process of creating more effective, more desirable and more efficient services of contractors. Contractors should perform their services based on time table and mechanized dry waste collections also performing an integrated approach to ensure no overlapping of services. There should be better use of economic incentives that have an effect on performance. There further needs to be better education and information provided through effective supervision by the councils. Additionally, there must be improved coordination and integration of dry waste management. Finally, the systems must be evaluated on their levels of planning and performance.

Tehran waste management organization's best approach is known as "integrated waste source separation" using buyback centers, a door-to-door service, and storage containers. These systems use a standard method of source separation under consumer responsibility.

V. Acknowledgements

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REFERENCES

- [1] Urban Mines team, 2012, <http://www.urbanmines.org.uk/>
- [2] Thomas E. Graedel, (2011), What is Urban Mining?, Yale School of Forestry and Environmental Science, takes it further and includes energy as part of the concept of urban mining.
- [3] Cossu R. (2012) The environmentally sustainable geological repository: The modern role of landfilling. Waste Management, vol.32, 243–244
- [4] Baccini P., P.H. Brunner (2012) Metabolism of the Anthroposphere - Analysis, Evaluation, Design. The MIT Press, Massachusetts Institute of Technology, Cambridge ISBN 978-0-262-01665-0
- [5] Coleman. R.W,C.G.Hill,A.Marsden,(1991),*Recycling Household Waste: the way ahead* ,Association of Municipal Engineers of the Institution of Civil Engineers (Thomas Telford ,London E144JD,printed by Faygate printing services , British Library)
- [6] MIESZKIS. K. W. and F. E. THOMAS, (1980), *Conservation & Recycling*, Pergamon (The Welsh School of Architecture, UWIST, Cardiff, U.K. Press Ltd., 1980. Printed in Great Britain. Vol. 3, pp. 413 -425)