CHAPTER-5

ASSESSMENT OF SOLID WASTE

5.1: INTRODUCTION:

The quality and quantity of municipal solid waste generated by a particular community will vary according to their socio-economic status, cultural habits, urban structure, population and commercial activities. Per capita generation of waste varies from 200 gm to 600 gm/capita/day in 0.1 million plus towns (Esakku et.al, 2007). Per capita waste generation increases by 1.3% per annum with urban population increasing between 3-3.5% per annum. The highest per capita solid waste generation rate (0.6 kg/day) in India is in Chennai (Esakku et.al, 2007). The experience from Chennai in waste management shows that cost effective waste management is provided by the private sector (Esakku et.al, 2007). With limited financial resources, low-cost highly effective solutions are vital to sustainable urban waste management in South Asia. Increasing citizen participation in Solid Waste Management (SWM) activities, particularly source segregation, is also important. Some of the key issues faced by the cities are how to maximize the 3R’s (reduce, reuse and recycle) to reduce waste for disposal, how to increase collection efficiency within limited budgets; how to safely dispose off waste at landfill sites in a cost-efficient manner and how to finance such waste management improvements and take advantage of Clean Development Mechanism (CDM) schemes (ADB, 2009).

Tourism can cause the same forms of pollution as any other industry: air emissions, noise, solid waste and littering, releases of sewage, oil and chemicals. In areas with high concentrations of tourist activities and appealing natural attractions, waste disposal is a serious problem and improper disposal can be a major despoiler of the natural environment - rivers, scenic areas, and roadsides. Pilgrimage places in India are called as Tirthkshetra’s which have always been tranquil, religious and enchanting for meditation, worship and recreation for saints, pilgrims and tourists respectively. But today there is no significant difference between metropolitan towns to tiny tourist/religious spots owing to high influx pilgrims. These places suffer from litter and foul smells due to unattended solid waste. Visitors and stall keepers are
the major contributory participatory groups in generating and causing primarily solid waste problems for peculiar periods of pilgrimage. Local population is also responsible for solid waste along with absence of effective collection, disposal and treatment methods to deal with these issues at pilgrim centers. Municipal Solid Waste Management rule (MoEF, 2000) was issued by the Government of India for regulating and improving solid waste management which requires source segregation and storage of solid waste at source, door to door collection, abolition of open storage, daily sweeping of the street, transportation of waste in covered vehicles, waste processing by composting or energy recovery and disposal of inerts by sanitary land filling. State governments along with local self governments through Pollution Control Boards are responsible for implementation of these rules.

5.2: METHODOLOGY:

5.2.1: Quantification method:

Generally, data on the quantity of MSW generation is maintained by the Urban Local Bodies. This is generated based on the quantity of waste collected and transported on a day to day basis, based on the number of trips made or on approximation based on guesstimates. Normally, there is no practice of weighing the MSW or measurement of its volume while transportation. Based on the studies carried out by the Centre for Earth Science Studies and data compiled by the Clean Kerala Mission for all the Municipalities and Corporations of the State, the average daily per capita generation comes to 0.178 kg with a very high variation from 0.034 kg for Koothuparamba to 0.707 kg for Thalassery (Varma, N.D.). The studies carried out by the National Environmental Engineering Research Institute (NEERI) in Indian cities have revealed that quantum of MSW generation varies between 0.21-0.35 kg/capita/day in the urban centers and it goes up to 0.5 kg/capita/day in large cities (NEERI, 1996).

Daily quantification was carried out and records were maintained for solid waste generation in the main temple premises at Dehu and Alandi during the year 2008-2009. Quantification was also performed during pilgrimage periods of Ashadhi and Kartiki during which about 4 - 4.5 lacks pilgrims reach at Dehu and Alandi.
5.2.2: Household Survey:

In order to assess the municipal solid waste management (MSWM) status of Dehu and Alandi, a household survey was conducted. 20% population was surveyed for better understanding of the trend of the solid waste generation, transportation, disposal and treatment of waste. 122 families at Dehu and 222 families at Alandi were surveyed in between January-March 2008. Questionnaire was also used for the household survey conducted at Bodakewadi which is a control station. The questionnaire was designed, refined and reviewed as per the need of the local residents. The head of the family was interviewed and asked to provide information for all members of the family. All family heads surveyed at Bodakewadi, Dehu and Alandi were confirmed to be residents of these places. Another questionnaire for the pilgrims visiting these places were prepared, designed, refined and reviewed. Pilgrims were asked about the type of the solid waste they produce and the disposal practices they follow. Pilgrims were approached and questioned directly.

5.3: RESULTS AND DISCUSSION:

Considering the NEERI (1996), observations, waste generation in the pilgrim towns of Dehu and Alandi were taken as a minimum of 0.21 kg/capita/day. This results into 5000 kg/day solid waste generation in selected pilgrim towns. On normal days on an average 20 and 200 kg/day solid waste was generated in temple premises. During festive occasions an additional 350-850 kg/day solid waste was generated (Table-5.1). There are no standard and flexible methods of collection and disposal of garbage in the study area.

At Alandi 33% population dispose garbage in dust-bins and 6% in waste collection vehicle. The frequency of waste collection vehicle was once or twice in a week. While more than 60% population dispose garbage in open environment, because of non availability of waste collection vehicle. At Alandi in absence of proper collection system the households, shops and commercial establishments throw the waste on to the streets. During rain it flows in drains or residents sweep it into the drains resulting in blocking of drains which create smell and mosquito breeding sites leading to unhealthy conditions. Further, the waste thrown into
the open drains is leading to choking the drainage and as a result, the wastewater flows on the streets rather than in drains and forms wastewater pools.

Table 5.1: Solid waste generation in the temple premises of Dehu and Alandi

<table>
<thead>
<tr>
<th>Day</th>
<th>No. of Devotees</th>
<th>Solid Waste Generated (kg/day)</th>
<th>No. of Devotees</th>
<th>Solid Waste Generated (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alandi</td>
<td>Dehu</td>
<td>Alandi</td>
<td>Dehu</td>
</tr>
<tr>
<td>Sunday</td>
<td>25000</td>
<td>225</td>
<td>3824</td>
<td>20</td>
</tr>
<tr>
<td>Monday</td>
<td>21184</td>
<td>210</td>
<td>3904</td>
<td>18</td>
</tr>
<tr>
<td>Tuesday</td>
<td>28672</td>
<td>270</td>
<td>4400</td>
<td>20</td>
</tr>
<tr>
<td>Wednesday</td>
<td>13040</td>
<td>180</td>
<td>5568</td>
<td>27</td>
</tr>
<tr>
<td>Thursday</td>
<td>38160</td>
<td>298</td>
<td>5856</td>
<td>23</td>
</tr>
<tr>
<td>Friday</td>
<td>28000</td>
<td>258</td>
<td>3104</td>
<td>19</td>
</tr>
<tr>
<td>Saturday</td>
<td>23400</td>
<td>213</td>
<td>5184</td>
<td>24</td>
</tr>
<tr>
<td>Average (one day)</td>
<td>25350</td>
<td>234</td>
<td>4548</td>
<td>21</td>
</tr>
<tr>
<td>Ashadhi Ekadashi (Monthly)</td>
<td>38400</td>
<td>350</td>
<td>6688</td>
<td>32</td>
</tr>
<tr>
<td>Kartiki Ekadashi</td>
<td>450000</td>
<td>850</td>
<td>400000</td>
<td>550</td>
</tr>
<tr>
<td>Tukaram Beej</td>
<td>200000</td>
<td>350</td>
<td>300000</td>
<td>450</td>
</tr>
</tbody>
</table>

While at Dehu the frequency of waste collection vehicle was daily and collects about 66% garbage from almost all parts. At Dehu 6% population disposes garbage in dust-bins. About 20% populations dispose garbage in open environment because of non availability of the disposal and collection system.

It was noted that every day five tons of solid waste is generated in Alandi of which 30% from households, 30% from Hotels, Dharmsalas, restaurants, and commercial establishments, 20% from street sweeping, drain de-silting, and others (MPCB, 2004-05). Collected waste is dumped without any treatment in the dump yards located about one kilometer from these towns.
Pilgrims staying for more than two days, and preparing their own food (in groups) throw waste food in the drains or open spaces causing foul smell. In the main temple premises (Tukaram Maharaj and Dnyaneshwar Maharaj) an average of 20 kg and 180 kg of waste in the form of flowers and tulsi was generated daily (Photo-5.1 and 5.2). This waste rises up to 450 kg and 850 kg during the pilgrimage times of Ashadhi (June), Kartiki (November) and Tukaram Beej (March). During Parayan (reading of holy books) periods pilgrims stay for an average of a week generating approximately 80 kg/day of waste (mainly in the form of food waste). At both places the collected waste was dumped at the dump yards without any treatment.

5.3.1: Institutional Framework:

Before 2006 the solid waste collection at Dehu was carried out with labor and on bullock cart. However, this method was inadequate because of increasing population size of Dehu (including Malinagar and Vitthalnagar). Total of 20 full time sweepers are working with Grampanchayat (Local Self Government) Dehu at present. Since 2006 with the provision of a vehicle (tractor) through the Government of India funding scheme every day a vehicle moves in the town and collects the waste from all parts such as Dehu, Malinagar and Vitthalnagar. In the main temple in Dehu (Tukaram Maharaj Temple) cleanliness was maintained by 5-10 sweepers. However, it was observed that only 60% of the waste is being collected at Dehu because of inaccessibility to the vehicle and ignorance of people to put waste in vehicle. It was further observed that even though there is access to vehicle 20% population throw the waste in open drains which leads to choking of drains. At Alandi also, vehicle runs through the town and collects the waste, However, the problem of solid waste at Alandi was very severe because of inaccessibility to the vehicle, congestion due to conglomeration of shops for visitors, growing urbanization; and limited manpower of Alandi Municipal Council. Because of this 60% population disposes the waste in open environment. This open disposal of solid waste either saturates in particular place for long times or thrown/swept in the drains. Further it was observed that stall keepers at these places throw the waste in the river directly.
Photo-5.1: Flower and *tulsi* waste in temple premises at Alandi.

Photo-5.2: Flower and *tulsi* waste in temple premises at Dehu.
5.3.2: Solid Waste Management by Local Bodies:

The management of solid waste stated in the schedule II of the Municipal Solid Waste Management and Handling Rules (MoEF, 2000) has listed collection of MSW with emphasis on segregation at source and door to door collection. In compliance with the above rules, following evaluation was made in the present study.

a. **Source Segregation** – If introduced, this scheme will help setting aside of biodegradable and recyclable materials before these are collected with the other MSW, to facilitate reuse, recycling and composting.

b. **Door to door collection** - Door to door collection is introduced to replace the street bin collection system with a view to reduce the environmental effects. Tractor trolley moves in each ward from door to door. The scheme was introduced recently at both the places.

c. **Abolition of open storage** - Abolition of community bins can be possible only when 100% garbage is collected regularly. Phase wise reduction in number of community bins from the streets is essential. Due to the lack of financial resources, non co-operation of the residents and inaccessible area/narrow lanes, it is difficult to achieve 100% abolition of open storage.

d. **Daily sweeping of the street** – Grampanchayat Dehu and Municipal Council, Alandi were sweeping the streets at least once in a day. The major constraints in implementing daily street sweepings were shortage of sanitary workers, and lack of financial support.

e. **Transportation in covered vehicles** – The solid waste was carried through a tractor trolley at both places. Some initiatives have been taken up for transportation of MSW in vehicles covered with fishnets to avoid spillage. Difficulties in using the covered vehicles for transportations were financial resource, insufficient number of vehicles and attitude of workers.

f. **Recycling of waste through composting** - Ward level composting units were proposed to reduce the transportation cost of MSW and the amount of waste reaching dumpsite. The segregated waste will be collected and the organic fraction is subjected to composting in ward level composting units, whereas the non-recyclable fraction will be transported to the dumpsites for disposal.

g. **Sanitary land filling** – In case of Dehu availability of space will not be a severe problem for another one decade. However, the town has been experiencing a fast urbanization with
increasing visitor’s number. Migration from rural areas in search of jobs will cater the needs of large scale housing which will put limits on available space for solid waste dumping. Presently, all the waste is transported to the open dump sites. The approach was a phase wise conversion of open dumpsite into a sanitary landfill as per the recommendation of the National Productivity Council. In case of Alandi, even though the solid waste was dumped in the sanitary landfills located at Vadgaon road, all waste does not reach to the landfill. The sanitary landfill was already crossed its carrying capacity and needs to be upgraded.

5.4: SOLID WASTE MANAGEMENT PLAN:

It is difficult to fulfill the requirements of all the above aspects in developing countries like India, due to practical problems such as lack of skilled personal for MSWM, administrative difficulties and public coordination. World Health Organization (2005) outlined some of the key activities in dealing with solid waste management. The process of solid waste management has been illustrated in figure-5.1.

5.4.1: Initial Assessment:

The first stage in dealing with solid waste is to understand the emergency context and the nature of waste being generated. The following sections outline key questions for considerations.

5.4.1.1: The Context:

- What solid waste management systems/equipment is already in place? How it has been affected? Is it possible to work with and learn from the existing systems?
- How many people are affected? Where are they? What are they doing with waste at present? Are there any pertinent cultural factors?
- What opportunities or restrictions does the environment present? Is it possible to dig pits? Where are surface water sources located? At what level does the water table like? Where is land available?
5.4.1.2: The Waste:

- What waste is being generated (e.g. organic, hazardous, dry etc.)?
- Where is waste being generated? How accessible are waste generators?
- How much waste is being generated?

Figure-5.1: The process of planning solid waste management in an emergency.
(Source: WHO, 2005)
5.4.2: Immediate Response:

Activities should be prioritized according to present and future hazards of different waste types and sources. Activities are likely to focus on clearing of existing scattered waste and managing waste from households and markets.

5.4.2.1: On-Site Household Disposal:

It is suitable for the area where space is not a problem and where waste has a high organic content. Also useful in areas where access is difficult. Pits should be 1 m deep and be frequently covered with ash/soil to prevent access to waste by insects and rats, and reduce foul smell. However, on-site disposal is labor intensive and requires advanced household cooperation.

5.4.2.2: Community Pits:

These must be located within 100 m walking distance of any household. As a rough guide 50 people will fill 1 m³ of a pit each month, depending on generation rates and density. These are rapid to implement and require little operation and maintenance.

5.4.3: Intermediate Solutions:

5.4.3.1: Community Issues:

a) Consultation: It is useful and important to consult potential users of a waste management system before and during design and implementation.

b) Education: It is important for participating communities to understand how good solid waste management can be achieved and can benefit their health.

5.4.3.2: Collection and Storage:

In some situations on-site, community pits may be a suitable medium-term solution, whilst in others it will be necessary to devise ways of removing and disposing of waste. This will usually involve the following:

- Storage in the house;
- Deposition at intermediate storage point; and
- Collection and transport to final disposal
In the home, plastic bags or small container with a lid make suitable storage containers. For intermediate storage points in communal areas bins of maximum 100 liter capacity are required for each 50 people.

5.4.3.3: Transport:

When selecting suitable vehicles, waste generation rates and densities need to be considered along with:

- Areas they need to access (e.g. narrow lanes or uneven paths); and
- Distance between collection and disposal points.

5.4.3.4: Disposal:

As a medium-term solution, larger-scale landfill pits can be constructed. Without leachate (liquid runoff) treatment these are not suitable for long term use. They should be situated at least 1 km downwind of settlements and also be situated downhill of water sources and at least 50 m from surface water sources with careful consideration of drainage slope.

5.4.3.5: Staff:

Approximately 2.5 workers are required for 1000 community members. Protective clothing and equipment need to be considered (e.g. gloves, boots, and visibility jackets). Options such as recycling and composting at household level may also be initiated. Continuous review, monitoring and response to the nature of waste, community participation and establishment of management structure at early stages are essential.

Therefore, considering the data provided in Table-5.1 as first approximation value, each Municipality need to make its own assessment of the quantity of waste generated which is one of the crucial basic data for developing a MSW management programme. It is also necessary to estimate the waste generated at different sources of a region for planning and undertaking effective management of MSW at respective sources, as far as possible. It indicates that most dominant sources to be addressed for waste management are domestic sources, commercial areas, hotels, streets and markets which generate 60% waste followed by street sweeping 20%.