Technical Cooperation for Environment in India

Solid Waste Transfer Stations

Factsheet

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Introduction

A Waste Transfer Station (WTS) plays an important role in a community's total waste management system, serving as the link between a community's solid waste collection program and a final waste disposal facility (Zemanek et al, 2011). A number of large Indian cities, such as New Delhi and Chennai, have constructed and operate WTSs, while there are a number of case studies across the world, including Finland, Germany, Brazil, Israel, and Australia, (ISWA, 2008; Department of Environment & Conservation, New South Wales-NSW, 2006).

The purpose of this Factsheet is to present valuable summary information regarding the technology options, design and operation criteria, cost estimations, case studies and relevant references for WTSs.

Technology Options

A typical WTS (Figure 1) includes scale areas, recycling point (if applicable), transfer building, parking, landscaping, etc. Each city should make adjustments according to specific needs, requirements and conditions.

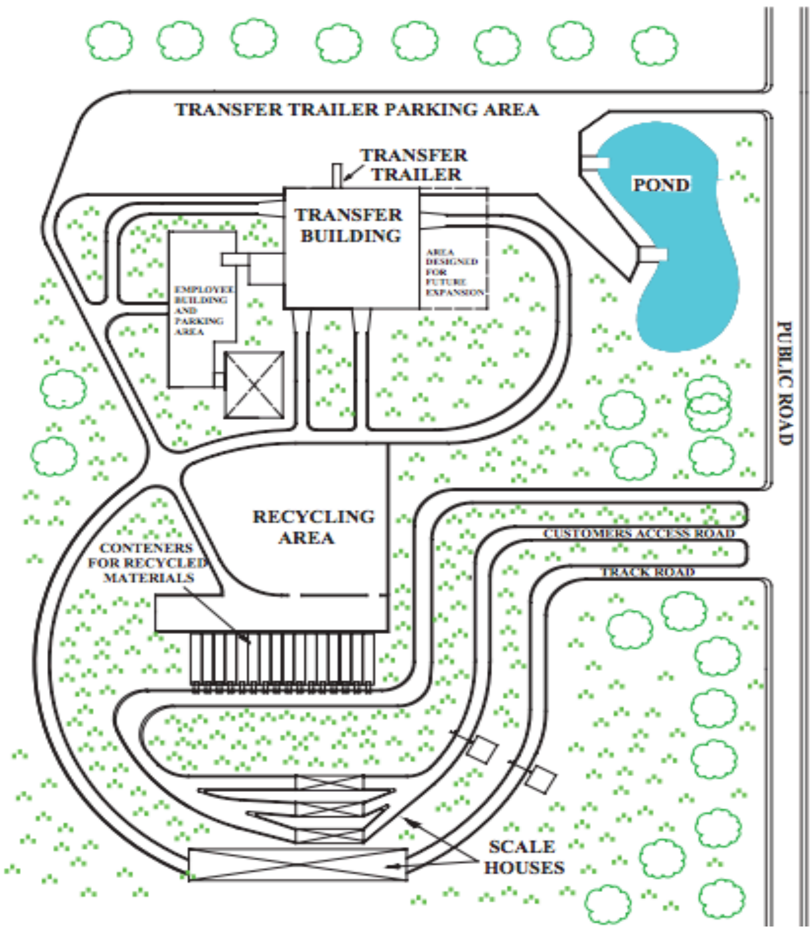

Figure 1: Typical Layout of a WTS (Zemanek et al., 2011)

Figure 2 presents a useful description and schematics of the basic technology options. A WTS can take many forms including open top, surge pit, compactor, etc. **Each type of WTS has a number of advantages and disadvantages, as analytically presented in Annexure I** (R.W. Beck, 2010).

Waste can be unloaded directly into the "open top" of the trailer, but is most often unloaded on the tipping floor to allow for materials recovery and waste inspection before being pushed into the trailer. Large trailers, usually 100 cubic yards or more, are necessary to get a good payload because the waste is not compacted. This is a simple technology that does not rely on sophisticated equipment (e.g., compactor or baler). Its flexibility makes it the preferred option for low-volume operations.

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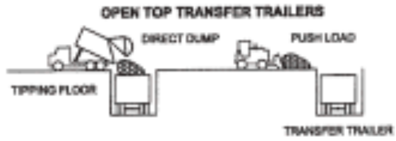

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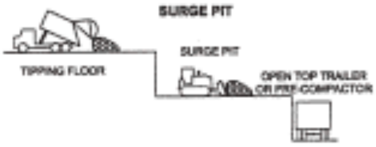

The surge pit is not a loading technology, but an intermediate step normally used with open-top or precompactor systems. The pit can store peak waste flow, thus reducing the number of transfer trailers needed. A tracked loader or bulldozer is used to compact the waste before loading, increasing payload. Because waste is often unloaded directly into the surge pit, this technology might deter materials recovery and waste screening efforts.

Stationary compactors use a hydraulic ram to compact waste into the transfer trailer. Because the trailer must be designed to resist the compactive force, it is usually made of reinforced steel. The heavy trailer and the weight of the onboard unloading ram reduce the payload available for waste. This technology is declining in popularity.

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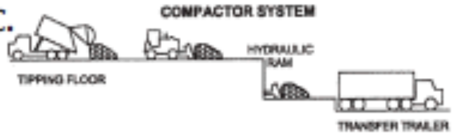

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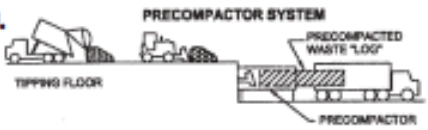

Precompactor systems use a hydraulic ram inside a cylinder to create a dense "log" of waste. The log is pushed into a trailer that uses "walking floor" technology to unload or relies on a tipper at the landfill to unload by gravity. Most precompactor installations have two units in case one unit requires repair. The capital cost is relatively high at more than $250,000 per unit, but the superior payload can offset these initial costs.

Balers are units that compress waste into dense, self-contained bales. Wire straps may be used to hold the bales intact. They are usually moved by forklifts and transported by flatbed trailers. The baler units can also be used for recyclables such as paper and metal. Payloads are very high, but so are capital costs. Most baling stations have at least two units in case one is down, and they cost more than $500,000 apiece. This high-technology option is normally used only in high-volume operations, and special equipment or accommodations might be required at the landfill (or balefill).

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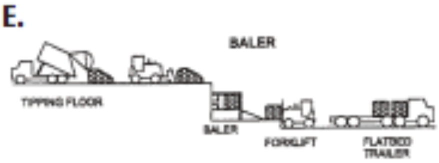

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In this alternative, waste is tipped at a transfer station, then loaded into intermodal containers. These containers typically have moisture- and odor-control features and are designed to fit on both flatbed trailers and railroad flatcars. The containers may be loaded directly onto railcars or transferred by truck to a train terminal. The sealed containers can be stored on site for more than 24 hours until enough containers are filled to permit economic transport to the landfill. At the landfill, these containers are usually unloaded by tippers. This option allows for reduction of total truck traffic on local roads and can make distant disposal sites economically viable.

Figure 2: Basic Options for a WTS (EPA, 2002)

There is limited information about "vertical" WTS, mainly from a video and link by CNNL (https://www.youtube.com/watch?v=HD55ayd0nbE). There is only one reported implementation of such a technology in Shah Alam, Malaysia.[1] Consequently, it is not feasible to assess relevant operations, technologies and other parameters.

[1] http://www.whbenvironment.com.my/index.php?option=com_content&view=article&id=67&Itemid=105

Design & Operations Criteria

There are a number of factors that should be considered in the design and operation of a WTS (Figure 3). These factors will depend on the specific conditions and requirements of each city.

Figure 3: Design & Operations Criteria

♦ Location and size of area	♦ Green building design
♦ Distance/time to final disposal site	♦ Dust/odour/noise control, ventilation, etc.
♦ Types and volume of waste	♦ Wastewater/leachate management
♦ Peak loads	♦ Health and safety
♦ Storage area capacity	♦ Training
♦ Frequency of waste delivery	♦ Emergency planning
♦ Waste vehicle type, size and capacity	♦ Climate and hydrogeological conditions
♦ Expected growth of the waste stream	♦ Supporting infrastructure (e.g., electricity)
♦ Accessibility	♦ Risk assessment
♦ Expansion capacity	♦ Permitting
♦ Cost and financing	♦ Community involvement

Costs

There is limited information about costs of WTSs in India. Yadav et al (2016) modelled the case of Nashik and concluded that the optimum size of a WTS for this city would be 200 tonnes per day with an expected daily cost of around 2.800 US $. Other publications include detailed cost estimations and methodologies for specific countries (Department of Environment & Conservation, NSW, 2006, p. 49), but they should be reviewed with caution as they are likely to be differences compared to the Indian scenario. A practical method for calculating the break-even point of a WTS is presented in Figure 4.

Calculating Transfer Station Break-Even Points

To calculate the break-even point for a specific facility, first determine the following values:

- **Transfer Station Cost** (cost to build, own, and operate transfer station, in dollars per ton)
- **Direct Haul Payload** (average payload of collection truck hauling directly to landfill, in tons)
- **Transfer Haul Payload** (average payload of transfer truck hauling from transfer station to landfill, in tons)
- **Trucking Cost** (average cost of direct or transfer hauling, in dollars per mile)

Once these values are known, use the following formulas to calculate cost at different distances:

Cost of Direct Haul (without the use of a waste transfer station)
Distance (miles) multiplied by Trucking Cost (dollars per mile) divided by Direct Haul Payload (tons)

Cost of Transfer Haul
Transfer Station Cost (dollars per ton) plus Distance (miles) multiplied by Trucking Cost (dollars per mile) divided by Transfer Haul Payload (tons)

Figure 4: WTS Break Even Point Calculation Method (Source: EPA, 2006)

Case Studies

Figure 5 presents three case studies that provide some useful information about WTSs in Germany, the Netherlands, and Israel.

Country	**Germany**	**Netherlands**	**Israel**
City	Freie and Hansestadt Hamburg	Nimwegen	Dan Region Association of Towns
Population served	1,750,000	600,000	2,500,000
No of WTS	2	1	2
Size of WTS	250 & 1,090 m^2	10,000 m^2	110,000 & 130,000 m^2
Transfers/year in tons			
Residual waste	72,000	7,800	800,000
Biological waste	9,200	6,000	n/a
Other		20,000	51,000
TOTAL	**81,200**	**33,800**	**851,000**
Average distance between collection area and WTS for residual waste (kms)	6	20	8
Average load (tons)	8	10	n/a
Average distance between WTS and next destination for residual waste (kms)	14	40	n/a
Average load of transport vehicle from WTS for residual waste (tons)	19	25	n/a

Figure 5: Selected Case Studies (ISWA, 2008)

Overall, WTSs can increase the efficiency in solid waste management operations in cities. There is a variety of technologies, which could be selected in accordance to the specific needs and requirements of cities. Design and operations criteria as well as costs should be carefully assessed, while case studies from other regions can provide useful lessons.

Annexure I

Comparison of Waste Transfer Station Technologies

Primary Transfer Stations Types

- Open Top
  - Waste is either unloaded directly into trailer below (direct dump) or dumped onto a tipping floor and pushed into trailer below (push load).
- Surge Pit
  - Variation of open top transfer station. Waste unloaded into an area below the level of the unloading vehicle. Transfer station equipment then pushes the material into trailer, typically open-top.
- Compactor/Precompactor
  - Waste is compacted into a trailer (compactor) or compacted then loaded into trailer (precompactor). Waste is typically loaded into the rear of fully-enclosed trailer.
- Other (Baler, Intermodal)
  - For baler transfer stations, loads of waste are baled then placed on a trailer for maximum load density
  - For intermodal, waste is loaded into containers that can be loaded onto rail cars.
  - Both are typically used when hauling long distances.

Open Top (Push Load)

Application

- Most common type of transfer station
- Design can be configured for both small and large transfer stations
- Allows for temporary storage of waste on tipping floor
- Examples: City of Killeen, City of Huntsville

Advantages	Disadvantages
▪ Simple technology ▪ Lower capital costs ▪ Some storage of waste is available on tipping floor ▪ Easier to inspect waste on tipping floor	▪ Needs grade separation for top-loading trailers ▪ Customers and floor equipment operating in same area ▪ Waste is only lightly compacted

Open Top (Direct Dump)

Application

- Typically for smaller volume transfer stations
- Some push-load facilities also have direct dump capability
- Example: City of Brenham

Advantages	Disadvantages
▪ Simple technology ▪ Lower capital costs ▪ No additional equipment needed for pushing waste into trailer ▪ Reduces the handling of waste	▪ Needs grade separation for top-loading trailers ▪ No temporary storage of waste ▪ Must always have trailer available for unloading customer waste ▪ Waste is only lightly compacted ▪ Limited inspection capability

Surge Pit

Application

- Most suitable for large transfer stations with uneven flows of incoming waste
- Examples: City of Dallas (Bachman), City of Garland

Advantages	Disadvantages
▪ Short-term storage of waste ▪ Bulky items can be broken down, waste compacted ▪ Simple technology	▪ High capital costs ▪ Additional equipment needed to reload waste into transfer trailer ▪ Fall hazard for people and vehicles ▪ Larger floor area to maintain

Compactor/Precompactor

Application

- Ideal for transfer stations that need to haul waste long distances
- Examples: Cochise County (AZ), North Texas Municipal Water District

Advantages	Disadvantages
Compacting produces densely packed loads Waste can be stored in containers for shipment Some compactors can be designed so that the need for a bi-level transfer station is eliminated	High capital costs Complex technology Not suitable for all types of waste High energy consumption

Other (Baler, Intermodal)

Application

- Ideal for transfer stations that need to haul waste long distances
- Not commonly used in Texas, mainly found in areas where landfill space is scarce
- Examples: Snohomish County (WA) Airport Road TS, Harlem River TS (NY)

Advantages	Disadvantages
Allows for economical shipment of waste from transfer station over long distances Baled waste can be placed in closed trailers or flatbed trailers for shipment	High capital costs Additional complexity Not widely used in Texas

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