Chapter B-3

Public sector refuse collection in Rajkot

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B-3.1 INTRODUCTION

This section describes a brief study of the refuse collection service operated by municipal vehicles and workforce in Rajkot, Gujarat. A parallel service was being operated by contractors, and this is described in the following section. In chapter B-4 there is a brief comparison of the two services - public and private.

B-3.2 EXISTING SYSTEM

The Rajkot Municipal Corporation (RMC) relies mainly on two types of vehicles for the municipal refuse collection service:

- ◊ Allwyn Nissan Cabstar tipper trucks fitted with 2.9m^3 tipper bodies, and
- ◊ DCM Toyota trucks fitted with Airtech dumper placer bodies which carry containers having a nominal capacity of 4.5m^3.

Further details of the vehicles used by the RMC are given in Appendix BB-3.1.

It was found during the studies that average loads of 1610 kg. were carried by the tipper trucks and 1672 kg. by the dumper placer trucks.

Recorded weights for the trucks were as follows:

Tipper trucks:

Average Gross Weight - 4,253 kg.

Maximum Gross Weight - 4,340 kg.

This compares with the manufacturer's permitted gross vehicle weight (GVW) of 5,750 kg indicating that the body size could be increased by around 90% without overloading the truck chassis. It is suggested that extension sides 0.30m high should be fitted to these trucks with drop-down top sections to enable the full load capacity to be achieved without excessive loading heights.

Dumper - placers:

Dumper placer mechanism	1 000 kg
Container	580 kg
Unloaded weight without bin	3 440 kg
Unloaded weight with bin	4 020 kg
Permitted gross vehicle weight (GVW)	5 990 kg
Payload (5 990 - 4 020)	1 970 kg

Measured loads averaged 1,672 kg. (85% of permitted load) with one load of 2,070 kg. (5% overload). This is considered acceptable and the truck is operating efficiently.

B-3.3 AVAILABILITY OF MUNICIPAL EQUIPMENT

The Conservancy Depot and Municipal Workshop were visited by the team and the information that was collected concerning the refuse collection vehicles is shown in table B-3.1.

The relatively good availability of the fleet of vehicles as shown by the records at the workshop indicate a satisfactory maintenance programme. The depot and workshop were found to be in a clean condition.

Table B-3.1 Details of municipal refuse fleet

Type of vehicle	Quantity	Capacity	Availability	History/ comments Date of study - December 1995
JCB loader	4		77%	1st machine procured 1987/8; 2nd 1989/90 and 3rd & 4th 1995
Large dumper	2	8 m^3	100%	Both trucks procured 1/5/95
Small dumper (Allwyn)	9	3 m^3	56%	All trucks procured 1988
Dumper placer (DCM)	10	4.5 m^3	81%	Two procured 1988, seven in 1989/90, one in 1995
Dumper placer containers	200	4.5 m^3		58 procured 1987; 125 procured 1995; 25 still awaited
Tractor	2		96%	One procured 1984, one 1995
Open truck (AL + TMB)	2	10 t GVW	75%	One procured 1985, one 1995
Small Truck (M + M)	3	2 t	93%	All procured 1984/5
Small dumper (M + M)	6	1.5 m^3	76%	All procured 1987/8

AL Ashok Leyland; TMB Tata Mercedes Benz

The total fleet was maintained by one deputy executive engineer assisted by two assistant engineers, 4 mechanics, 1 electrician, 1 gas welder, 1 lathe operator and 8 helpers. Each mechanic, electrician, welder and lathe operator had a locked cupboard; these cupboards were found to be kept systematically. Scrap and wastes generated were observed to be collected daily in containers earmarked for the purpose and transported daily to the locked scrap room. All equipment for maintenance (welding equipment, lathe, air compressor, water jets, fixtures for hydraulic cylinder repairs etc.) were found to be in good working condition. It was reported that, over the last ten years, no adverse report had been made of any employee and no overtime had been paid over a similar period. Monthly get-togethers for all employees were held as part of a scheme to promote goodwill.

B-3.4 PERFORMANCE OF EXISTING VEHICLES

Tipper trucks: The Municipal Corporation of Rajkot had nine tipper trucks with a carrying capacity of 2.9m^3. The team measured actual vehicle loads of refuse carried by these tipper trucks at the disposal site - (the data are given in appendix BB3.2) and calculated that the average load was 2.66 m^3 of refuse. The trucks made only 2 to 3 trips per shift and were working in 2 shifts.

Dumper Placers: The Municipal Corporation of Rajkot had ten dumper placers of which two had not been in use since the previous year, for want of suitably sized containers. The other eight dumper placers were in operation, collecting containers from different wards of the city.

The nominal volume of the containers was 4.5 m^3 according to the data received from the Municipal Corporation. However, the actual volumes of waste inside the containers and loads carried by the dumper placers were shown in appendix BB-3.2. These results show that the containers were not filled, but carried only 2.0 m^3 to 2.9 m^3 of refuse. They also were working in two shifts and making only four trips per shift.

B-3.5 DISPOSAL SITE RECORDS

The team collected reports from the register kept at the Ayodhya disposal site. This showed the number of trips, vehicle registration numbers, and arrival and departure times, but did not provide any information on waste quantities.

The study team carried out a sample survey and the data collected are shown in appendix BB-3.2. The site records indicated that there was no waste collection on Sundays.

B-3.6 LIFE EXPECTANCY OF MUNICIPAL VEHICLES & CONTAINERS

Table B-3.1 shows that all the Allwyn and DCM vehicles used for refuse collection were still within their probable economic lives (which is, in general, eight to ten years).

RMC has a large number of containers (210). Some of the containers had been damaged by fire and it was noted that if these containers were not painted immediately after being damaged by burning, then severe corrosion of the containers would take place. The life of the containers was three to four years, according to the Municipal staff.

B-3.7 MAINTENANCE FACILITIES

The Rajkot Municipal Corporation had various types of vehicles for various duties, such as sewer cleaning, refuse collection, etc. There were a total of 170 vehicles, out of which 38 were used for the transportation of refuse. A fully-fledged workshop managed by trained staff is vital for the proper maintenance of the vehicles.

During the investigations, it was observed that the central workshop of the Corporation had the following facilities:

- ◊ A well-planned conservancy depot, workshop and office complex surrounded by boundary walls;
- ◊ Separate sheds for cleaning, servicing and repairs, a tool-room, storage for essential spare parts, storage for discarded parts, storage for tyres and storage for waste;
- ◊ Most of the mechanical and electrical repairs were carried out by the workshop, with only major overhauls contracted out;
- ◊ Up-to-date records were available;
- ◊ The officers and staff were a devoted team and deserved high praise for maintaining the facilities in a neat and clean condition..

In a nut-shell, the staff and facilities available were operating well because they were maintaining an average availability of 80% to 85% for the vehicles, and this was a major factor contributing to the upkeep of the city.

B-3.8 WORKING CONDITIONS OF THE LABOURERS AND THEIR EFFICIENCY

The refuse collection labourers were being required to work in unhygienic conditions. In some cases they were required to handle the garbage more than once. They were being exposed to high risks for want of proper uniforms, gloves and shoes or gumboots and they had been provided with tools which were not appropriate for the requirements of the work and therefore reducing the efficiency of the labourers. Unloading of refuse from open, non-tipping trucks is time consuming and the efficiency of municipal labourers in this task appeared to be low in comparison with the performance of the contractors' labourers.

The conditions of the dumping sites at Sinduria Khan and Ayodhya were such that they were a health hazard. They could not be called sanitary landfills. Houses had been constructed on land adjoining the dumping sites and there was no proper fencing. During the field study some women residing near Sinduria Khan requested the investigators to assist them in obtaining fencing and a gate for the safety of their children. This was seen to be an urgent need. The approach roads were dusty and uneven, and there is no provision for covering the garbage with soil. Rag pickers, birds and animals were adding to the nuisance. The area was also being used for open defecation.

B-3.9 ESTIMATION OF UNIT COLLECTION COSTS

In this section the costs of collecting one tonne of solid wastes by the Municipality are estimated, using existing dumper-placer and tipper trucks, at 1995 costs for single shift working 6 days per week.

a) Unit costs for existing dumper placer system (single shift)

Line	Item		annual cost, Rs	
1	Cost of vehicle	Rs 5,37,000		
2	Economic life	10 years		
3	Depreciation	line 1 / line 2	53,700	
4	Interest of capital @ 10% *		53,700	
5	Miscellaneous annual costs (insurance etc.)		6,176	
6	Maintenance (average over life of vehicle at 10% of purchase cost)		53,700	
7	Fuel (7 km/litre; 12 km/trip; 4 trips/shift, 312 days/year, Rs 8 /litre)		17,115	
8	Labour cost (driver plus one loader)		36,500	
9	Overheads (based on single shift, 25% of labour costs)		9,125	
10	**Annual costs for dumper-placer vehicle**			**2,30,016**
11	Cost of one container	Rs 22,000		
12	Economic life of container	3.5 years		
13	Depreciation (line 11 / line 12)		6,285	
14	Interest on capital at 10% *		2,200	
15	Maintenance		1,000	
16	Annual cost for one container		9,485	
17	If each container is emptied every two days, and each truck does four trips each day, each truck services eight containers, so the annual cost of containers for one vehicle is 8 X (line 16)			**75,880**
18	Total annual cost for one truck and its containers			**3,05,896**
	Total weight of solid waste collected by one truck in one year		weight, tons	
19	Loads per shift	4		
20	Average load per container (tons)		1.673	
21	Annual capacity = 4 x 1.620 x 312 (tons/year)			**2 022**
22	**Cost per ton for single shift work** = (line 18) / (line 21)			**Rs 151**

* interest based on World Bank Loan Rate

Note: The above cost may be reduced by:

- Increasing the number of loads collected per vehicle by working longer hours or double shift work.
- Increasing the average load per container. This can be done by a careful study of all container locations and adjusting the locations and the frequency of collection to maximise on container loads.

The above costs include for both depreciation of the capital, and interest on the capital cost. A replacement fund equivalent to the combined costs of these items will allow for both the initial borrowing required and future vehicle replacement as they become obsolete. No allowance has been made for inflation and the above costs should be updated annually in line with the increased cost of replacement vehicles and with a corresponding increase in the costs/ton collected.

b) Unit costs for dumper placer system operating two shifts

Economic life reduced to 7 years due to longer working hours, and maintenance is increased to 15% of purchase cost

Line	Item		annual cost, Rs	
1	Cost of vehicle	Rs 5,37,000		
2	Economic life	7 years		
3	Depreciation	line 1 / line 2	76,714	
4	Interest of capital @ 10% *		53,700	
5	Miscellaneous annual costs (insurance etc.)		6,176	
6	Maintenance (average over life of vehicle at 15% of purchase cost)		80,550	
7	Fuel (7 km/litre; 12 km/trip; 8 trips/day, 312 days/year, Rs 8 /litre)		34,230	
8	Labour cost (driver plus one loader for each shift)		73,000	
9	Overheads (15% of labour costs)		10,950	
10	**Annual costs for dumper-placer vehicle**			**3,35,320**
11	Container cost = 16 x 9,485			**1,51,760**
12	Total annual cost for one truck and its containers - two shifts / day			**4,87,080**
	Total weight of solid waste collected by one truck in one year			weight, tons
13	Collection capacity (two shifts) = 2 x 2022 (line 21 in table above)			**4,044**
14	**Cost per tonne for double shift work = (line 12) / (line 13)**			**Rs 120**

c) Unit costs for small open tipper trucks

Item	Costs Rs	
	Single shift	Double shift
Depreciation: cost Rs 4,20,000, economic life 10 years (1 shift); 7 years (2 shifts)	42,000	60,000
Interest (10%)	42,000	42,000
Miscellaneous costs	6,176	6,176
Maintenance costs (10% for one shift, 15% for two shifts)	42,000	63,000
Fuel (2 trips per shift, 12 km per trip, 8 km/litre)	7,488	14,976
Labour (One driver and three loaders per shift)	68,400	1,36,800
Overheads (25% single shift, 15% double shift)	17,100	20,520
Total annual costs	**2,25,164**	**3,43,472**
Collection capacity (tonnes) 2 trips per shift, 1.583 tonnes/trip	988	1,976
Collection cost per tonne, Rs	**228**	**174**

B-3.10 CONCLUSION

The unit costs calculated above are summarised in table B-3.2

Table B-3.2 Summary of unit collection costs

Vehicle type	shifts	cost per tonne, Rs
Dumper placer	1	151
	2	120
Open tipper	1	228
	2	174

These results show that there are clear cost savings when vehicles are used for two shifts instead of one; in the case of the dumper placer the saving is 21% and with the open tipper the saving is 24%. The dumper placer system is 34% cheaper than the tipper truck for single shift operation and 31% cheaper when two shifts are worked each day. Other points to note are that loading the tipper is very labour-intensive and unhygienic, and that no provision is made in the cost analysis above for the provision of containers to be used with the tipper trucks.

By increasing the body size of the tipper trucks it might be possible to reduce substantially the cost per tonne, but the loading time would be increased unless more labourers were able to load the truck simultaneously - and since labour costs are already the largest item of expenditure, and transporting the loaders in a safe and hygienic way might be difficult, the decision to increase the size of the labour force should not be taken without much thought. A significantly longer loading time might reduce the number of trips that could be undertaken during a shift.

Two shift operation can be a useful way of saving costs, but operational considerations must be considered such as

- ◊ the provision of adequate supervision for both shifts - one supervisor cannot be expected to be present for both;
- ◊ the problems resulting from drivers sharing vehicles, and supervisors sharing responsibility;
- ◊ the need for lighting at the disposal site if the second shift operates after sunset;
- ◊ the time necessary for routine maintenance tasks (which can be done in the afternoon with single shift operation).

Two shift operation can provide useful flexibility to cope with larger quantities after weekends and holidays and to allow a delay in the purchase of extra vehicles to cope with the growth in demand.

APPENDIX BB-3 MUNICIPAL COLLECTION IN RAJKOT

BB-3.1 Existing Conservancy vehicles

Type of Vehicle	Number	Capacity	Working hours per day
JCB loader	4		16
Dumper		2 8 m^3	16
Dumper		9 3 m^3	16
Dumper-placer	10	4.5 m^3	16
Dumper-placer container	200	4.5 m^3	16
Tractor	2		8
Open truck	3	7000 kg	8
Small truck	3	2000 kg	8
Water tanker	4	7000 kg	8
Cesspool tanker	5	2000 to - 7000 litres	8
Dumper (small)	6	1.5 m^3	16
Dog van	1		16

BB-3.2 Results of investigation into loads carried by collection vehicles

Type of vehicle	Registration number	Loaded weight (kg)	Unloaded weight (kg)	Weight of refuse (kg)	Volume carried (m^3)	Waste density (kg/ m^3)
Dumper Placer	GJ3U 8662	5560	4010	1550	2.9	530
Dumper Placer	GJ3T 5680	6160	4090	2070	2.5	840
Dumper Placer	GJ3T 5670	5280	4040	1240	2.0	610
Tipper Truck	GRP 6180	4300	2680	1620	2.0	810
Tipper Truck	GRP 6184	4120	2660	1460	2.7	550
Tipper Truck	GRP 6181	4340	2670	1670	2.5	670
Average values						
Dumper Placer				1620	2.5	660
Tipper Trucks				1583	2.4	660

Weight of empty containers - 580 to 600 kg.