Chapter C-2

In search of the ideal dumper-placer container

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The dumper-placer, or skip-lift, vehicle comprises a standard chassis equipped with a pair of hydraulically operated lifting arms which are used to lift a separate container on or off the flat floor of the vehicle, and also tip the container to empty it. Operations of these trucks in Mumbai have been described in chapter B-1, and two current types are shown in photographs 4 and 6. Operational data for dumper-placers are given in Part D, which is concerned with maintenance. There are many different designs for the containers; these variations suggest that the ideal design has not yet been developed. This article discusses some of the problems associated with the design of the containers and the material used to construct them. It is hoped that the comments here will assist those who design dumper-placer containers to avoid some problems, and guide those who select containers to make a wise choice.

The dumper placer system has become very popular for the following reasons:

- Higher productivity, because of the short time required to load; it may replace three or four conventional tipper vehicles;
- There is no need for double handling of the waste, since the waste stays in the same container and can be unloaded mechanically;
- It is hygienic, containing the waste and keeping it off the ground;
- The containers restrict rag-picking activities;
- Most containers do not allow access to cows and goats, so that the waste is not scattered around the container by such animals;
- The breeding of rodents is minimised because the container removes all of the waste each time, if it is properly used;

The main disadvantage of this type of vehicle is that the load-carrying capacity is restricted because the container must fit between the lifting arms, and the geometry of the lifting and tipping system restricts the length. For this reason, these trucks are favoured where the haul distances are reasonably short. It should be noted that the designer should aim to maximise the capacity of the container within the restrictions imposed by the vehicle and the way in which the container is used.

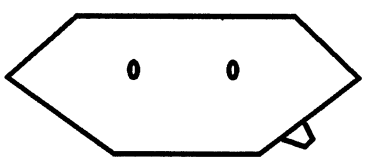
C- .1 COMMON CONTAINER DESIGNS

Skips used for municipal solid waste are usually made of mild steel and weigh between 800 and 1000 kg. The bottom plate (or floor) of the container is usually made of 5 mm plate, the sides are 3 mm thick and the lids (if fitted) are 1.5 mm thick. The structural strength is provided by channel and heavy angle sections. The volumetric capacity of the containers varies from 4 m^3 to 7 m^3. The loading height is a critical dimension if the container is loaded by the general public or from carts or small vehicles, since it has a major influence on the volume of refuse that the container will carry; this height is usually about 1000 mm.

Containers used in UK

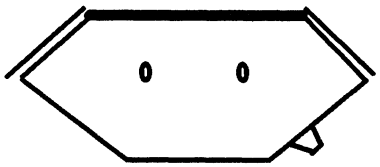
1. Open container

   capacity approx. 4 - 5 m^3
   simple and robust
   covered with net or tarpaulin
   used for rubbish, earth and soil (which are significantly more dense than municipal solid waste)



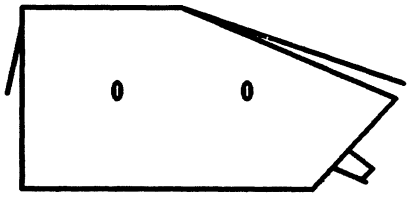
2. Covered container

   capacity approx. 5 m^3
   centre section with fixed cover, hinged flaps at either end



3. Covered container

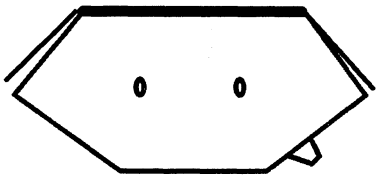
   capacity approx. 6.5 - 7 m^3
   good design, though lid is very heavy
   A second flap door at the front of the container helps to increase the volume that can be loaded.



Containers used in India - mainly in Mumbai and Calcutta

1. Covered container, Mumbai

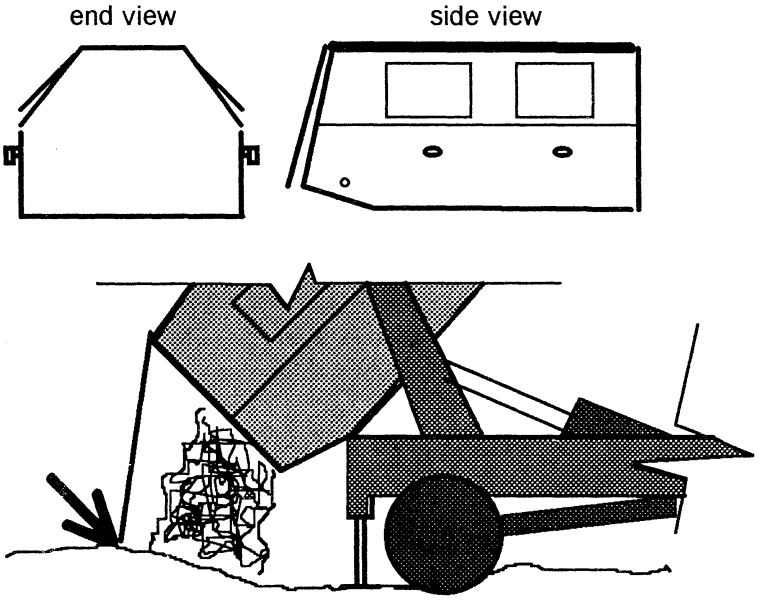
   capacity 4 m^3
   Unloading is sometimes difficult, since the waste tends to arch across the opening so that it does not fall out when the container is tipped. In addition, the hinged lids may be damaged if they come into contact with the ground.
   The life of the container is about 3 years



   If the density of the refuse is 600 kg/ m^3, the container should theoretically carry 4 x 600 = 2400 kg of waste, but it is not possible to fill the whole container in practice. The maximum load is likely to be less than 2000 kg, and the weight of the container itself is 800 kg, so the total load for the vehicle will rarely reach 2800 kg.
   However, the payload capacity of the dumper-placer vehicle is about 6000 kg.
   Comparison of these weights shows that the vehicle is under-utilised, since it carries less than half its payload capacity.

2. Covered container, Calcutta

   capacity 7 m^3
   There are two hinged lids on each side and a large back lid. The volume of waste that can be conveniently loaded into this container is much less than 7 m^3 since it is not possible to fill the container up to its ceiling. All the lids are very heavy and cannot be operated easily. . The clearance between the back lid and the ground when the container is being tipped is so low that the lids frequently become damaged on uneven ground (such as is found on dump sites - see arrow in diagram). The clearance between the back lid and *level* ground is only 500 mm. Because of this problem, lids usually last between one and two months before they must be replaced if the container is to be closed properly to allow the maximum volume of waste to be stored securely in it.



C-2.2 A NEW MATERIAL FOR CONTAINERS

The Steel Authority of India is now producing a special variety of high strength, low alloy steel in its Alloy Steels Plant in Durgapur in West Bengal. The particular product of interest here is called "SAILCOR" steel, and has excellent resistance to atmospheric corrosion. It is principally intended for applications requiring durability, less weight and low maintenance. It is an excellent replacement for mild steel. A similar steel available in Britain is called "CorTen". Figure C-2.1 below shows how much more resistant "SAILCOR" steel is to corrosion than ordinary mild steel.

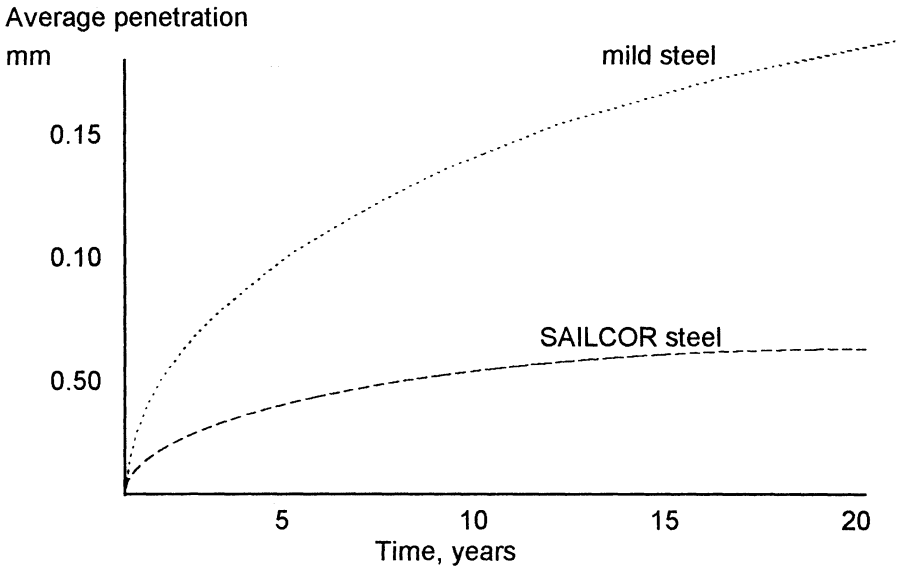


Figure C-2.1 Corrosion curve, comparing the resistance of Mild steel and SAILCOR steel in a semi-industrial environment. *Note: If the steel is in contact with garbage the rate of corrosion will be greater.*

If this material is used for dumper-placer containers, with some minor changes in design, the life of the container should be increased to nine years.

(It is perhaps appropriate to note here that design and construction details can have a significant effect on the extent and rate of corrosion. Sharp corners should be avoided since these trap garbage, which encourages corrosion. Crevices between metal sheets, where the welding is not continuous, can also favour corrosion.)

Cost comparison

As an example, consider a garage that needs 200 containers. If a mild steel container needs to be replaced after 3 years, a total of 600 containers will be needed for a period of nine years. If the containers are made of SAILCOR steel, with an anticipated life of nine years, then only 200 are needed for a nine year period. The total capital costs for the two alternatives are calculated as follows:

Material	Unit cost (Rs)	Number required	Total cost (Rs)
mild steel	45 000	600	2,70,00,000
SAILCOR steel	58 000	200	1,16,00,000

This simple comparison shows that the cost for the SAILCOR containers is only 43% of the cost when mild steel is used.

This calculation assumes that corrosion is the only reason for replacement of containers - some must be replaced because of mechanical damage - and it does not include the cost of maintenance, but the difference is so large that it cannot be ignored or explained away.

Containers fabricated from CorTen steel are being used in Gaza.

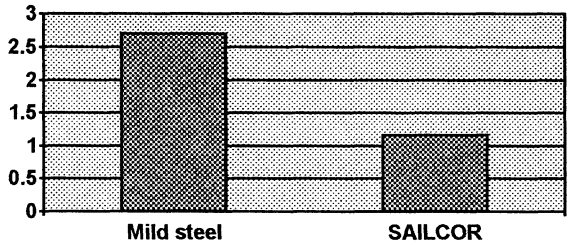


Figure C-2.2 Cost comparison of mild steel and SAILCOR containers
Costs in crores of rupees

C-2.3 THE IDEAL CONTAINER?

In designing a good dumper-placer container, the following factors should be considered:

- ◊ The *effective* capacity should be as large as possible, in order to maximise the payload on each trip and so minimise the cost per ton transported. In many designs there is usually a considerable empty void above the waste because the type or location of the opening(s) are such that it is very difficult to load the waste up to the ceiling of an enclosed container. The width of the container is limited by the lifting system, and the height is usually limited by the method of loading, (especially if the container serves as community storage and is, therefore, loaded by the general public). The length of the container is constrained by the chassis dimensions and the lifting equipment. The optimum effective capacity depends on the payload of the vehicle and the density of the waste.
- ◊ The container's load should be covered when it is moving on the vehicle, so that the contents are not dispersed in transit. In some cases it may be necessary to keep the contents covered when the container is stationery, but if the container is to be used as community storage, it is not realistic to expect that lids will be closed and opened by the public using the container, so the lids should be left open in this case. A large lid can be very heavy to operate, so careful design is necessary. It is possible to cover an open container with a net or tarpaulin, but drivers will usually omit to do this unless there is strict supervision, and if the container is high, the driver may need to climb over the waste to spread the tarpaulin - a dangerous practice.
- ◊ The container should be strong. Apart from the pick up and pivoting points, the most vulnerable parts are the doors or flaps. Often the doors are damaged when the containers are being tipped to unload and the door comes into contact with the ground. The design should make allowance for tipping on uneven ground and over a concrete upstand.
- ◊ Unloading should be quick. Some designs have comparatively narrow openings through which the waste must fall, and certain types of waste form an arch that spans the opening so that the waste does not fall out.
- ◊ The container should be durable. Corrosion often limits the life of containers; the effects of corrosion can be reduced by using special steel as described above, by designing the containers with corrosion in mind, by maintaining a protective paint layer, and by washing the containers frequently. It is useful to note where rust holes develop in old containers - it is often at the lower part of the sides rather than in the base - so that the containers can be redesigned for a longer life.
- ◊ The container should be economical. Economy is often best achieved with a simple shape

One of the best designs is shown here. The shape is simple. There is a large opening to facilitate emptying, and the square end helps to maximise the effective volume. However the flap lid is likely to be very heavy and difficult to use, unless it is made of rubber - in which case the wind might catch it.

Alternatively, it may be possible to split the lid along the centreline of the container (🡐) or hinge it parallel to the main hinge (🡒), but in most situations these arrangements are likely to be damaged quickly

If there is an opening only at one end it will be difficult to load it uniformly over the whole plan area, so in some cases it may be advisable to have a smaller opening, only for loading, in the vertical wall

It may be possible to maximise the useful volume by increasing the overall length and slightly modifying the shape of the front end of the container so that it does not hit the rear of the truck when it is being lifted into position.

C-2.4 CONCLUSION

Clearly this last design is not the ideal, and there is no one ideal design for all applications. The degree to which the container should be closed and the level of supervision and responsibility for the container are important factors to consider. Covering with a tarpaulin or a net has many advantages, provided that the covering operation does not involve walking on the load of waste.

This chapter has not defined the ideal container, but has illustrated many of the steps and considerations that can lead us towards the ideal container.