# Technology for efficient waste transport

Increased efficiency of wide-area collection and transport through transfer stations

The expansion of urban areas widens the garbage collection zone. It is possible to improve the efficiency of collection and transport operations in cities with widening collection zones by setting up waste transfer stations where wastes can be transferred from small- or medium-sized garbage trucks to larger trucks.

The cost of collecting and transporting garbage accounts for high percentage of waste disposal operations. Improving the efficiency of collection and transport leads to cost reduction while maintaining or improving services to residents.

Domestic Case

The transfer station method commonly adopted in Japan is the compactor container transfer station shown below.
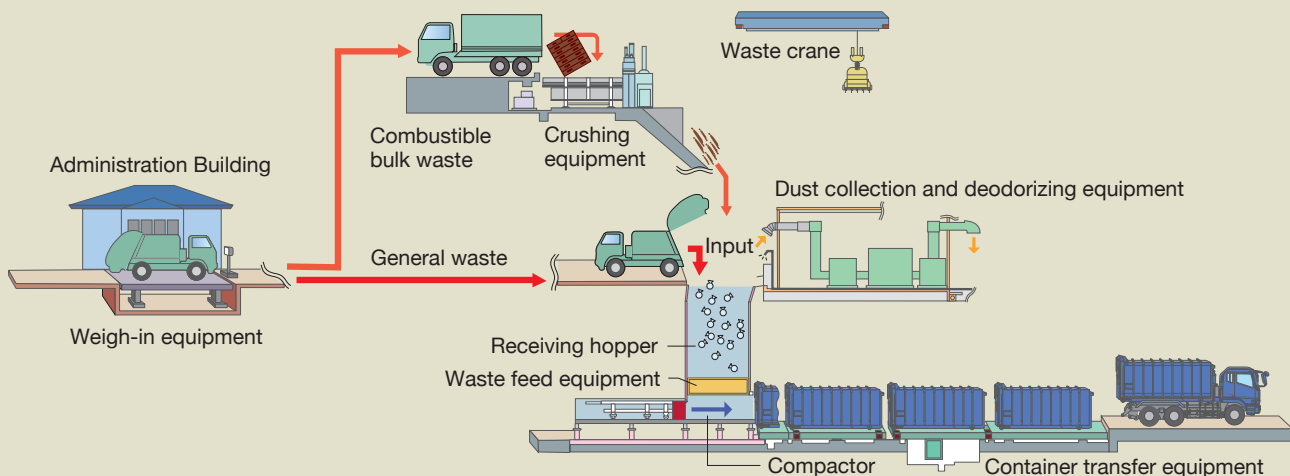
Garbage collected by small garbage trucks is dropped in a hopper, compressed in containers and reloaded onto larger trucks. In this transfer station, garbage collected by three 2-ton trucks can be compressed in one container.

The container is then transported to a disposal site or incineration plant on a large container truck.

Source：ShinMaywa Industries, Ltd.

Overseas Case

Some Japanese enterprises have established joint ventures in China with high achievements in the production and sale of transfer stations. Some also sell them to other Asian countries.
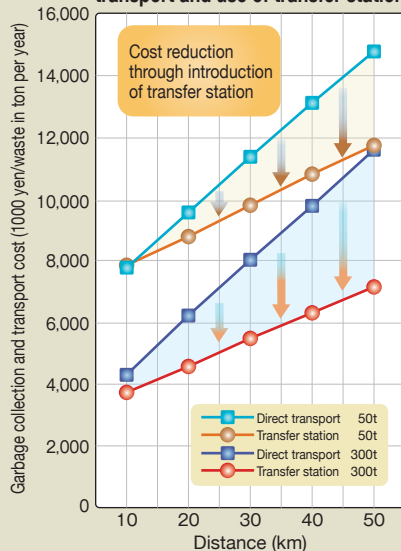

Transport Station (Xian, China)

Transport Station (Kuala Lumpur, Malaysia)

Setting up transport station to streamline collection and transport operations
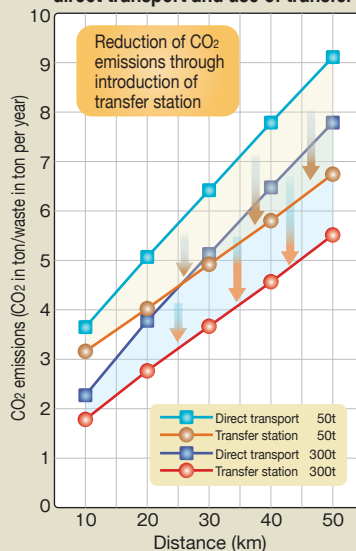
Transfer to larger trucks at transport stations improves transport efficiency and reduces fuel consumption by transport vehicles per garbage volume. This not only leads to cost reduction, but it also reduces CO_2 emissions, contributing to the prevention of global warming.

● Economic effect and CO_2 emissions after introduction of transport station

■ Comparison of cost between direct transport and use of transfer station

Cost reduction through introduction of transfer station

Garbage collection and transport cost (1000 yen/waste in ton per year)

Distance (km)

- Direct transport 50t
- Transfer station 50t
- Direct transport 300t
- Transfer station 300t

■ Comparison of CO_2 emissions between direct transport and use of transfer station

Reduction of CO_2 emissions through introduction of transfer station

CO_2 emissions (CO_2 in ton/waste in ton per year)

Distance (km)

- Direct transport 50t
- Transfer station 50t
- Direct transport 300t
- Transfer station 300t

【Conditions】
- Collection area $500km^2$
- Operating days   250days/year
- Operating hours   5hr./day
- CO_2 emission factors for $0.002619tCO_2$/L
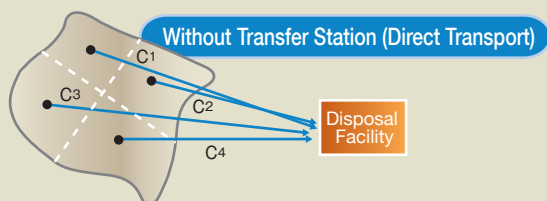 collection and transport vehicles

	Collected volume	Collection vehicle	Transport vehicle
Direct transport	50t/day	2t packer vehicle	
Transfer station	300t/day		
Direct transport	50t/day	2t packer vehicle	10t arm roll vehicle
Transfer station	300t/day		

※1 Calculated for compactor-container type
※2 CO_2 calculation is emissions from collection and transport vehicles

Source：ShinMaywa Industries, Ltd.

Determination of whether or not to set up transport stations depends on its cost effectiveness. As shown in the figure below, it is advantageous to introduce a transport station when the total collection and transport fee with the transport station (T_{cB}) is cheaper than the total collection and transport fee without the transport station (T_{cA}) ($T_{cA} > T_{cB}$). Generally speaking, when the transport distance exceeds 18km, a transport station should be considered.

Without Transfer Station (Direct Transport)

C1 C3 C2 C4 Disposal Facility

$T_{cA} = C_1 + C_2 + C_3 + C_4$

T_{cA} : Total cost for collection from collection zones 1~4 and direct transport to disposal facility
C_1, C_2, C_3, C_4 : Cost for collection at each collection zone 1~4 and transport to disposal facility

With Transfer Station

C1 C2 C3 C4 C5 Transport Station Disposal Facility
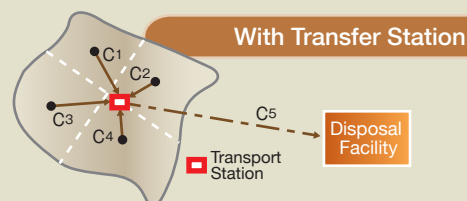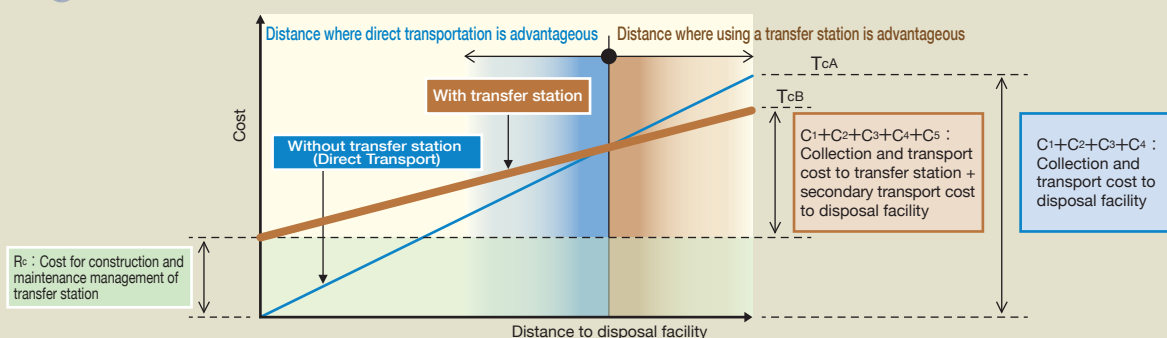
$T_{cB} = (C_1 + C_2 + C_3 + C_4) + R_c + C_5$

T_{cB} : Total cost for collection from collection zones 1~4 and transport to disposal facility via transport station
C_1, C_2, C_3, C_4 : Cost for collection at each collection zone 1~4 and transport to transport station
R_c : Cost involving operation at transport station (Construction cost, operation and maintenance management cost)
C_5 : Cost to transport from transport station to disposal facility (Secondary transport)

● Cost structure for with and without transfer station

Distance where direct transportation is advantageous Distance where using a transfer station is advantageous

T_{cA}
T_{cB}

Cost

With transfer station

Without transfer station (Direct Transport)

R_c : Cost for construction and maintenance management of transfer station

Distance to disposal facility

$C_1 + C_2 + C_3 + C_4 + C_5$: Collection and transport cost to transfer station + secondary transport cost to disposal facility

$C_1 + C_2 + C_3 + C_4$: Collection and transport cost to disposal facility

Source："Waste Collection:Theory and Practice",P145,Maruzen(2011)

Fuel-efficient collection and transport vehicles with high load volume

It would be more efficient in many of the Asian countries to use small collection trucks because of narrow roads. Many of the roads in Japan, too, are narrow, and 1t to 2t compact garbage collection trucks were developed with reduced body weight in order to increase load capacity.

There are two types of this garbage collection trucks - mechanical trucks (Mobile Packers) and compressor-type trucks, but mobile packers are more commonly used. Packers scoop up the garbage with a spinning disk and thrust it into the storage space with a sliding board. Garbage with high moisture content reduces compression efficiency; however, with continuous modification, trucks have achieved high compression rate, with 1.5 times more load than flat pile trucks.

Compressor-type trucks press down the garbage on to the floor with a compressor board (pressing plate), and after breaking it up and reducing volume, the garbage is slid into the storage area. The trucks efficiently collect large garbage requiring breakdown, bulky PET bottles and plastic waste.

Due to the worldwide problem of global warming, low-pollution-type garbage trucks, such as electric motor-drive and hybrid trucks are being developed and put into practical use.

Mobile Packer

Safety, loading efficiency and operability are required for garbage collection trucks. Smaller trucks have openings set less than 800mm above the ground to realize outstanding workability and operability.

● Low-pollution garbage collection trucks (Example) Generally, garbage loading and unloading is powered by the engine. This type of truck generates electricity required for loading and unloading while the truck is running. This reduces the consumption of light oil and CO_2 emissions.

Source：ShinMaywa Industries, Ltd.

Column

History of Garbage Collection Trucks in Japan

Kitchen waste being collected during 1950s

Truck first used for garbage collection during 1950s

Transferring garbage carried by rickshaw during 1950s

Transferring garbage carried by rickshaw during 1950s

Source：100-year History of Cleaning Operations in Tokyo