



# DESIGN AND OPERATION OF SANITARY LANDFILL

**THE URBAN UNIT**

Urban Sector Policy & Management Unit

P & D Department, Punjab



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The Urban Sector Policy and Management Unit is part of the Planning and Development Department, Government of the Punjab. It furthers the Government of Punjab's vision to make cities engines of economic growth by providing high quality technical assistance and support to urban planners and managers in the quality technical assistance and support to urban planners and managers in the province on a non-commercial basis.

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## **ACKNOWLEDGMENTS**

The Urban Unit owes a debt of appreciation to Japan International Cooperation Agency (JICA) and Fukuoka University for their support in providing this useful literature on operation and design of sanitary landfill sites. The Urban Unit appreciates the efforts of the author Professor Yasushi Matsufuji in developing a very useful resource that would serve the purpose of technical capacity building of the professionals working in the solid waste management.

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# Design and Operation of Sanitary Landfill

## 1. Background

### 1-1 Land and Population

Japan's territory encompasses an area of 378,000 sq.km. With 119 million people, it registers a population density of 320 people/sq km. Japan's population density is higher than that of major Western countries, including the United States with 25 persons/sq.km; France with 99 persons/sq.km; Great Britain with 229 persons/sq.km, and West Germany with 248 persons/sq.km.

Moreover, 70% of Japan's land is mountainous and wooded. The habitable area is only 80,000 sq.km, or only 21% of the total land. In term of population per square kilometre of habitable area, amongst the countries mentioned above, the United States has the lowest figure of 50 people, followed by France (158), Great Britain (358) and West Germany (386). In Japan, this figure stands at 1,452. Thus, Japan has one of the highest population densities in the developed world.

### 1-2 High Economic Growth and Changes in Industrial Structure

Japan's population marked gradual increase from 83 million in 1950, to more than 100 million in 1970 and 119 million in 1983. However, with gradual decline in the annual population growth rate, the 1983 population represents a slight increase of 0.66% over the previous year and indicates a state of stable population growth.

The Japanese economy started showing high growth in the 1960s and had successfully maintained remarkable growth until 1973 when skyrocketing oil price halted the high growth rate.

Table 1.1 Population per square kilometre of habitable area in major countries

	Japan	W. Germany	France	Britain	U.S.A.
Habitable area (10sq.km)	805	1,594	3,389	1,564	45,814
Total area (10sq.km)	3,777	2,486	5,470	2,441	93,718
Ratio of habitable area to total (%)	21	64	62	64	49
Population in the habitable are (person/sq.km)	1,452	386	158	358	50

Note: The population figures used to derive habitable areas are based on the years 1980 for Japan, 1975 for West Germany, 1979 for France, 1977 for Great Britain and 1974 for the United States. For Japan, the population figure is as of 1 October 1980 and whereas for the rest of the countries it is mid-1980.

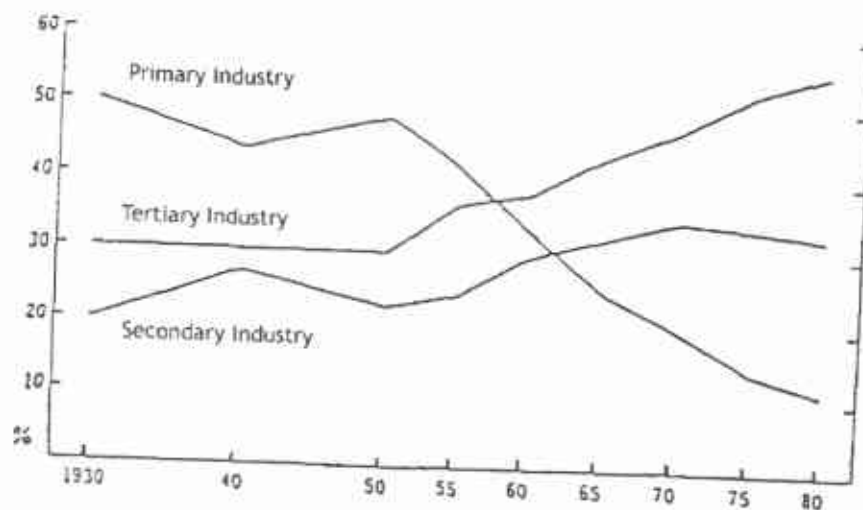


Fig 1.1 Japan's employment structure

Between 1960 and 1965, real GNP growth rate averaged 10% a year. Average annual growth rate reached a record high of 11.6% during the 1965-70 period. Economic recession, triggered by increasing oil prices, however, slowed the growth rate, with average GNP growth rates standing at 5.4% during the 1970-75 period and 6.0% during the years between 1975 and 1980.

On the other hand, resulting from economic development, dramatic changes have occurred in the employment structure since 1950. The number of persons employed in primary industry, the largest at that time, started diminishing rapidly and become the smallest, while the number of persons in secondary and tertiary industries has continued to grow. In particular, the tertiary industry marked sharp increases in the number of persons employed and this upward trend is still continuing.

### 1-3 Gravitation of Population toward Cities and Changing Environment

The changes in employment structure are synonymous with shifts of population from agricultural sector to commercial / industrial sectors. In other words, population shifts from rural to urban areas become marked. Particularly the migration to the major urban areas of Tokyo, Osaka and Nagoya was most pronounced. Of Japan's total population, 22.5% is currently concentrated in the Tokyo metropolitan area, 13.0% in the Kinki district around Osaka and 6.7% in the Chukyo district around Nagoya. These figures show that as much as 42.2% of the total population is concentrated in the three major urban areas, resulting in an incredibly high population density of 3,491 persons/sq.km in the Tokyo metropolitan area, 2,076 persons/sq.km in the Kinki district and 1,080 persons/sq.km in the Chukyo district.

Table 1.2 Population in Japan's three major urban areas (1983)

	50km radius around Tokyo		50km radius around Osaka		50km radius around Nagoya	
	Population (1,000 persons)	Growth rate over the previous year (%)	Population (1,000 persons)	Growth rate over the previous year (%)	Population (1,000 persons)	Growth rate over the previous year (%)
0 - 10km	3.639	Δ 0.1	4.233	Δ 0.2	2.118	0.1
10 - 20km	7.808	0.7	3.670	1.0	1.848	0.9
20 - 30km	5.518	1.7	2.380	1.2	1.435	1.6
30 - 40km	5.979	1.7	2.831	1.2	1.865	0.8
40 - 50km	3.788	2.0	2.263	0.8	640	0.6
Total	26.732	1.2	15.377	0.7	7.907	0.8
Density of Population (persons/sq.km)	3.491		2.076		1.080	

In fact this phenomenon of population shift from rural to urban areas has been noted nationwide.

The concentration of both the population and industries in major urban areas during the high economic growth period created massive housing demand in major cities as well as suburbs. Such a highly concentrated population also caused sharp increases in the cost of land in these areas. Subsequently, conventional independently built housing was replaced by collectively built housing. Indeed, the large number of public and private apartment houses that were constructed in major cities and the suburbs dramatically changed the Japanese lifestyle.

Concurrently with the start of modernization of the distribution system, an increasing number of supermarkets opened primarily in newly developed residential areas. These supermarkets facilitated large-quantity sales of pre-packed goods.

The high economic growth brought about an improved income level, which spurred individual consumerism, thus creating an age of mass production, mass distribution and mass consumption. At the same time, housing standards remained low, particularly in major cities and the suburbs where a growing number of people were forced to live in cramped housing. The living environment was changed by this trend.

Without storage space even for a temporary period, people began discarding used products and consumer durables as soon as such products became redundant.

Under such circumstances, the amount of waste grew rapidly along with significant changes in the quality of wastes. This necessitated having waste related laws and regulations in place.

## 1-4 Waste Management and Public Cleaning Law

The Waste Management and Public Cleaning Law (Waste Management Law) is designed to preserve the living environment and improve public health through the promotion of adequate and safe waste disposal practices to keep the environment clean.

### 1) Definition of wastes

The Waste Management Law defines wastes as "waste, bulky waste, ashes, sludge, excreta, waste oil, waste acid and alkali, carcasses and other dirty and unnecessary matter, which are in solid or liquid state (excluding radioactive waste and waste polluted by radioactivity)".

Even if they are dirty or unnecessary, gaseous substances and those contaminated with radioactivity are excluded from the waste category specified by the Law. Other types of waste not subject to the Law are:

- Earth and sand as well as the like resulting from dredging activities conducted at ports, rivers, etc.
- Aquatic animals and plants, etc. netted during fishing activities and discharged near the fishing site.
- Earth and sand as well as the like which can be used in land reclamation.

### 2) Municipal and industrial wastes

Under the Waste Management Law, wastes are roughly classified into two categories:

- Municipal wastes generated mainly from domestic activities, and
- Industrial wastes resulting from industrial activities.

Industrial wastes are further divided into 19 groups, including ashes, sludge, waste oil, waste acid, waste alkali and waste plastics. Figure 1.2 shows the 19 groups and examples from each group.

Municipal wastes are defined as wastes other than industrial ones. The greater part of municipal wastes results from the daily activities of the citizens, i.e. garbage (kitchen wastes), paper including newspaper and magazines, glass and metal in such forms as bottles and cans, plastics and fabrics. Municipal wastes also include discarded bulky wastes, such as furniture and household appliances.

Of the wastes resulting from business activities, those that municipalities can dispose of without difficulty in terms of quality are designated separately from other industrial wastes and are labelled as "municipal wastes from the business sector."

### 3) Obligations of the government, municipalities and business enterprises

The Waste Management Law requires business enterprises, the government and municipalities to fulfil their obligations as outlined below.

- Business enterprises are responsible for disposing of wastes resulting from their business activities. They are also required to make every effort to reduce the volume of the wastes they produce and take necessary actions to prevent the products, containers and others involved in their manufacturing, processing, sales and other business activities from becoming a waste too difficult to dispose of.
- Municipalities are required to promote the concept of public cleansing, while endeavouring to carry out efficient management of waste disposal operations.
- Prefectural governments are required to provide municipalities with necessary technological support or assistance, if any, and make effort to take necessary measures for adequate disposal by monitoring processing status of industrial wastes.
- The central government is required to promote technological development related to waste management and make every effort to provide municipalities as well as prefectural governments with technological and financial assistance.