7 Waste landfill technology

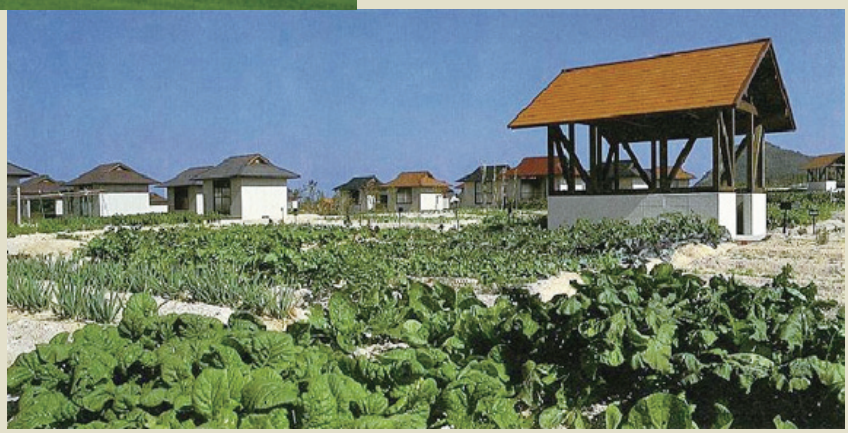
Landfill disposal technology that enables the stabilization of waste in a short time

Enabling early use of land with a semi-aerobic landfill structure

In many Asian city's waste landfill sites, waste is dumped and burned openly. Japan used to be the same; however, a joint research by Fukuoka University and Fukuoka City in 1970s produced and applied a semi-aerobic landfill structure for landfills that is sanitary and presents no environmental problem.

Compared to anaerobic landfill, the semi-aerobic landfill technology quickly stabilizes landfill sites after the land has completed its role as landfill, enabling it to be used for parks and open space for sports. This technology was accredited as CDM methodology by the UN CDM Executive Board.

The Moerenuma Final Disposal Site in Sapporo City, Hokkaido was used from 1979 to 1990, and now the site is a recreational park open to residents and tourists.
The park was designed by world famous designer, Mr. Isamu Noguchi.



Fukuoka City had been using Imazu Landfill to dispose waste from 1975 to 1999. A section of the landfill is now used as a sports park and allotment garden.

Source: Hydraulic Sanitary Engineering Laboratory, Faculty of Engineering, Fukuoka University

Column

Improvement of the current landfill to a semi-aerobic landfill structure was accredited as a CDM method

In the past, CDM accreditation for waste disposal had been limited to aerobic landfill and methods for the recovery and use of methane gas generated at landfill as energy. At the 62nd UN CDM Executive Board held in Morocco on July 15, 2011, it was officially recognized that improvement of the current landfill to a semi-aerobic landfill structure is an effective method and added as a new methodology for Clean Development Mechanism (CDM) stipulated in the UN Framework Convention on Climate Change (UNFCCC).

- Accreditation: AM0093 "Avoidance of landfill gas emissions by passive aeration of landfills"
- Announced: URL: http://cdm.unfccc.int/EB/index.html

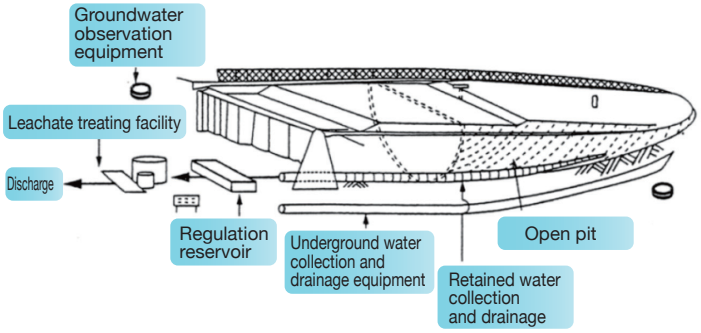
Waste landfill technology and system

In 1977, structural and maintenance management standards were established for final disposal sites. The standards grouped the final disposal sites into three categories - controlled landfill, inert landfill, and isolated landfill - and stipulated that waste must be safely disposed at landfill according to their properties. The semi-aerobic landfill structure is employed as the structure for controlled landfill.

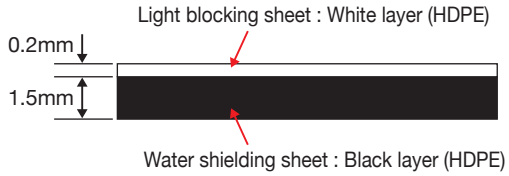
Harmful waste such as waste containing heavy metal and PCBs has the potential to adversely affect health and the environment, and must be disposed of at isolated landfill sites. Non-harmful waste that has the potential to pollute public water areas and underground water, or may affect the environment because of gas, odor and/or pests must be disposed of at controlled landfill sites. Plastic waste, rubber debris, metal debris, glass, ceramics and bricks that has little potential to cause environmental pollution can be disposed of at inert landfill sites.

Controlled Landfill Sites

Water catchment and treatment facilities for seepage control and leachate are established because landfill waste may decompose and pollute the environment.



■Cross section of the sheet (example)

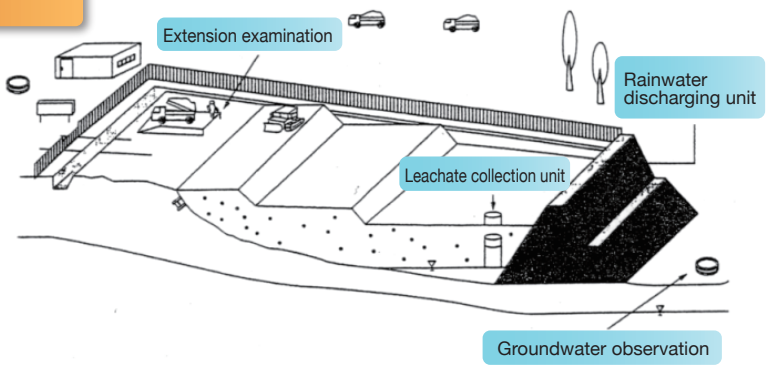


A water shielding sheet covers the floor and sloped surfaces of the controlled landfill site to prevent the pollution of underground water. Sheets with outstanding durability are being developed and used.

When the site is constructed over an impervious layer, a liner sheet need not be required if the layer has a thickness of 5m or more and the coefficient of permeability is 1×10^{-5}cm/second or less.

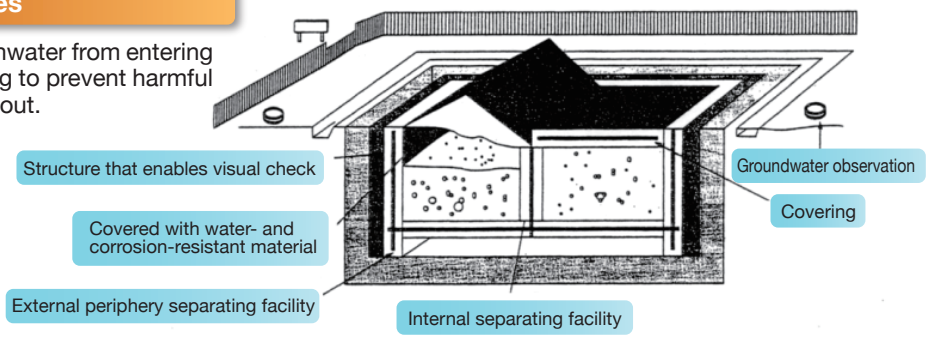
Inert Landfill Sites

Landfill waste is bio-chemically stable and will not pollute water. Water catchment and treatment facilities for seepage control and leachate are not established because of the low risk of environmental pollution.



Isolated Landfill Sites

The structure prevents rainwater from entering or leachate from outputting to prevent harmful substances from seeping out.



Source: "Comprehensive Construction Byproduct Recycling Measure" 2002 Edition, Advanced Construction Technology Center

Semi-aerobic Landfills

The semi-aerobic landfill structure was developed in a joint study by Fukuoka University and Fukuoka City. A leachate collecting pipe is set up at the floor of the landfill to remove leachate from the landfill, so that leachate will not remain where waste is deposited. Natural air is brought in from the open pit of the leachate collecting pipe to the landfill layer, which promotes aerobic decomposition of waste. This enables early stabilization of waste, prevents the generation of methane and greenhouse gases, which make it effective technology in the prevention of global warming.

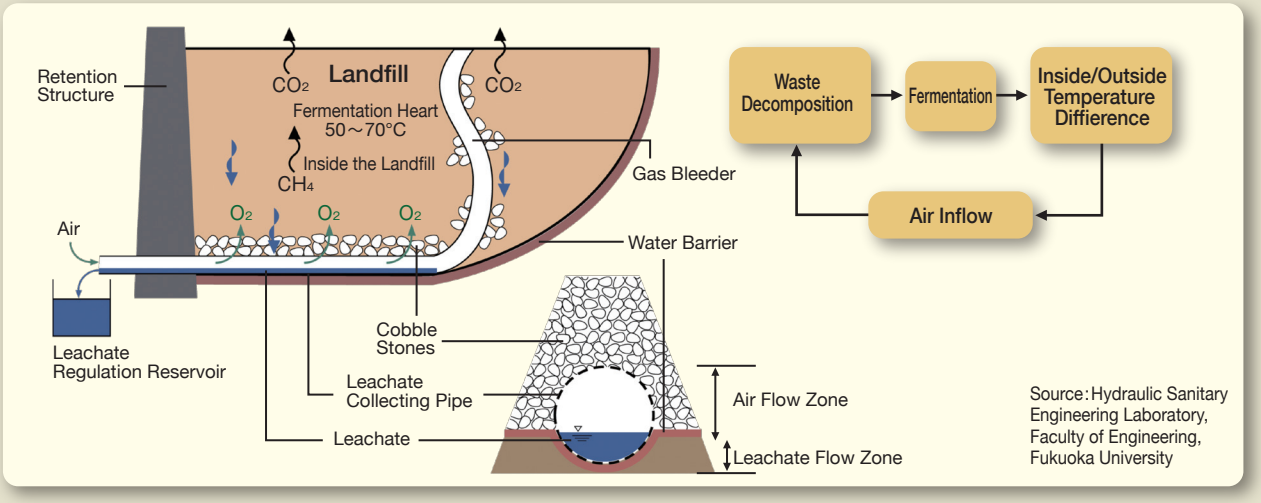
Generally, the air present in an aerobic environment transforms carbon in organic matter to carbon dioxide, nitrogen to nitrification denitrification, and sulfur to sulfur ion, which reduce the generation of foul odor and flammable gas. Moreover, an aerobic environment increases the activity of microorganisms that decompose waste, accelerating the stabilization process.

On the other hand, in an anaerobic environment, where oxygen is not present, organic matter is transformed into volatile organic acids, such as acetic acid, and then become methane gas or carbon dioxide, and nitrogen and sulfur are transformed to ammonia, amine, hydrogen sulfide, and mercaptan, which emit foul odor and negatively affect the living environment of the surrounding area.

Features of Semi-Aerobic Landfill

1. Better leachate quality than anaerobic landfill
2. Low emission of greenhouse gases
3. Landfill stabilizes faster than anaerobic type
4. Less underground water pollution from leachate
5. Cheaper to operate and manage

Mechanism of semi-aerobic landfill structure



Composition of gas generated from landfill

	Semi-aerobic landfill	Anaerobic landfill
Methane	30%	60%
CO_2	70%	40%

The global warming coefficient of methane, one of the greenhouse gases, is 21 times that of CO_2

The quality of the leachate improved significantly with a significant drop in BOD one year after the semi-aerobic landfill structure was introduced. NH_3-N also showed a significant drop within one year. Anaerobic landfill, on the other hand, shows very little drop.

Landfill structure and changes of BOD in leachate over time (combustible waste)