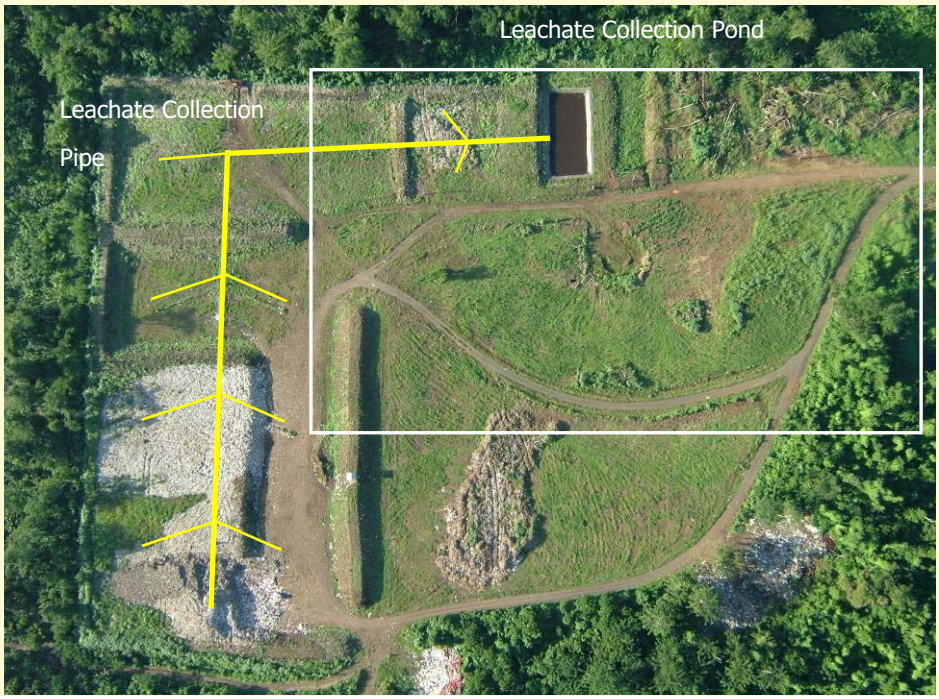
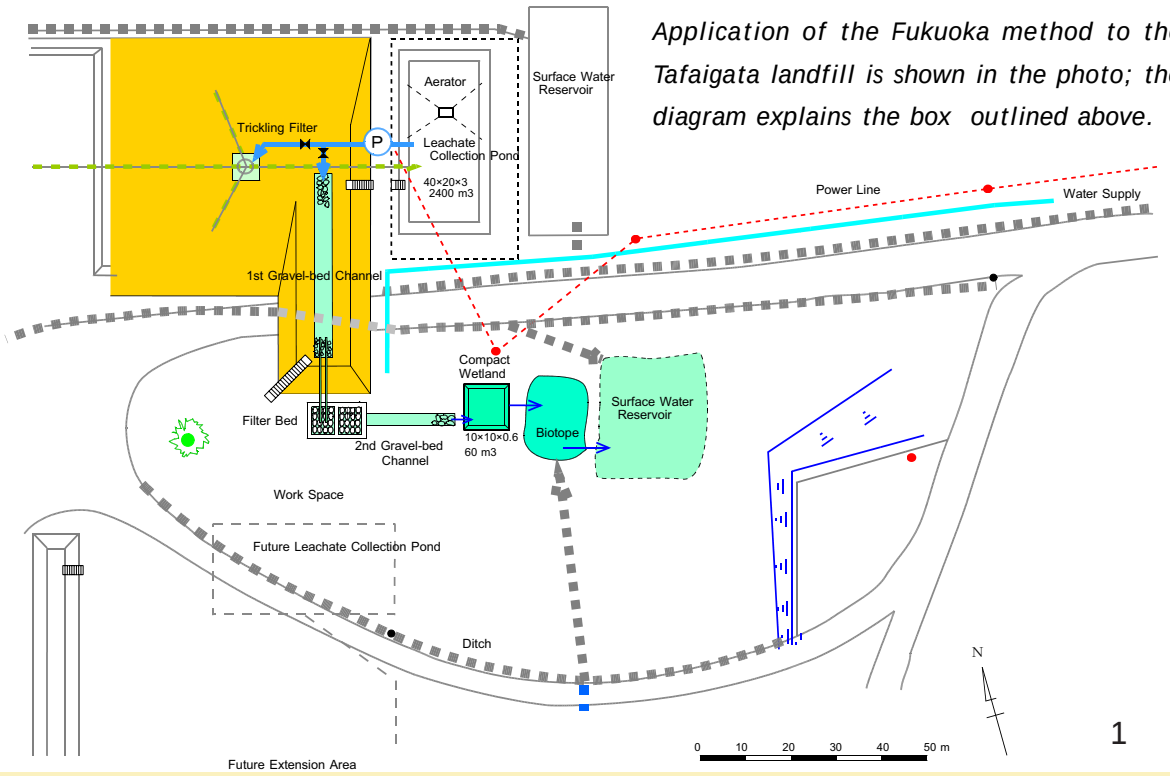
Samoa's Tafaigata Landfill Rehabilitation Project in Action

The Tafaigata landfill in Upolu, Samoa, has been transformed from a messy, smelly dump to a clean and fresh semi-aerobic landfill structure using the Fukuoka method, now the standard method of landfill in Japan. The transformation process was funded by the Japan International Cooperation Agency (JICA), at a cost of only US$400,000 (consultant supervisor not included). Transformation took place in two phases. The first one was setting up waste cell bunds, consolidating the soil "floor", installing the air ventilation / leachate collection pipes, a leachate collection pond, and all-weather access roads. The second phase included setting up the leachate treatment facilities. When completed in December 2005, the project was handed over from JICA to the Samoan Government's Ministry of Natural Resources, Environment and Meteorology (MNREM).



What is the 'Fukuoka method'?

Researchers at Fukuoka University on Kyushu Japan were comparing anearobic and aerobic landfills. Aerobic means air (which includes the required oxygen) is blown into the waste pile through a network of pipes; this increases the breakdown speed of organics such as food, paper, and garden waste. The fans were too expensive to run. The experimenters found that the heat in the waste caused a convection current drawing air through the pipes anyway. This *passive ventilation* keeps the waste pile supplied with enough oxygen to maintain rapid breakdown. It also reduces the impact on global warming by 60%.



Application of the Fukuoka method to the Tafaigata landfill is shown in the photo; the diagram explains the box outlined above.

This is a joint project from the Secretariat of the Pacific Regional Environment Programme (SPREP) and the Japan International Cooperation Agency (JICA).

For further information, contact:

Mark Ricketts
MarkR@sprep.org

SPREP
PO Box 240
Apia
Samoa
P:+685-21929
F:+685-20231
W: www.sprep.org

How does Tafaigata differ from a 'normal' landfill?

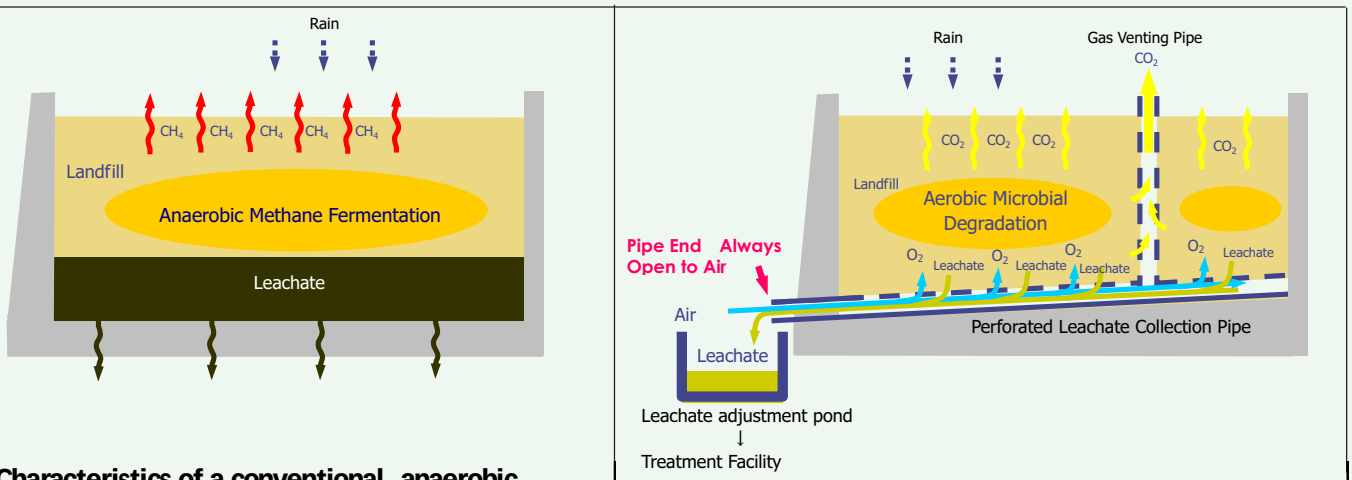
The Samoan landfill used to be an open dump, just like most landfills in the world (including rural ones in the USA, Australia and New Zealand). Waste was simply piled on top of itself. Usually a waste pile becomes quickly anaerobic because the moisture and the digestion of the organics consume any oxygen in the pile; the composition of dominant bacteria then changes to species that can live without oxygen.

Instead of carbon dioxide (CO_2), these "anaerobic" bacteria give off strong odours and methane (CH_4). Methane is flammable and so open dumps often have fires burning, with toxic pollution (from plastics for example) being blown over neighbouring areas. It also affects global warming as methane gas has an effect that's 21 times worse than carbon dioxide.
The leachate, the liquid produced by the breakdown of waste, is very high in nutrients which can cause damaging algal growth in streams and lagoons. This in turn can consume all the available oxygen in the water so that fish and other biota sufficate.

Developed countries usually have their anaerobic, urban landfills fully contained in a giant, expensive, plastic or clay "bath". Their methane is captured and burnt or used for electricity generation. The leachate is caught in drains and treated before discharge.

Above: One of the vents in the landfill, giving off less harmfull CO_2 and passively sucking air into the pipes for aerobic garbage / leachate breakdown.

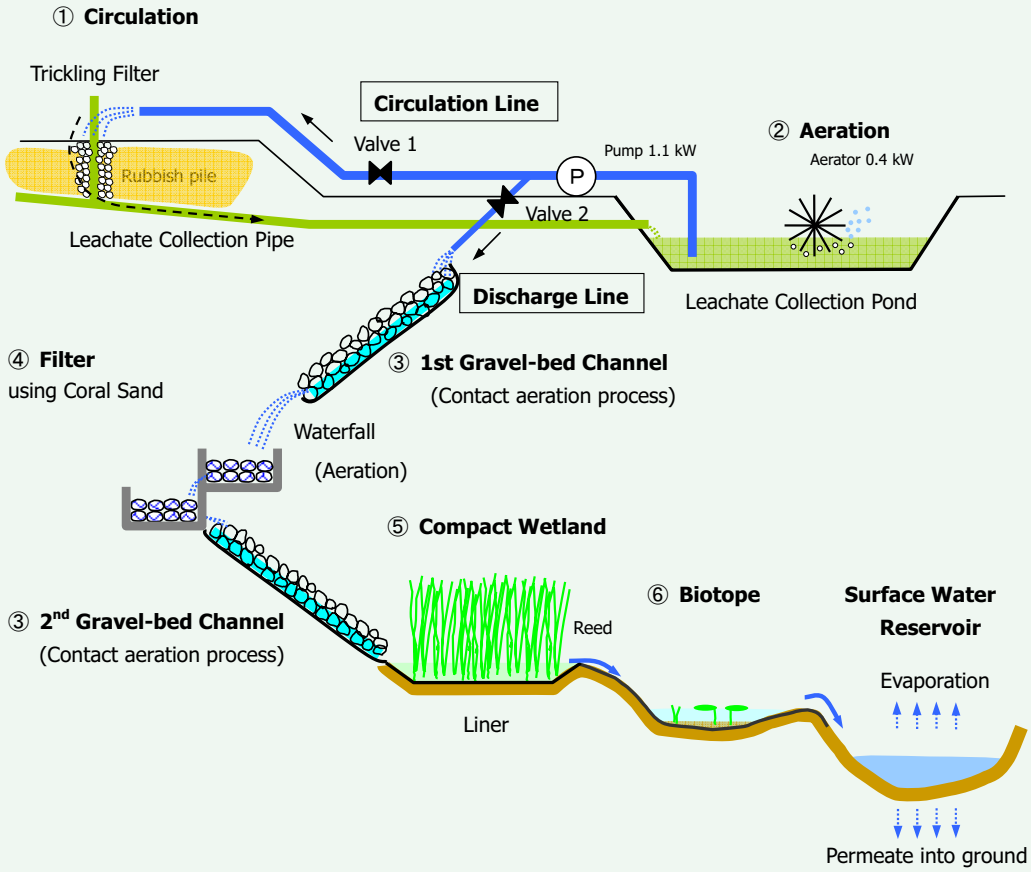
Below: A comparison of a conventional, anaerobic rubbish dump and a semi-aerobic landfill structure.



Characteristics of a conventional, anaerobic rubbish dump	**Semi-aerobic landfill structure (Fukuoka Method)**
Rubbish dumped on the ground or in a hole. Leachate stagnates which leads to anaerobic condition	Leachate collection and gas venting pipes are set up. These provide fresh air into the rubbish layer through the convection effect of heat generated by fermentation in the rubbish
Emits an offensive odour into the air and gives off high nutrient leachate to soil	Immediate removal of leachate and flow of air makes landfill aerobic, causing cleaner leachate and less smell than conventional landfill
Aggravates global warming through the generation of methane gas (CH_4)	Generation of methane gas is low and therefore reduces fire risk and global warming impacts
Methane has a 21 times more negative effect on the atmosphere than carbon dioxide (CO_2)	Fast stabilization for re-use and easy maintenance
Long-term decomposition is required under anaerobic conditions before land can be reused	Cost-effective using local materials such as bamboo, waste tyres, waste drums for pipes

The Leachate Treatment System

The Tafaigata Facility uses mainly natural cleansing methods and effects such as gravel-bed channels and compact wetland. This cheap and eco-friendly system requires little energy for operation and only minimum maintenance.



It comprises six discrete steps:

1. Aeration—mechanical stirring provides more oxygen into the leachate collection pond, so micro-organisms can decompose the organic matter better.

2. Circulation treatment—a leachate treatment system through a trickling filter back down to the leachate collection pipe. Trickling filters are an aerobic treatment system that exploit micro-organisms growing on the rocks exposed to air: these aerobic bacteria metabolise organic matter from waste water.

The contents from the Leachate Collection Pond are pumped up and sprinkled onto a trickling filter; the now cleaner leachate flows back to the collection pond again.

By repeating this process, organic matter is gradually consumed by the bacteria until the Biological Oxygen Demand is low enough to be directed into the next phase of purification.

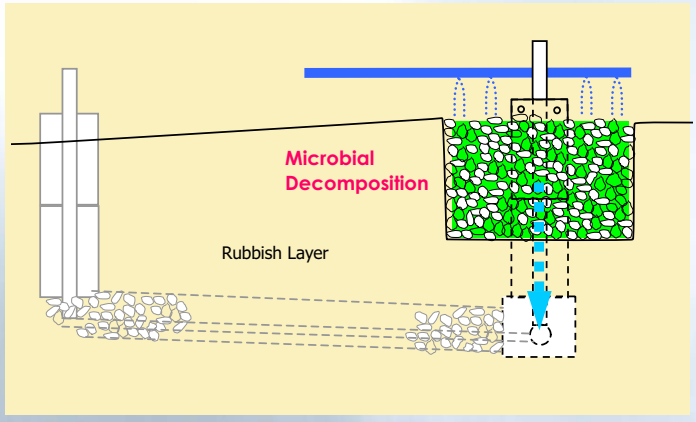
3. Gravel-bed channel— another natural cleansing method. It continues the process of the trickling filters but uses aquatic organisms such as algae that are attached to the surface of gravel.

When water flows over and through the gravel, these aquatic organisms decompose and absorb the polluting nutrients.

4. Filtration. Local materials such as coral sand, coconut husk and activated carbon are used as filters to adjust the acidity (pH) and remove heavy metals and organic compounds from the leachate.

5. Compact Wetland—This is another natural cleansing method using aquatic vegetation, such as reeds. These plants remove the nutrients phosphorous and nitrogen to prevent any undesirable excessive plant growth downstream. The outflow is now clean enough to be released into the natural environment.

6. Biotope—a mini-natural ecosystem, which is an indicator of treated water quality. If the plants and animals in the biotope are healthy, then the harmless water is ready to be released into streams, over land or to the sea.



Illustrated are various components of the leachate purification process:
Top, left: The aerator draws air into the leachate pond to help aerobic bacteria break down the harmful substances.
Top, right: The effluent of the pond is given the circulation treatment over a trickling filter, shown here as photo and diagrammatic cross-section.
Right: The leachate collected from the inflow, and then again after a month's circulation.
Below: The Tafaigata Landfill in December 2005. Only a small area of rubbish is exposed; the remainder is breaking down under a layer of topsoil. Vents remove carbon dioxide and supply air with the oxygen needed.

What next? **JICA has handed over control of the site to the Samoan government in December 2005. Samoa, JICA and SPREP will use the Tafaigata as a showcase and training facility to encourage other Pacific island countries and territories, and donors to consider installing these in their own countries.**

Is this method suitable for atolls? **Atolls have very little land and the high tides often come up into the landfills. Being waterlogged slows down the aerobic breakdown. SPREP is now looking at how best to manage waste on atolls in the future; the Fukuoka method may be part of the solution. At present, there is no approach that is affordable for atolls yet without environmental impacts.**