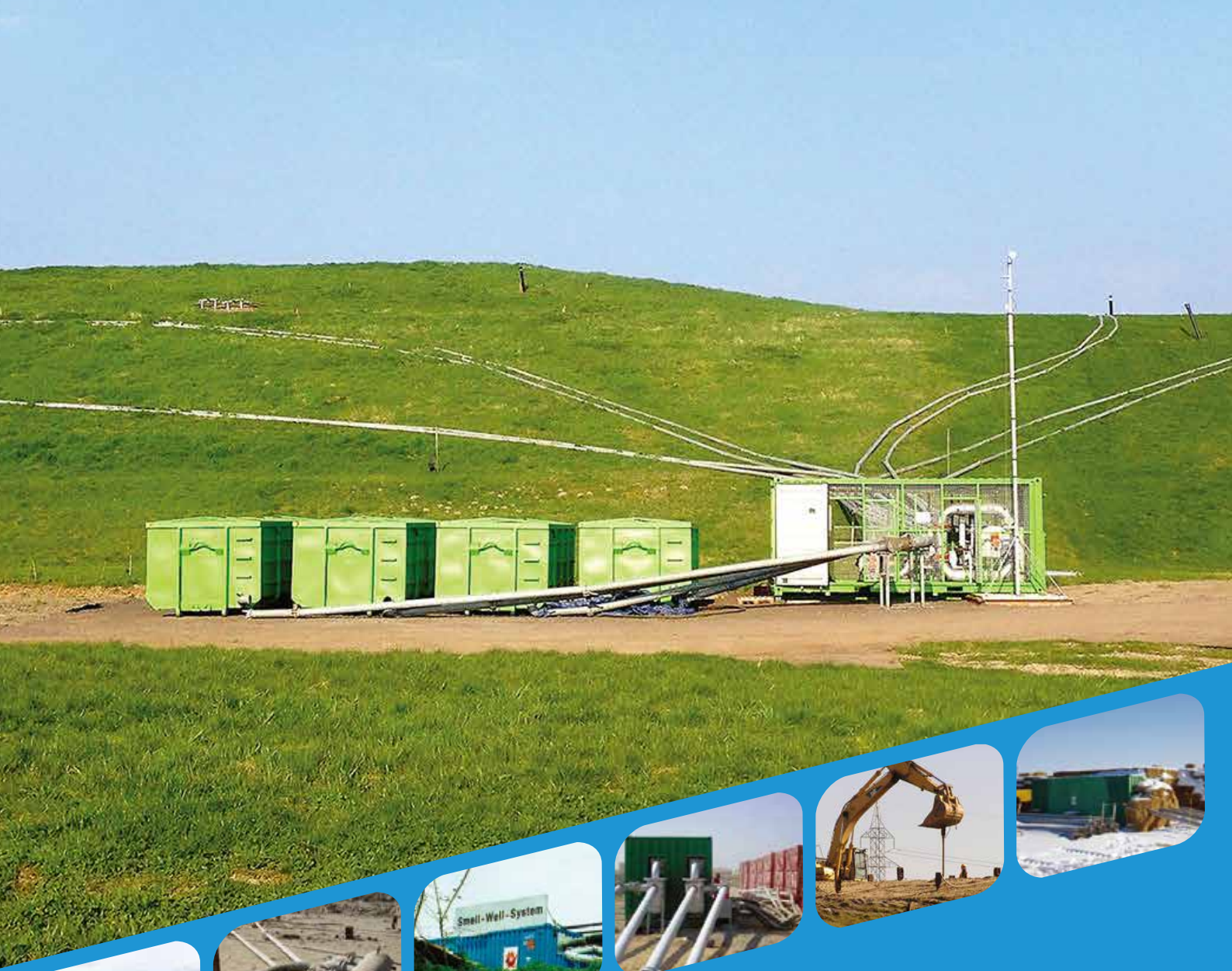


Landfill Management

Using the Smell-Well System

DP CleanTech

Creating value from waste

Landfill Management and Aftercare – The Problems and Opportunities

Landfill Management Problems

Local pollution and odours

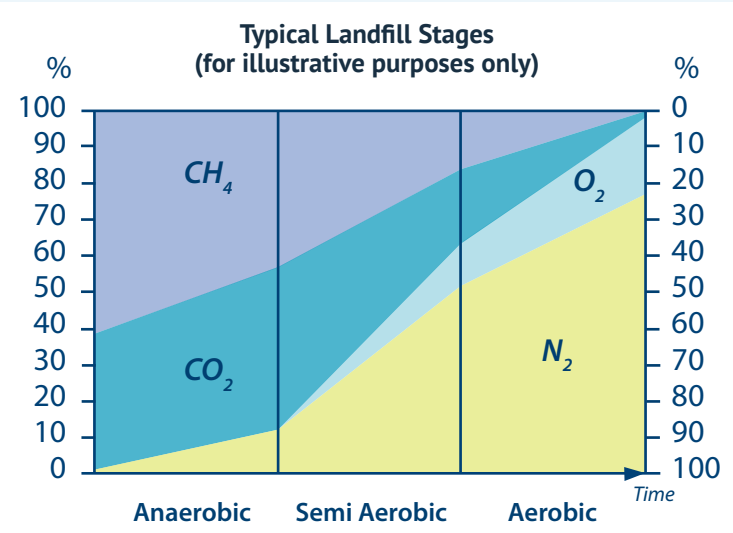
Until relatively recently, landfills were the primary solution for large scale waste disposal in most countries. Older, existing landfills often contain waste materials that have not been sorted or treated beforehand, and have high organic content. This can lead to local environmental problems such as odours, gaseous emissions and groundwater contamination, both during operation and after closure. Landfills that are not yet capped are a particular source of odour nuisance.

Long term costs

Even after closure, landfills remain active for up to 30 - 50 years. Although the landfill is no longer generating income, in many countries the cost of landfills is ongoing until the landfill no longer poses a threat to the environment or public health. Landfill aftercare activities such as gas and leachate collection have to continue; which requires maintenance and monitoring of variables such as emissions, groundwater and leachate measurements. Depending on the nature of the waste, these costs may be incurred for up to 50 years.

Landfill Lifecycle Stages

In simple terms, landfill waste decomposes in various phases through anaerobic, semi-aerobic and aerobic processes, with varying concentrations of methane, carbon dioxide and oxygen according to microbial activity. Decomposition of easily degradable materials and anaerobisation begins almost immediately after deposition and more stable compounds will form as the process transitions from anaerobic to aerobic. Microbial activity is high during the early anaerobic stages, generating odiferous methane and other minor compounds. Gas generation decreases over time but can continue at a low level for decades. As gas pressure decreases, air can begin to enter the landfill and it slowly begins to oxidise. Typically, problem of leachates is more prevalent in these latter phases. The final, aerobic or 'air' phase is when the landfill no longer has emissions and is considered to be safe. **Speeding up landfill stabilization can eliminate gaseous emissions and leachate contaminants.**



Landfill Management Opportunities

In-situ aeration techniques can improve the landfill's environmental and economic performance. The specialised Smell-Well system (developed originally by IUT GmbH) is the most well proven and effective solution for in-situ aeration available in the market. It is uniquely flexible and highly effective for permanent and temporary interventions to achieve the following:

- **Elimination of local pollution and odours**

Stabilization of uncapped or partly capped landfill areas through aerobisation can deliver immediate benefits, eliminating odour nuisance in as little as 3 hours. This can be a temporary or long term solution.

- **Preparation of landfill for landfill mining activities**

Landfill mining must take place under safe working conditions and aeration renders the landfill safe for approximately 6 weeks by creating a 'new' aerobic landfill surface.

- **Significant reduction of long term costs**

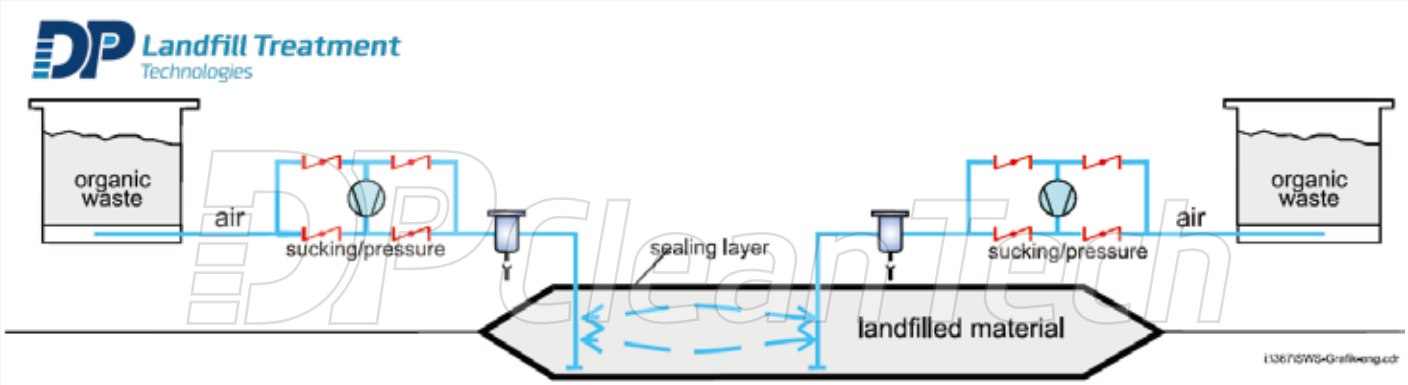
Landfill aftercare costs are usually calculated at the financing stage and are typically based on at least a 30 - but often up to 50 - year period. Shortening this period could significantly reduce the long term financial burden for closed landfills; as well change the economics of those being developed or in operation. **Generally it can be stated that savings of up to 80% can be made on after - care cost** - but of course this is subject to each individual landfill.

The Smell-Well Process: Changing "Anaerobic" to "Aerobic"

The key is to reduce the anaerobic activity within the landfill, and this is achieved by injecting enriched, aerobic air through a grid of steel lances situated 5-10m apart (depending on landfill conditions). Supply air from the surrounding environment is forced through a wet biofilter where it is heated and enriched with aerobic bacteria before being blown into the landfill through the lances. The mixture of foul gas and air is simultaneously captured and cleaned in a parallel biofilter.

Frequent reversing of the air flow through the lances prevents 'channeling' inside the landfill body and facilitates continuous aeration. This reversion also avoids problems of water condensing in the piping system.

Throughout the process, the biofilter must remain wet, and reasonable moisture levels in the landfill must be maintained. The Smell-Well System has been specifically designed to regulate and adjust these parameters. Water is extracted from the landfill and evaporated in the biofilter before being transported back as steam to the landfill. Excess water is collected in a special collection system. This method maintains the constant and appropriate level of moisture in both the landfill and biofilter and eliminates the need for additional water during operation.



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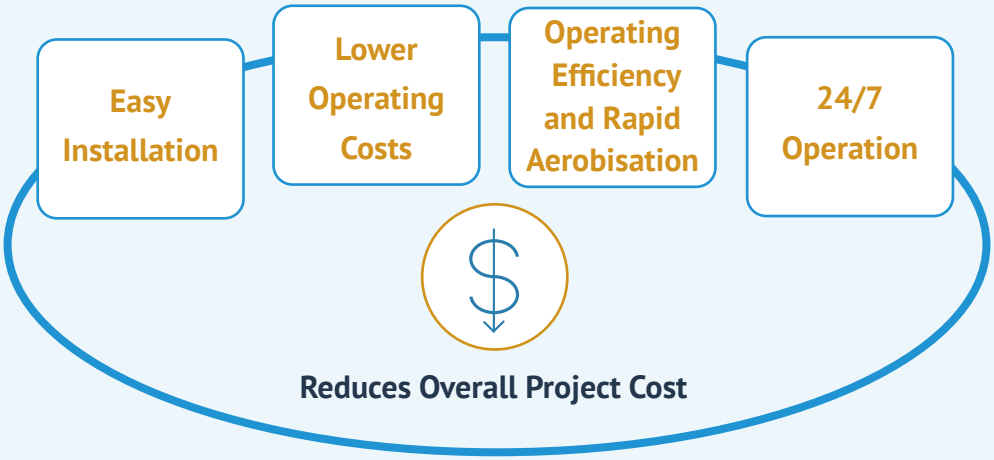
The proven, patented SWS has been operating successfully since 1993 and is established as one of the most efficient and cost-effective systems available. Compared to other systems which utilise the existing gas extraction system/layout, the specific features of the vertical lance system increases the speed of the process.

Key Benefits

Compared to other processes, Smell-Well has several major advantages which makes it more efficient and cost effective.



Easy Installation

The Smell-Well lances are installed easily using a standard vibration ram or a drill. The installation leaves no gaps, eliminating the need for costly filling and sealing of the surface around the lances. The holes in the lances are opened and cleaned using compressed air which is simple, cost effective and protects employees from toxic emissions. The lance system enables all parts of the targeted landfill volume to be reached and aerated; and the system can be moved to a new area within a few days.

Lower Operating Costs

The Smell-Well system uses fresh air for aeration, which is cheaper than oxygen and reduces explosion risk. This is a particularly significant cost benefit for long term in-situ landfill aerobisation, which can take from 6 to 24 months.

Operating Efficiency and Rapid Aerobisation

The design features of the SWS are more efficient and effective than systems that use an existing gas extraction layout. The proximate layout and the length of SWS lances aerate larger volumes of waste at multiple points and depths; whereas horizontally based piping systems can aerate only limited waste volumes around existing pipes. The reversible air flow system further accelerates the process and also enables the biofilter to treat both the exhaust air and enrich the injected air.

The system is so efficient that the conditions are fully aerobic after 3 hours, reducing methane concentrations in exhaust air to less than 1%. Odours and explosive risk are rapidly eliminated, and landfill excavation and other works can commence within several hours.

24/7 Operation

Smell-Well continually aerates and ventilates the landfill by switching the air direction. This prevents "channeling" whilst maintaining a stable moisture level and allowing work to continue uninterrupted 24/7. Channeling can occur when air flows are constantly routed through the same opening, thereby creating pathways through the waste rather than dispersing and penetrating the landfill body. This prevents full aerobisation and perpetuates the explosion risks and odour contamination.

Technical Information

Installation

Depending on the requirement, (temporary or permanent), 'standard' (3.5m) or 'flexible' (1-15m) length lances are inserted into the landfill using a vibration ram or by drilling. Complete installation takes approximately 5 to 15 minutes per lance. Each lance has holes for air distribution and lances are connected to each other and to the biofilter/compressor with steel pipes and quick-use couplings. All the pipes are inclined towards the lances to return excess condensed water back to the landfill. The aeration process can begin immediately after installation. Landfill gases cannot escape and there is no need to seal the lances. Safety standards are monitored using a 4-gaseous instrument.

Operation

Once the aeration process begins, the methane concentration is continuously measured (see Measurement techniques). After a few days, the landfill status is fully changed from anaerobic to aerobic and the level of methane has decreased dramatically. The duration and process is dependent on the objective.

Aeration before landfill mining:

The designated area is aerated for 5-7 days to a depth of 3.5m using standard lances. This further reduces the easily degradable organic pollutants and the water content. After aeration, the top 3 metres are excavated, leaving a 'new' aerobic landfill surface. This facilitates later treatment of the excavated material and prolongs the aerobic condition up to approximately 6 weeks, which is sufficient time for excavation and mining.

Aeration to reduce odour nuisance:

The designated area is aerated as long as necessary – mostly until the landfill is closed for operation and capped. The system can then be converted for permanent in-situ aerobisation of the landfill.

Permanent In-situ aerobisation:

Depending on the quality and the age of the landfill material the total reduction of the organic content can take between 6-24 months. The lances remain inside the landfill body during the entire period, and provide ongoing monitoring of the landfill condition.

Technical Data

1. Pressure and Exhaust Supply	
Installed power: 2 x 30 kW up to 2x 55 kW, depending on the excavation capacity	**Aeration period:** Excavation - between 5 - 7 days Total aerobisation from 6 to 24 months
Aeration capacity: For excavation - from 500 to 2,500 m^3/day For total aerobisation - up to 50,000 m^2	**Number of lances:** Dependent on the area to be treated Lances always work in pairs to blow in and draw off air
Noise level: 75 dB(A) per compressor (other figures on demand)	**Composition:** To meet GUV 17.4 standards
2. Lances for Aeration and Ventilation	
Lance material: Steel	**Distance between lances:** 5 - 6 m (up to 10 m)
Length of lances: 3.5 m standard lance 1 - 15 m flexible lance	
3. Biofilter	
Number of biofilters: 4 to 8 filter containers, depending on the size of the area to be aerated	**Sewage disposal:** Any sewage which accumulates on the bottom of the filter container can be drained as required
Filter materials: Multi-level composition – based on proprietary know-how	
4. Pressure Pipe Network	
Material: Pressure pipes are made of fire-galvanised steel and equipped with a quick fastening coupling. Distributors are made of fire-galvanised steel, PE-EL pipes res. Rubber tank lorry pipes, electrical transmission possible.	**Nominal pressure:** 10 bar **Rupture pressure:** 22 bar
The pressure and absorption net meet all security regulations, and can be moved quickly to different places within the landfill area. It is easily and quickly connected to the pressure pipes without the use of heavy tools.	

Measuring Techniques

Exhaust CH_4, O_2 and CO_2 gases are continuously monitored using portable gas measuring devices to achieve the following general limits.

	CH_4	CO_2	O_2
General limits for safe excavation	< 1 Vol%	< 0.5 Vol%	17.0 Vol%
General limits for total landfill stabilisation completion	< 1 Vol%	< 0.3 Vol%	>19.0 Vol%

Control and Security Instruments

The safety control and alarm system ensures automatic plant shutdown if temperatures exceed 60-70°C or if the internal pressure exceeds certain limits. In the unlikely event of an explosion, the explosion and any fire are contained firstly by flame arrestors (installed in front of the blowers) and secondly by reducing the pressure in the biofilters. The piping system is dimensioned to withstand an explosion pressure of 7.5 bar and a maximal pressure of 22 bar. There have never been any explosions in the long history of Smell-Well system operation.

International Standards

- TÜV (Technischer Überwachungsverein)
- German "GUV 17.4"Safety Regulations for Landfills
- Acknowledged by the German "Berufsgenossenschaft" (Employers Liability Insurance Association)
- Worldwide patents

Case Study Highlights

Several projects highlight the effectiveness of the Smell-Well System for use in different types and scales of landfill.

- **Braambergen, Netherlands, 2001 - 2003**

Dutch company Afvalzorg Holdings used the SWS system to aerate a 460,000m³ landfill in Braambergen. An alternative system had performed poorly on a previous project, but the SWS system met all expectations.

- **Maleo, Italy, 2004 - 2008**

This 400,000 m³ landfill was successfully totally aerobised in 2 stages. Each stage took 26 months, using one SWS system which was moved between the 2 areas.

- **Sharjah, UAE, 2006 - 2010**

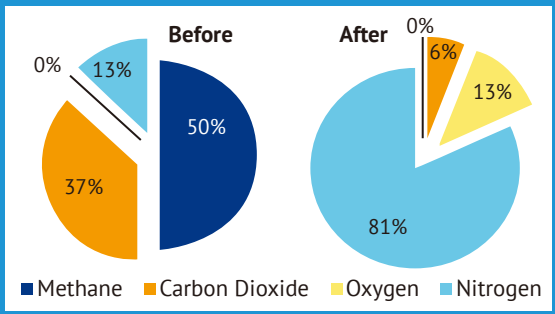
In 2006, this 6.4mill m³ landfill was the largest in the world. Full and permanent remediation took 4 years, with 9,000m³/day remediation capacity. The elimination of CH_4, reduction in CO_2, and increase in O_2 and N_2 was evident after only 5 days.

- **Braambergen and Wieringermeer, 2017**

The "Accelerated Aerobisation" is a joint project by Afvalzorg Holdings, the Dutch Govt, and the University of Gent to determine how landfill stabilisation can be expedited using accelerated aerobisation. The SWS was chosen for its previous performance.

- **Remo, Belgium, 2019**

The landfill in Remo, Belgium caused local odour problems, and the owner Machiels Group turned to SWS for an urgent solution. SWS was installed on the uncapped section, solving the problem within days. The system will remain until permanent capping takes place.



From "Report of the Sharjah Landfill Remediation Project", K.Koch, University of Dresden,2005

Braambergen Demonstration Project

Aeration lances at the Remo landfill, Belgium

Contact Us

DP has 7 offices around the world in 6 countries – China, Denmark, Poland, Thailand, UAE and UK.

To ensure that we can address your needs appropriately, please email **info@dpcleantech.com** for enquiries or further information.

About DP CleanTech

- Founded in 2004, DP CleanTech Group designs, engineers, manufactures and commissions a broad portfolio of biomass, waste to energy and waste management solution.
- DP's core technologies originate in Europe and are behind over 300 biomass and waste projects around the world.
- DP has facilities and references across Europe, Asia and the Middle East, with projects underway in Africa and South America.
- DP's portfolio of innovative waste-to-energy and environmental management solutions spans a broad range of technologies to ensure the right solution for each project.

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