



NIGEL ADAMS

Landfill and Machine Control



Until recently landfill has never been an activity that has been associated with machine control, machine control has traditionally been linked to the more prestigious activities such as large scale civil engineering and construction projects where the return on investment (ROI) is very measurable in the terms of materials (removed and applied), labour and time. However, as the technology of machine control has adapted and diversified then so have the applications. One such operating area that has seen measurable benefits of utilising machine control is that of waste management and more specifically landfill sites. So what is it that makes machine control beneficial to landfill? This is the first of a short

series of articles which will cover this subject by answering what is landfill, why does it need technical assistance, how is the technology deployed and what are the benefits?

What is Landfill

In its simplest term, landfill is the dumping of waste into an open hole in the ground where it is then covered and buried (out of sight out of mind). In fact, historically it was never anything more complicated than this and was a favoured option of disposing of waste — space was readily available at old quarry sites and it therefore a very cheap option of waste disposal. On early landfill sites the monitoring of disposed material type, site management, health and safety

etc was approached with a very relaxed attitude and cannot be compared to the measures taken with a modern landfill site, it was originally an anything goes method of waste disposal, but that has now all dramatically changed. As time passed and the holes were filled a better understanding of landfill design and management became standard practice giving better management of some of the problems associated with landfill.

Waste Material

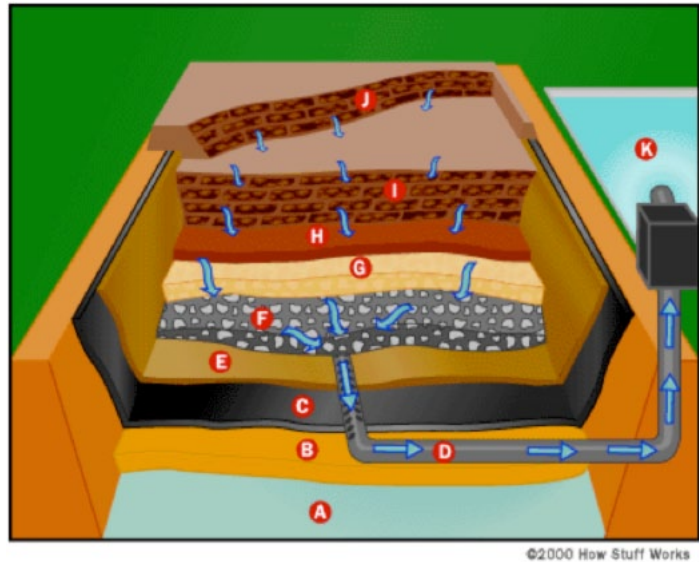
Waste material is now better sorted than ever before, most certainly in the UK and Europe where there is such a hard drive towards “zero landfill”. This has required a huge effort on the population of these countries to comply with

Landfill Design

The landfill is no longer just the hole in the ground and is carefully designed to stop the surrounding environment being damaged.

The landfill area is divided into areas known as cells. These are where the waste is disposed of and are carefully managed until they are complete upon which a new cell will be opened. This gives much better monitoring and control of the landfill rather than just tipping everything into one large hole.

The main features to be aware of as demonstrated in the above diagram are:



A Ground Water

B Compacted Clay

C Plastic Liner

D Leachate Collection Pipe

E Geotextile Map

F Gravel

G Drainage Layer

H Soil Layer

I Old Cells

J New Cells

K Leachate Pond

recycling efforts, sorting waste at source (household, factory) prior to collection. Much of this waste is sent to a material recycling facility (MRF) where the dry waste is sorted and separated using technical and manual (by hand) methods to sort plastics, card, glass, metals etc. Even with this effort the material sent to landfill (in the UK) is about 60-70% of the waste is biodegradable matter from households and businesses such as paper, card, textiles, food and garden waste. The remaining amount is 'inert' waste from construction and industry, as well as non degradable household waste like glass, metal, plastic and ash. The implementation of the European Landfill Directive has done much to control the way in which materials are selected for landfill. The Landfill directive has seen the following steps implemented:

- ensuring that hazardous waste is only disposed of in certain sites and banning the disposal of hazardous liquid wastes

- ensuring that wastes are only disposed of in accordance with waste acceptance criteria
- banning the disposal of used tyres (2005 & 2006)

There are many other facets to the "zero landfill" target methodology employed by different EU countries, but that is a whole new topic for discussion.

Leachate

The decomposition of biodegradable materials and water from rainfall can mix with chemicals and heavy metals in the site to make a liquid substance called leachate. If a landfill is not designed and managed properly the leachate will leak — water supplies, rivers, agriculture etc can all be seriously affected by this.

Gas generation

The decomposition of biodegradable materials generates methane gas and carbon dioxide. These gases are monitored, managed and in some cases used to generate energy.

Dust, Odour

Managed by the implementation of odour and dust control systems.

The Liner System

Liners are designed to prevent waste and dirty water escaping from rubbish into soil and water outside the site.

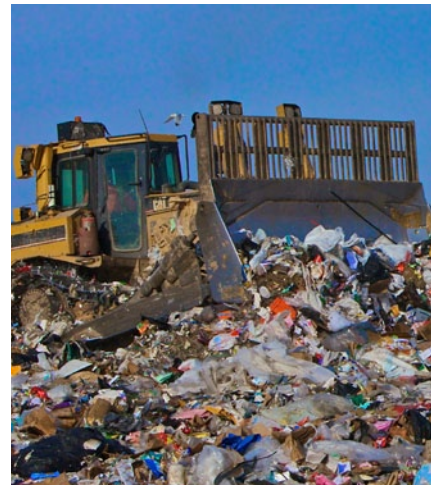
Leachate collection system

Leachate is collected by a system of drains within the waste and pumped to the surface. Often the leachate is then treated before being sent to the sewer system. Modern landfill sites also include systems for detecting leaks of leachate through the liner. The leaks are then dealt with before the liquid escapes.

Gas collection system

Gas levels are measured around landfill sites before tipping of rubbish begins so that normal levels of gas in the area are known. When tipping of rubbish into landfill sites begins, gas levels at the edge of the site are monitored so that any changes are detected quickly.

The compactor is the most widely used landfill site machine. The large front blade, heavy base and wide footprint makes it ideally suited for moving waste material and increasing site fill density.



Normally landfill sites use gas collection pipes to collect and then make use of the gas e.g. energy generation.

Cells

The landfill area is divided into plots known as cells. A cell is where the waste is disposed of and is carefully managed until full / complete upon which a new cell will be opened. This gives much better monitoring and control of the landfill rather than just tipping everything into one large hole.

The landfill cap


A cap is placed on top of the rubbish across areas of the site as they become full. The cap is normally made of a thick layer of clay compacted to prevent rain from entering into the site. The cap is also there to stop the odours and gases made by the rubbish from escaping out of the top of the site. After the period of decommissioning (can be few years) the site will be landscaped as part of the restoration program.

So that's landfill 101 concluded, where does machine control fit in all of this ?

Let's have a look at what is required to construct and maintain a landfill site:

- A landfill site will be designed and modelled using 3D techniques
- The landfill growth will be to specific design requirements
- Landfill is a design to plan
- Slope design to manage leachate run off, waste run off
- Compaction layers
- Optimum densities of compacted waste
- Gas well placement
- A need to monitor waste types and locations within the site
- Covered / uncovered areas (landfill is regularly covered — usually with soil) to reduce problems associated with contamination / odours / scavengers. When the area is required again, the cover is removed.
- Site requires regular surveying — landfill construction is as complex and layered as a road construction with the added complication of a constantly changing topography.

All of these items are clearly addressable with machine control, but it's not just about the employment of technology for technologies sake, it's about the payback in using it that really matters. So as well as addressing the design, build and maintenance issues, machine control usage can be directly related to cost savings seen by a more efficient use of landfill airspace, fuel savings due to optimising machine operations, savings due to more efficient use of labour etc. These issues will be covered in more detail in a later article.

The next article will cover the machine control system requirements to achieve best practice landfill management and how this can be deployed. 

Nigel Adams is based in the UK, and was formerly the Engineering Director for Prolec. He now owns OnGrade Ltd and focuses his 21 years experience on machine guidance.