

Waste Landfills

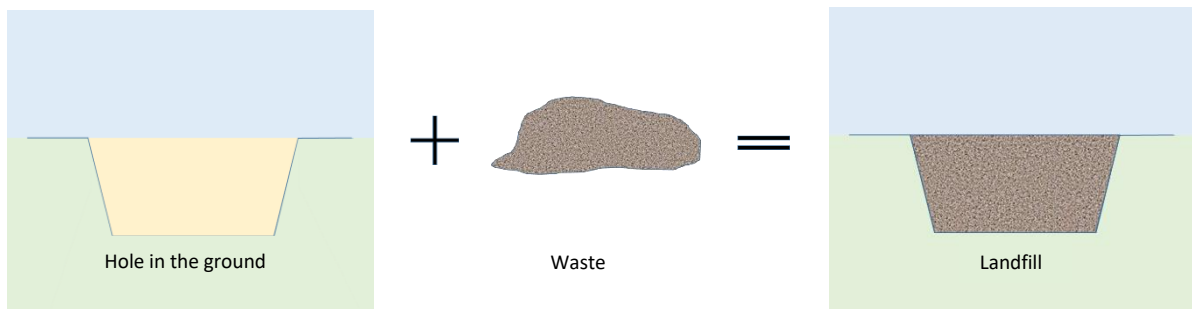
Summary:

What is a waste landfill? - and why do we need to simulate them using models like the LDAT landfill waste and transport model? This is probably a good place to start reading about landfills if you are not sure about the answer to this question. Put simply a waste landfill is a hole in the ground that gets filled with the waste we produce after we can think of nothing else to do with it. But the object that we call a waste landfill becomes a bit more complex, when you realise that, for the reasons outlined in this article, this object can become a very dangerous emitter of liquids that can range in toxicity from just 'dirty water', to infectious, radio-active, and deadly. It is certainly a threat to human health and the natural environment, and generally 'unwanted'. To make matters worse it can emit greenhouse gases and contribute to climate change. By simulating these problems using models like the LDAT landfill waste and transport model we can find out how to design and operate waste landfills safely.

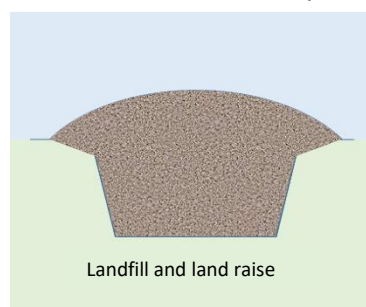
What is a waste landfill?

A waste landfill is the repository, the final resting place, of the waste material that we produce, after we can think of nothing else to do with it.

A waste landfill is what it says on the tin. A hole in the ground that gets filled with waste.



The owner of the hole in the ground gets paid by the owner of the waste to dump the waste in his hole and leave it there. The owner can find more room for waste by overfilling the hole. That bit of the landfill is sometimes called a 'land raise', or an 'on land disposal site'.



So this seems like a great business model. Buy some land that you can mine for a resource, rock, gravel, sand, brick-clay - all valuable materials. Then get paid again to back-fill the hole that's left with waste. What can possibly go wrong with that?

Provided the waste stays as it is, not a lot can go wrong. But waste is made up of a lot of different components, and some of these can be chemically reactive when they come into contact with water. The waste can be wet on arrival at the landfill, it can also have water added to it by rainfall

infiltration into the landfill. So the chemically reactive components of the waste will dissolve and decompose, a process that will happen even faster if there are any bacteria present in the waste, – and there always are!

So the waste ends up in a liquid soup of chemicals called leachate. This soup is still nearly 100% water so it is very mobile. But the chemical content, or the solutes in the leachate, means that it is very impure. If it leaks out of the landfill and finds its way into the ground water system, it can do a lot of damage. The leachate can range in toxicity from just 'dirty water', to infectious, radio-active, and deadly. It is certainly a threat to human health and the natural environment, and generally 'unwanted'.

But it does not end there. Some of the solutes in the leachate can degrade further and emerge from the leachate as a multi-component gas – landfill gas. The dominant components of landfill gas are the climate changing greenhouse gases carbon dioxide (CO₂) and methane (CH₄), so these emissions need to be reduced as much as possible. Furthermore small concentrations of methane in air can explode.

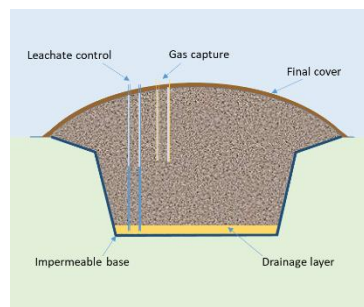
So it will come as no surprise that owning and operating a landfill is a heavily regulated activity in many parts of the world. These days, landfill owners are regulated to operate their landfill safely, which includes making a number of engineered provisions to maintain control over leachate and gas emissions. These provisions can include the following:

Construction of an impermeable base to retain leachate.

Provision of a drainage layer from which leachate can be pumped out of the landfill to be treated prior to release into the natural environment.

Completion of the landfill after it has been filled with a cover layer.

Inclusion of a permanent gas collection system to capture landfill gas.



Following closure of a UK landfill to waste, owners are obliged to remain responsible for maintaining the landfill for an 'aftercare' period which lasts until such time as it no longer poses a risk to human health and the environment – and this can be as long as 60 years, maybe more. There are many uncertainties about how best to manage closed landfills in the aftercare period. For this reason the approach taken by the UK and other European waste regulating bodies is to avoid the problem in the future by reducing the amount of waste received by landfills. At the moment there are 360 landfills currently receiving waste in England and only a few of these are expected to be operational by 2025. There are 1480 legacy landfills in England that are closed and in a state of aftercare.

Landfills in the UK vary greatly in size and shape. Surface areas are typically in the range of 10 to 200 Hectares. (1 Hectare = 10,000 m².) Depths range between 10m and 25m. Maximum waste acceptance rates are between 200,000 and 1,000,000 tonnes per year.

There are reported to be 1250 operational landfills in the USA and 670 in China.