Manager's guide to landfill operations

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From Waste to Value®


Guide contents

Landfilling remains an important part of the waste management process, even though the amount of waste being landfilled is decreasing in many countries. Optimizing the incoming waste streams and their handling at the site leads to an efficient process and increased profits.

Operating a landfill is and has always been a combination of right technologies and smart processes. From the beginning of landfill planning the managers should think about optimizing spreading and compacting the waste since this is a prerequisite in determining the life cycle of the site. Local regulations and the equipment in use always factor into the process, but smart planning and operation of the site bring increased life cycle. In this guide, we will show how a landfill can be set-up to efficiently handle the waste streams and operated to a improve the use of the available area.

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Landfilling – the final disposal of waste

With the increase of waste shredding, recycling and burning for energy, the amount of waste ending up at landfills is decreasing in many countries. This does not mean that the basic need for landfills or the best practices in managing a landfill have changed.

Landfills are and have been the final resting place for many types of waste and the need for spreading and compacting the waste remains the same.

A sanitary landfill is traditionally defined as an engineered method of disposing of solid wastes on land in a manner that protects the environment by spreading the waste in thin layers, compacting it to the smallest practical volume and covering it per local regulations. The rate at which landfill capacity is used up can be reduced through resource recovery and compaction.

Increasing the capacity and life expectancy of a landfill is directly linked to increased profits. The more waste that can be landfilled at a specific site in the densest possible layers, the longer it can remain operational and generate income for the owner.

Optimizing the landfill process at all stages:

- **Pre-shredding waste that takes up unnecessary airspace**
- **Organizing the landfill to allow easy unloading**
- **Minimum amount of moving waste around after unloading**
- **Compacting the waste as densely as possible**
- **Minimum amount of cover soil used**

Pre-shredding waste

Pre-shredding waste that takes a lot of airspace can improve the efficiency of a landfill by a very large margin, when there is no other feasible way to treat the waste flow in question. Waste such as mattresses or used tires take up precious airspace and as such, reduce the profitability of a landfill. Shredding them can reduce the airspace needed by up to 75%, while also recovering valuable material such as steel from the shredded waste.

The value of airspace at a landfill is so high that the reductions gained by pre-shredding landfilled large materials very often justifies the purchase and operating cost of a waste shredder.

The separation of valuable materials to be recycled or re-used also helps pay back the investment of a waste shredder. Instead of burying the valuable materials, several landfill operators around the world are leveraging pre-shredding and material separation as part of their landfill management process.

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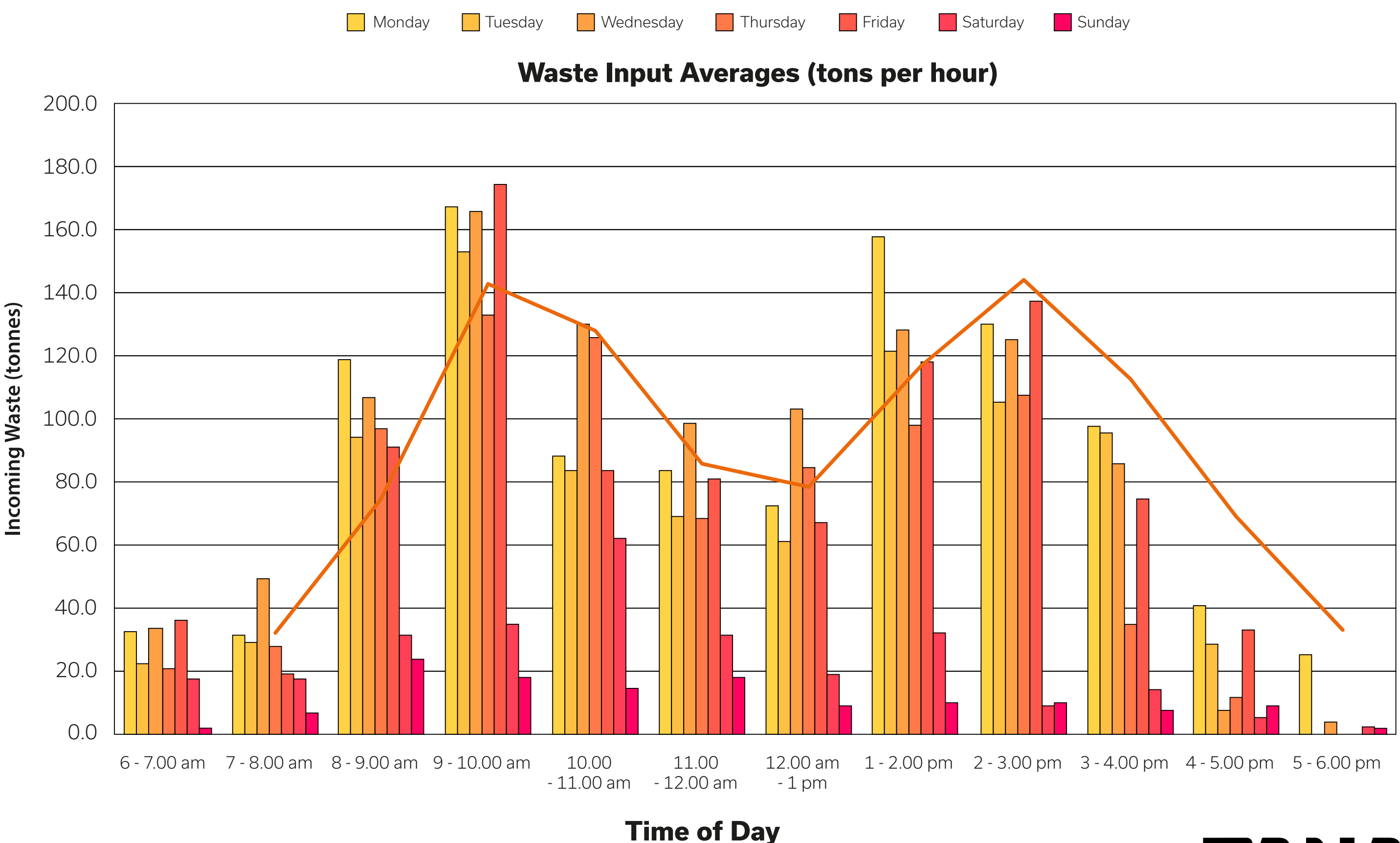
Incoming **waste**

The amount of incoming waste is not a constant stream that stays the same. Therefore, it's important for the landfill manager to plan for efficient delivery and unloading at the site. Different methods of landfilling presented in the next section require different processes.

In all methods, the need for unloading to happen as close as possible to the final landfilling area for the waste remains the same. The closer the waste trucks can drive to the area the waste will be spread, the more efficient it is. An evenly compacted area allows the trucks to do this. Thus, less work by a track type tractor (bulldozer) is needed to move the waste. Ideally the compactor can spread the waste directly from the unloading spot to the area it will be landfilled.

As said, the amount of incoming waste is not a constant stream. In the following graph are real world waste streams from a customers' site.



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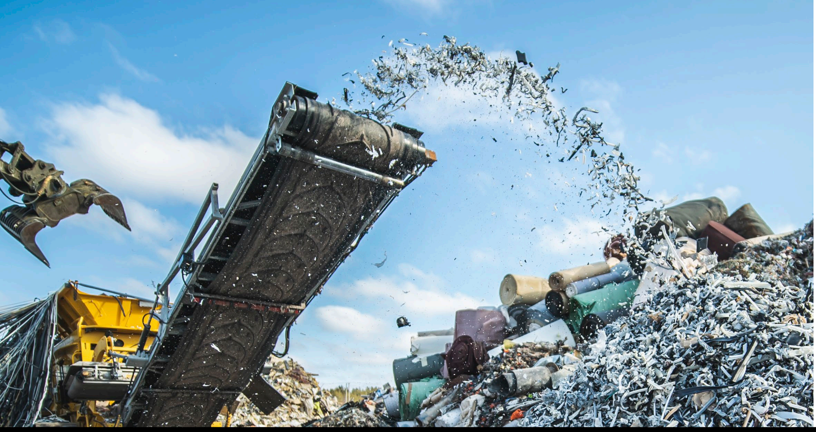
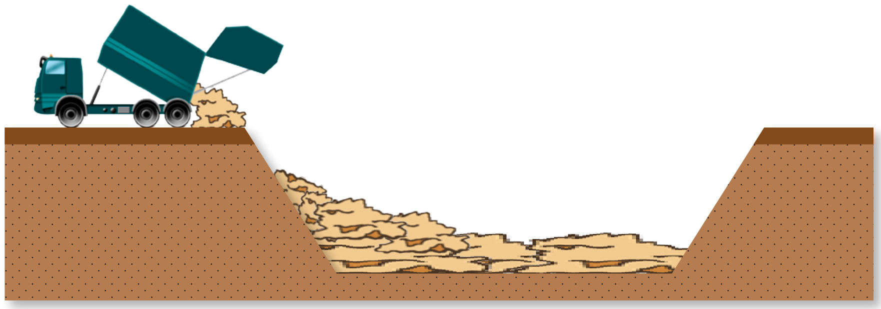


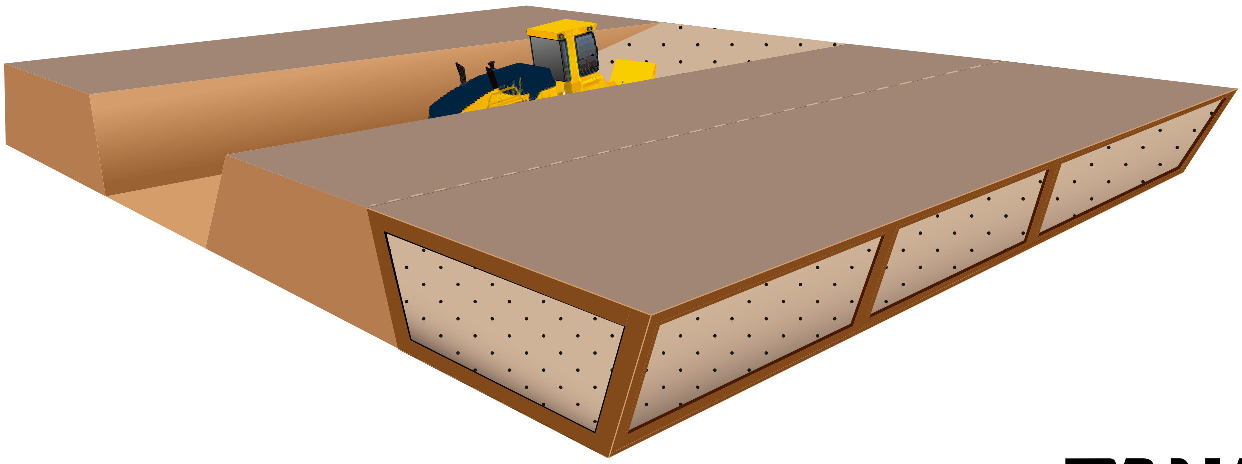

Landfilling methods

Trench Method:

The Trench Method is generally used on flat or gently sloping land. A large hole in the ground is excavated and the soil that is removed is stock piled for use as cover material. Layers (cells) of waste are compacted and covered until the hole is filled. Filling existing holes in the ground saves the cost of excavation. Very often the Trench Method requires more machinery (excavators, trucks, wheel tractor-scrapers) to move soil which increases the operation costs.

This method normally suits only very small landfills because it reduces truck unloading congestion. Drainage can also be a problem, but it can be solved by opening the other end of the trench and sloping the trench floor towards that end. Surface water must also be allowed to run off at the end of the trench.





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Landfilling methods

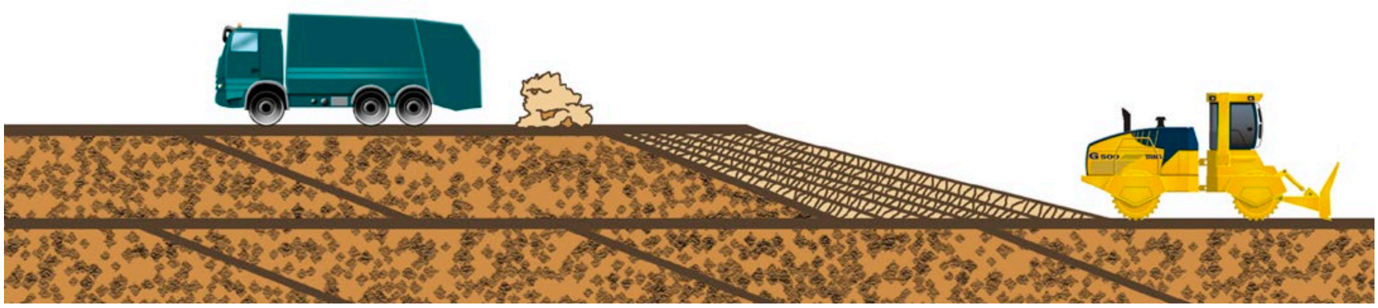
High Rise or Area Method:

The Area Method is currently the most popular method of landfilling. In the method, layers of waste are compacted on top of the ground and covered with soil at the end of the day or per the local regulations. The covered, compacted waste is called a cell.

Cover material, usually soil, is hauled in from adjacent locations. Additional cells are placed above the first in a pyramid type fashion.

Refuse is spread and compacted in thin layers on optimum slope. Working area on the face of the slope is easy to keep small which reduces the need of cover soil and saves valuable landfill space and soil hauling costs. Compactor can spread cover soil or suitable cover dirt which is stock piled near the filling area. If the correct type high density compactor is used the refuse trucks can move right on the edge and unload the refuse just in front of the filling area.

Well compacted surface carries heavy refuse trucks. Trucks can drive on well compacted waste. There is no need for expensive road materials. When trucks unload on the right side of the slope's working area, compactor works on left side - and vice versa. This minimizes the compactor pushing distance and optimizes the compactor use. The operation of an Area Method will vary due to the many different areas where it applies: on flat ground, in clay pits, etc. The method itself is highly adaptable.



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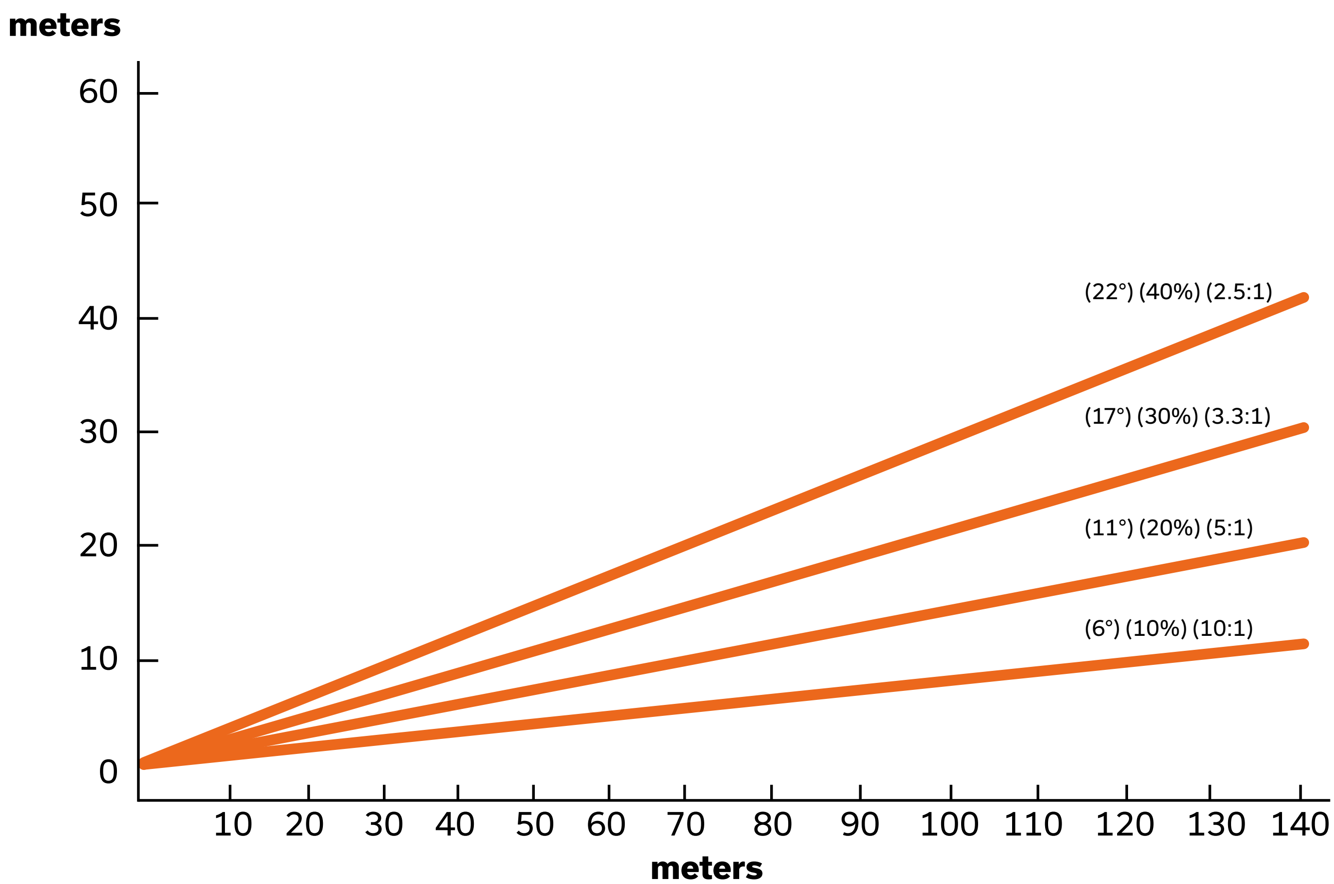
Effect of landfill slope

Maximum density by a track-type unit is achieved by working the waste on a slope of 3:1. Track-type units achieve higher densities on slopes by grinding and shredding the refuse into smaller pieces as they climb the slope.

Just the opposite is true for the landfill compactor. The flatter the slope, the better the compaction. This is because the weight of the landfill compactor is more efficiently utilized and concentrated when working on flatter slopes. Fuel economy and compactor load are ideal when operating on flatter slope. An optimum slope for a landfill compactor is 5:1. However, landfill compactor operators often make the slope steeper at the end of the day to reduce the area to be covered.



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Compaction

Compacting waste properly increases the amount of material that can be stored in each area and is a basic function of an operational landfill. Compaction rates vary based on several factors, including the type of waste being compacted and the equipment used.

Increasing compaction rate increases the life expectancy of the landfill and directly, the lifetime profits of the landfill.

Increased waste density will benefit landfill operations in many ways:

- Extended landfill life
- Decreased landfill settlement
- Decreased voids
- Decreased waste erosion during heavy rain (floating and/or washing out)
- Reduced soil volume needed for daily cover
- Reduced migration of leachate and methane
- Improves travel surface and safety
- Increased revenue over the life of the landfill
- Lower disposal cost of a ton of refuse
- Lower closure cost per ton of refuse

Factors governing compaction

If machine weight is equal, regardless of the type of the machine, the following factors affect compaction:

- Layer thickness of refuse
- Amount of compaction force exerted on the refuse
- Amount of crushing force exerted on solid items and humps
- Control of the compaction force
- Number of landfill compactor passes made over refuse
- Slope
- Moisture content of refuse
- Composition of refuse

Example of compactability of waste components

Material	**Loose** (kg/m³)	**Compacted** (kg/m³)
Corrugated cardboard	60	300
Wood waste	145	410
White goods	120	590
Residential waste	120	750
Yard waste	120	615

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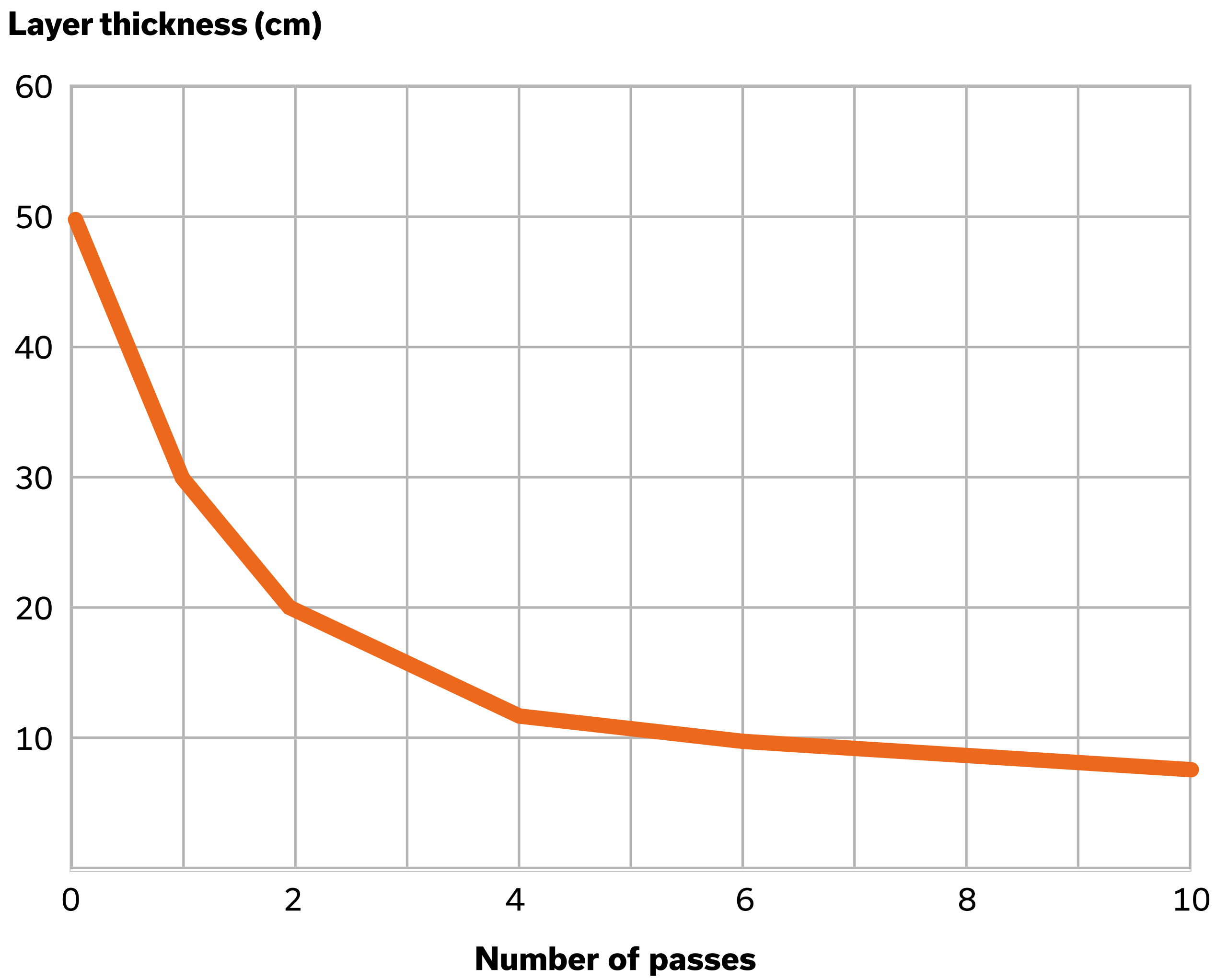
Number of passes

The number of machine passes made over the refuse will also affect density. Regardless of what type of machine is used, the unit should make an average of 3-5 passes to achieve optimum density.

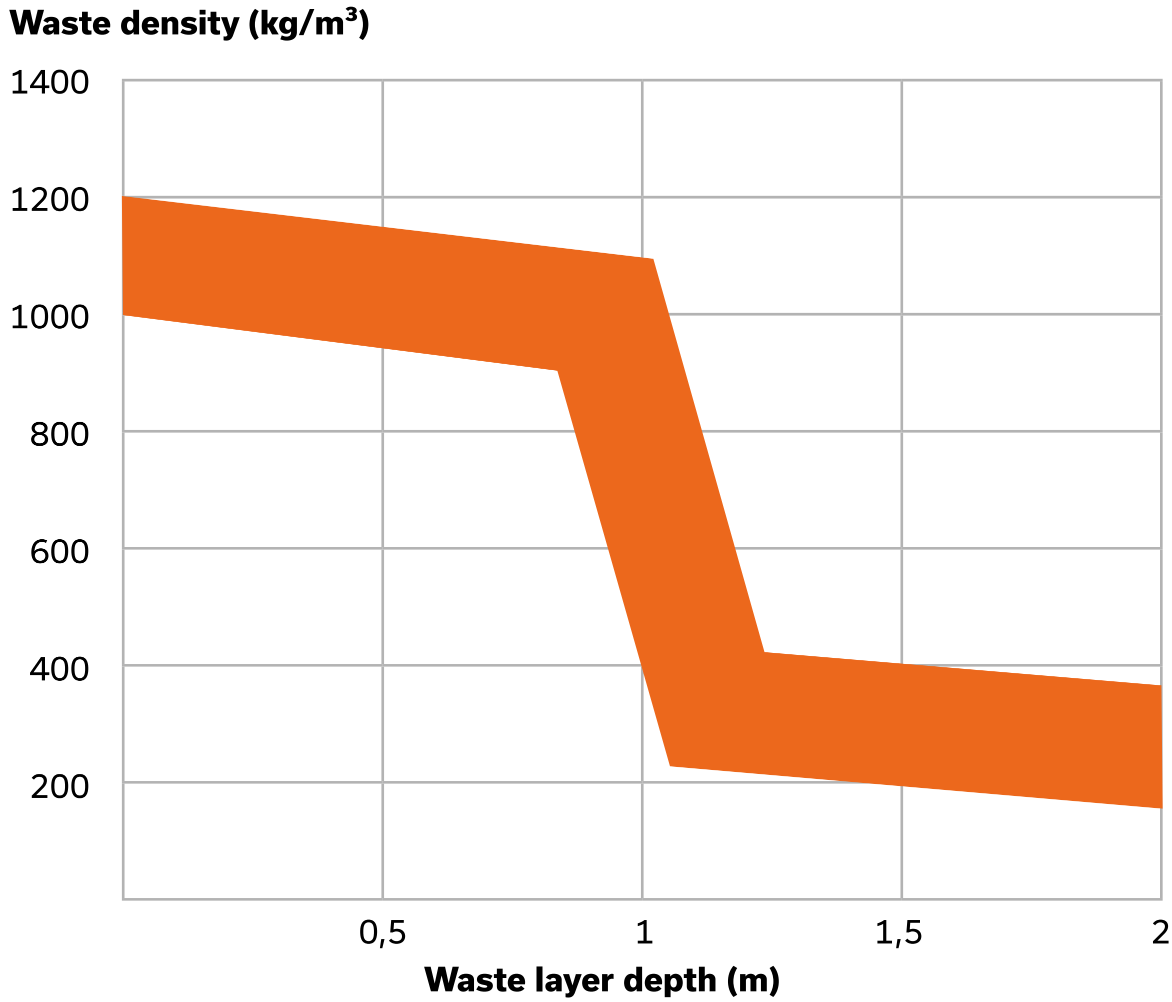
The graph below shows that additional compactor passes will result in increased density. After 5 passes density does not increase considerably.



Refuse layer thickness

The thickness of each compacted layer is a very important factor influencing density. To obtain maximum density, waste should be spread in layers of not exceeding a thickness of 0,8 m. With thickness of 0,8 m of uncompacted refuse, crushing feet 0,2 m high can provide effective compaction throughout the layer.

Thicker layers will reduce the density that the compactor can produce in a given number of passes. If the uncompacted layer is too thick, the crushing feet are not able to crush and compact all refuse -this will result to lower density.



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Cover material

Covering each day's compacted waste helps to seal in odours, controls blowing paper, and prevents rain from entering the landfill, thus reducing leachate generation. In most countries covering the landfill waste is a requirement by law.

Cover material must perform several functions:

1. **It must be able to be compacted so that the space needed for the cover material is minimized**
2. **It must not be dusty**
3. **It must be free of organic materials and large objects**

Requirements of the cover material also depend on whether there is a need to operate with refuse collecting vehicles on it. In that case, it is essential that water is able to penetrate through the cover material and it does not become slippery.

Cover material is usually soil. Reusable tarp and foam is sometimes used as a daily cover to save space. Intermediate and final cover soil thickness is usually up to 2″ thicker.

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Conclusion

Managing a successful landfill requires planning and willingness to adapt to changing regulations and assessing the current process at any given time.

After the landfill is initially started in one method, it's rarely possible to change that, but other aspects of the process can be optimized for the entire lifetime of the site to improve efficiency and optimize profits.

Key factors to consider at a landfill:

1. **Should some of the incoming waste be pre-shredded before landfilling?**
2. **Do I know at what times different waste material comes to the landfill?**
3. **Is the incoming waste being unloaded and distributed efficiently?**
4. **Can the compactor work in the most efficient way possible?**
5. **Is the compactor compacting the waste enough?**
6. **What is the life expectancy of the landfill?**

Learn more about TANA landfill operations at
www.tana.fi/landfill-operations

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