DESCRIPTION OF IN-VESSEL (TUNNEL) COMPOSTING

OVERVIEW

- In-vessel composting (IVC) creates ideal conditions for the aerobic bacteria already present in organic waste to thrive by providing them with the basic ingredients of life - food in the form of carefully selected/blended organic materials, water and oxygen (air). The only difference with IVC is that it is done inside a building in a sealed tunnel and not outside.
- Mimicking what they do in nature, the aerobic bacteria do the work of breaking down organics into the basic building blocks of a nutrient-rich compost, including carbon, nitrogen and phosphorus.
- These bacteria generate heat in the tunnels which can reach up to 85 degrees Celsius – this acts to pasteurise or sterilise the compost, killing off harmful bacteria such as salmonella and E. coli.
- It's the same process that occurs in a well-managed 'hot' compost bin at home.

STEP-BY-STEP PROCESS

The following is a step-by-step description of the in-vessel composting process. Where possible we have added photographs or diagrams to assist with clarity. These images have been sourced from the suppliers of our IVC equipment or our own photos from visiting other IVC facilities. They are not photos from the actual site which is yet to be built.

1. First Stage Decontamination

Unfortunately, organic waste from some sources such as household FOGO can be contaminated with items like plastic bags, metal cans and other non-organic waste which must be removed manually.

2. Shredding

The material is passed through a shredder which breaks down the particle size - this maximises the surface area that will be exposed to aerobic breakdown. We currently decontaminate and shred our FOGO at our Barwick's Bridgewater site.

The FOGO is then transported and dropped off inside the facility at our Boyer site. To prevent odours from escaping during unloading, the facility has an active air pressure system and quick-close doors.

Figure 1: Photo supplied by CEA Equipment, suppliers of IVC technology

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3. Bulking

Additional bulk is added if needed to act as both a source of carbon and prevent the material becoming too compacted which can limit moisture and air flow during the composting process. Our plan is to use our own Barwick's pine bark.

Figure 2: Photo of Barwick's pine bark at our Bridgewater site

4. Mixing

The material is passed through a mixer which ensures it is well blended. Controlled amounts of liquid waste are also added at this mixing stage.

Figure 3: Barwick's IVC proposed facility 3-D fly-through available at www.barwicksfogo.com.au/

On our website is a digital 'fly-through' video which takes you through the proposed building showing the unloading area, shredding, bulking and tunnels in situ.

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5. Moisture Check

To ensure there is the correct amount of moisture to foster aerobic bacterial growth but not too much to create excess runoff, moisture levels are checked. If the material is too dry, additional water is added.

6. Tunnel Loading

The blended material is now loaded into the tunnel using a front-end loader. The concrete tunnels are 40m long and 7m wide and can hold approximately 500t of organic material when fully loaded. Tunnels are fully enclosed and sealed with a specially designed door mechanism to maintain negative air pressure during composting.

Figure 4: Photo supplied by CEA Equipment, suppliers of our IVC technology

7. Composting

Air is injected via an array of small air vents located throughout the floor of the tunnel. The air percolates through the material to enhance bacterial growth and organic breakdown. The temperature and moisture of the composting material is monitored, and more moisture is added as required.

The temperature at this stage frequently reaches 80 degrees. To meet Australian Standards the composting material must reach 55 degrees consistently over a three-day period as this guarantees the destruction of noxious weeds, pathogens and bacteria. In-vessel composting systems have sensors that record temperatures 24 hours a day. This ensures that we exceed the minimum standard over the required time period and guarantees that the pasteurisation process is taking place.

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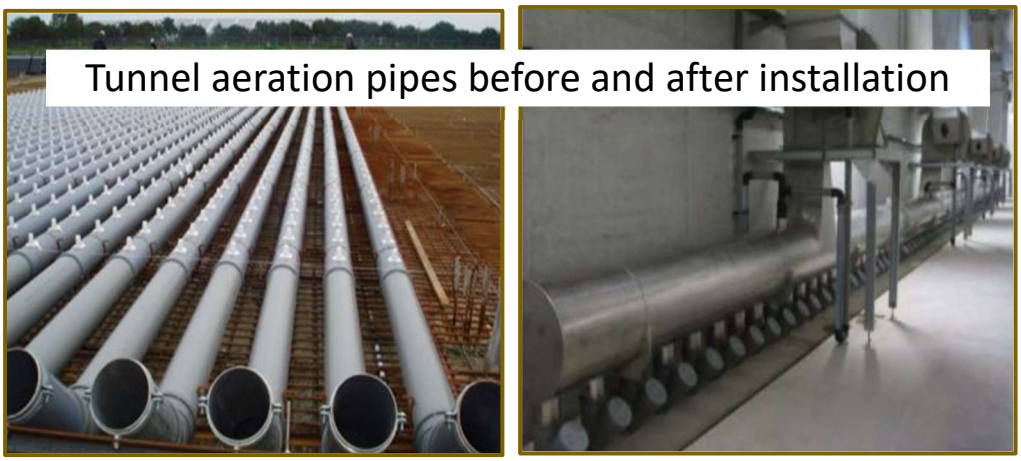

Figure 5:Photo supplied by CEA Equipment, suppliers of our IVC technology

8. Turning

About halfway through the composting cycle (7 to 12 days) the entire contents of a tunnel are relocated or 'turned over' to another tunnel, which acts to de-compact/aerate the composting material and reinvigorate bacterial activity, triggering a second pasteurisation event. Our facility is planning to have four tunnels, one of which will always be kept spare and available for turning.

Figure 6: Photo taken by Barwick's staff at Dandenong's IVC facility in Victoria

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9. Exhaust/Run-off Capture

In-vessel composting includes a two-stage odour control process. 100% of the exhausted air, condensation and runoff from the composting material are captured within the system and treated as follows:

i. **LIQUID:** Any condensation or leachate run-off is captured in a series of drains and re-applied to the material within the tunnel. The high heat produced during IVC composting dries out the material, so additional rainwater is also added.

ii. **AIR:** Exhaust air is vented through a scrubbing unit and when ammonia levels exceed 150ppm sulphuric acid is automatically added to produce liquid ammonium sulphate condensate which can then be 100% utilised as a liquid organic fertilizer - the same as Sulphate of Ammonia available at any garden center.

The air is then passed through a biofilter, which is a deep (approximately 1.5 m – 2m) bed of wood fibre material (essentially wood chips), which absorbs any remaining odourous gases prior to being released to the environment. Once this wood fibre reaches a saturation point - approximately every 3-4 years if the facility is operating at high capacity - it is blended into the next batch of compostable material. Vents from the scrubbing unit are switched off while the biofilter is replaced.

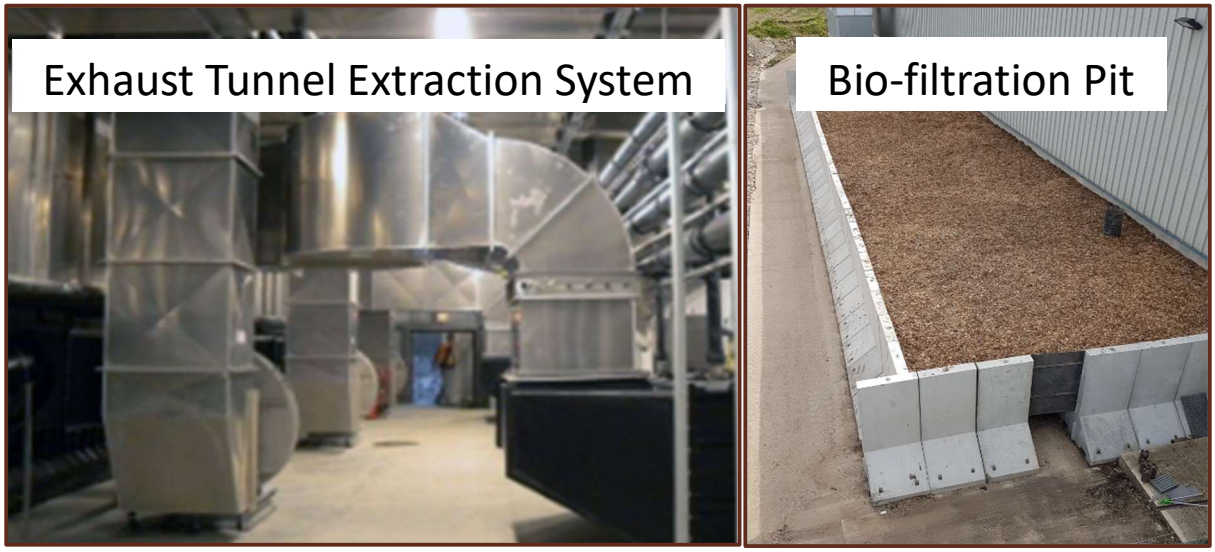

Figure 6: Photo supplied by CEA Equipment, suppliers of our IVC technology.

10. Screening

After 21 days the compost is removed from the tunnel and passed through a screening or sieving process, where the finer, smaller particles are captured as a mature compost or soil conditioner.

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11. Second Stage Decontamination

The larger particles that didn't pass the screening test can contain a small percentage of non-organic contamination, mostly plastic, which is removed using wind-sifting techniques. The remaining organic material can be used as a garden mulch or re-used in the bulking process (see stage 3).

12. Process Monitoring/Product Testing

A number of both manual and automated controls and tests are utilised throughout the process. Additionally, once the composting process has completed, six samples from different parts of the finished compost batch are sent to an independent laboratory for testing. This ensures the composted material qualifies as a "Composted Product for Unrestricted Use" as per Australian Standard AS 4454-2012. At Barwicks this is the minimum standard, we also do our own testing and blending to meet the nitrogen and nutrient requests of our customers.

IVC KEY POINTS

- The process is entirely closed-loop with respect to leachate/water run-off management – there is no need to discharge process water to the environment.
- Unpleasant odours normally associated with composting are entirely captured within the air-tight tunnels and treated twice (scrubbers and bio-filter) prior to release. There is no detectable smell within the proximity of the IVC bio-filter.
- The only 'waste' would be any non-organic contamination from an incoming delivery. This is screened out and must be disposed of in a landfill.
- The temperatures achieved during the process ensures that the composted product is sterilised / pasteurised and safe for general, unrestricted use.
- The process can be completed in a much shorter timeframe - between 14-21 days. This means that both household and industrial organic waste can be turned into a safe, high quality usable compost much more efficiently and effectively than more traditional composting methods.

Any feedback?
Please let us know at www.barwicksfogo.com.au

Barwick's
WHOLESALE/RETAIL LANDSCAPE SUPPLIES