



Report:

# ISSUES RELATING TO ORGANIC WASTE DISPOSAL

## PART 2 – HOTROT SYSTEM SUMMARY

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A REPORT SUPPLIED BY:

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## Executive summary

HotRot is a continuous in-vessel composting system capable of processing most types of organic waste. The HotRot unit is a u-shaped vessel with a central tine-bearing shaft running down its length. The shaft rotates periodically and slowly to mix, aerate and facilitate transportation of the material through the composting unit. The operation of the shaft is under microprocessor control based on readings from several sensors installed within the unit. The shaft manipulates the physical structure of the material within the vessel allowing efficient aeration, moisture and temperature control, providing optimal and sustainable conditions for effective composting.

This is the second report in a three-part series. The first report looks at the issues of organic waste recycling (composting) and reuse. This report provides an overview of the HotRot composting system, and a third report looks at the science behind the operation of the HotRot system. Each report is complete, but combined provide a detailed reference tool for those wishing to understand organic waste composting using the HotRot system.

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## Summary of the HotRot composting system

The HotRot technology is the foundation of a highly efficient and cost-effective composting system. The system utilises a horizontal composting chamber combined with appropriate ancillary equipment for waste preparation and materials handling. Each HotRot unit is individually controlled and monitored ensuring consistent and predictable product. Units can be installed individually or in groups to provide a modular solution.

HotRot units are manufactured in three basic sizes offering a large throughput capacity range.

The three models are:

- HotRot 1206
- HotRot 1811, and
- HotRot 3518.

The model numbering gives an indication of physical size (of the composting chamber) such that a 1206 is 1200mm wide and 6m long, whereas a 3518 is 3,500mm wide and 18m long.

The 1206 has a nominal throughput capacity of 0.3-0.4 tonne per day is designed for smaller on-site applications and is normally supplied with a bin-lifter or small feed hopper for loading waste into the unit. The largest unit, the HotRot 3518 with a throughput of 10-12 tonne per day is designed for multi-unit installations for municipalities, larger waste management companies and treatment of biosolids. The intermediate sized HotRot 1811 is generally offered in two configurations; a base configuration with a bin-lifter feed unit has a throughput capacity of 1.0-1.8 tonne per day or alternatively supplied with an integrated feed hopper which increases throughput up to 2.5 tonne per day. With a bin-lifter the unit is suitable for on-site applications with a feed hopper the system can either be used singularly or in pairs as an on-site solution or used in multiunit installations for smaller municipalities and local waste management contracts.

Feed hoppers can be considered as buffer storage units that once filled with material to be composted allow the plant to be left unattended for extended periods of time. Hoppers are available in size from 2.5 to 60m<sup>3</sup>.

Material to be composted enters one end of the HotRot unit where a central shaft ensures that the mix is uniform, and moisture and heat are evenly distributed. The central tine-bearing shaft is turned intermittently, in both forward and reverse directions, and is under programmable logic controller (PLC) control. This facilitates process control, provides material loft to prevent compaction and to aid aeration, and assist movement of material through the unit. Aeration is a function of total shaft rotation and air injection whereas movement through the unit is a function of net forward rotation and waste volume additions (displacement).

The central shaft, by way of the tines arranged around it, releases excess heat, moisture and carbon dioxide into the overhead airspace, eliminates compaction and redistributes heat and moisture within the material being composted. Prevention of compaction of wastes ensures efficient air injection. Supplementary low volume air injection ensures that the material is maintained in an aerobic state and the composting process proceeds at an optimum rate, without the evolution of nuisance odour. Controlling moisture and heat removal eliminates the potential for leachate formation and allows optimises compost temperatures (prevents over heating).

The HotRot composting system is fully modular allowing plant capacity to be easily extended by installing additional units as collection services or demand increases. Modularity also allows the plant to be configured to produce niche products from defined feed materials.

All HotRot units are fully enclosed and do not need to be housed in a building.<sup>1</sup> This minimises capital and maintenance costs. The significant problems of moisture and by-product gas build-up causing corrosion of structures and electronic components observed in within-building composting systems are completely avoided with the HotRot system.

Each HotRot unit incorporates a relatively low volume headspace. This ensures that the amount of air that is passed through the process is minimised, reducing the size of the biofilter and the cost of moving air. Air injection is 'pulsed' to meet the "oxygen demand" of the waste being processed. There are no fugitive emissions from the HotRot composting system as the entire system is under slight negative pressure; indeed, HotRot is offered with an Odour-Free Guarantee.<sup>2</sup> Importantly, plant operators are not exposed to the composting atmosphere, reducing the risk of respiratory illness or disease and providing a more comfortable work environment.

Each HotRot unit is equipped with monitoring equipment that provides on-line diagnostic facilities and an auditable record demonstrating compliance with international regulatory guidelines and standards. Each unit is fully insulated protecting the process from the influence of fluctuating ambient environmental conditions, including solar heat gain and moisture loss.

## Advantages of the HotRot process

The HotRot process overcomes several inherent composting problems and offers a number of technological benefits.

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<sup>1</sup> A unit is installed in Nova Scotia, Canada, in ambient conditions down to -25° C

<sup>2</sup> See HotRot Odour Free Guarantee.

The major concerns with all composting processes are the provision of a consistent product that meets quality criteria and control of impacts such as aerosols, odour, dust and noise (See Part 1 of this report series). Other important issues include process monitoring, capital and operating costs, reliability, ease of use, land area and scalability/modularity.

HotRot does not simply offer a composting unit it offers a system. HotRot works with its customers to identify their needs and provide an integrated solution from waste reception, through pre-processing, composting and final product handling and use.

## Product consistency

- The rotation of the central shaft ensures that all material is evenly mixed and composted.
- There are no edge effects in the HotRot system that might lead to material that has not been efficiently aerated and/or pasteurised.
- All material must pass through the thermophilic zone of the composter and there is no opportunity for short-circuiting (bypass).
- The rotation of the shaft prevents compaction and channelling and therefore permits fine particles to be composted with confidence. Compaction and channelling are problems associated with static piles or unmixed systems. Compaction can lead to areas of anaerobic activity, and channelling can result in preferential air movement with subsequent odour problems. This can be overcome by other systems but requires far greater operator experience, diligence and attention to feed characteristics.
- Composted material cannot be contaminated by leachate that can be released by the composting process; HotRot units do not produce leachate. The air draw and therefore moisture removal from the HotRot unit is manipulated to ensure moisture removal is sufficient to prevent moisture build-up within the unit<sup>3</sup>, which could in turn lead to the formation of leachate. Additionally, the regular mixing that occurs through shaft rotation ensures that moisture is evenly distributed within the material in the unit.

## Odour control

- HotRot offers its users a contractual OdourFree Guarantee.
- Each HotRot is maintained under slight negative pressure thus preventing the emission of fugitive odours.
- All exhaust gases are treated via a biofilter that can also draw air from feed units and adjacent waste storage/reception facilities.

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<sup>3</sup> Provided efficient composting temperatures are maintained.

- Feed systems are enclosed and integrated with the HotRot units. Electronic slide gates or manual interlocked hatches can be fitted to feed inlet chutes when loading with a bin-lifter; these are only open for short periods of time to allow waste entry.
- Excessive odours are normally associated with inefficient aeration and anaerobic conditions. The HotRot systems efficiency ensures odour concentrations are modest prior to treatment and absent in exhaust air from biofilters.
- Odours are more concentrated and greater volumes of moisture are released during shaft rotation, during this period the speed of the biofilter fan is increased to draw more air through the system. Operating the biofilter fan on a variable speed drive further minimises power consumption and operating costs.

## Leachate

- The HotRot system is leachate-free. Excess moisture is released from the HotRot vessel as vapour during periodic but frequent shaft rotation (approximately 6-9 minutes every hour). By effectively distilling the water, nutrients and particulates remain in the composting material where they belong. Excess moisture and carbon dioxide is released from the process before it reacts and has a chance to lower the pH and inhibit the process.
- By avoiding leachate, HotRot can reduce wastewater disposal costs by 99%.

## Dust

- The shredding process, transportation of materials and storage of compost may generate dust and appropriate processes, and equipment must be used to mitigate this.
- Waste shredders (if required) can be supplied with a cover to minimise dust and odour release during processing.
- All feed units and feed and discharge conveyors or augers are covered.
- The moisture content of the compost can be monitored and controlled to minimise dust formation.
- Wind protection on the site may be needed to minimise waste and product movement.

## Noise

- Most noise will be associated with vehicle and loader movements and the operation of certain shredders.
- Some shredders are slow speed units that generate considerably less noise than conventional high-speed shredders, hammer mills or tub grinders and these can often be used.

- The use of electric drives and large reduction gearboxes (and thus slow speeds) ensures that each individual HotRot unit is virtually silent in operation.
- Biofilter fans can be housed in soundproof enclosures, if additional noise control is required.
- Feed conveyors and the screen will generate minimal noise as they are covered and only operate periodically.

## Aerosol control

- Aerosols are corrosive due to their temperature and moisture content and the presence of gases such as ammonia. All vital equipment such as electronics and motors are external to the HotRot unit, isolating them from this damaging environment. Internal steel work is stainless, or zinc-arc sprayed, and unit covers are corrosion resistant concrete, stainless steel lined or fibreglass depending on the model.
- Aerosols may also contain pathogenic microorganisms that may cause respiratory illness. The HotRot system contains aerosols within the unit, eliminating operator exposure.
- Workers and other equipment are not exposed to the composting atmosphere.

## Minimisation of capital cost

- In-vessel composting systems are capital intensive but tend to compensate through lower operating costs. Significant efforts have been made to ensure that HotRot is as cost effective as possible.
- Each individual unit is rated for outdoor operation, thus obviating the need for a building.
- Plinth foundations are all that is normally required, as opposed to full slab foundations and most of the site can be sealed with asphalt or compacted aggregate.
- The amount of air requiring treatment via a biofilter is kept to a minimum. This reduces both the capital cost of this item and its operating costs.
- HotRot units are highly efficient; compost to be used in broad-acre applications requires little or no storage significantly reducing the area of land needed for a composting plant.
- The HotRot PLC controls ancillary equipment, reducing the need for additional control systems.
- As HotRot units produce relatively stable compost, space for storage and maturation is minimised; a HotRot system generally requires 50-75% less land area than a comparable in-vessel or within building system and a tenth of the land area of a conventional windrow system.



- Additional equipment such as dewatering units are offered, these can significantly reduce moisture levels in food waste, animal manures and sludges, greatly reducing the size and cost of the composting system.
- The HotRot system is designed to process putrescible wastes with minimal bulker. Excess green waste should not be processed through a HotRot unit unless there is excess capacity or other compelling reasons; this material can generally be safely (in terms of odour, etc.) composted in open windrows for minimal cost.

## Minimisation of operating costs

- A HotRot composting system (including biofilter)<sup>4</sup> uses approximately 25-30 kW of electricity per tonne of waste processed. This is one of the lowest figures of any in-vessel system.
- Odour can be the biggest operating cost – either through on-going control and mitigation methods or the economic impact of plant closure. HotRot offers its clients the insurance of a contractual OdourFree Guarantee.
- Leachate disposal costs may also be significant for a traditional composting system. HotRot can reduce these by 99%.
- A HotRot system can be operated with 25-40% less labour than other similarly sized operations.
- The HotRot PLC integrates the operation of the feed system (and other ancillary equipment) minimising operator involvement.
- Shredders, screens and conveyors can all be integrated with the composting units themselves.
- Routine maintenance is low. The HotRot is a mechanically simple machine. Averagely competent operators can accomplish most maintenance tasks. Many potential problems can be resolved online by Global Composting via telephone/web-based dialogue with the site operator or by remote operation of the unit. This means that problem resolution is both rapid and inexpensive.
- HotRot units can be located close to where the waste is generated reducing transport costs and GHG emissions.

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<sup>4</sup> Note the figure for energy consumption varies depending on the throughput/residence time of the material being composted, as well as the ancillary equipment installed.

## Reliability

- The HotRot composting unit has proven extremely robust in service. The first HotRot was installed in February 2001. Units have now been installed in more than 15 countries treating a variety of wastes.
- Installations include remote mine sites and work camps, testament to their ease of operation and mechanical reliability.
- Each HotRot composting unit can be equipped with a data link and data connection permitting remote operation and troubleshooting. Remote monitoring ensures that Global Composting can report and action any operational deviations (such as low temperatures or high motor currents) that suggest suboptimal performance.
- The HotRot design ensures that significant and vulnerable parts are protected from the composting atmosphere thus avoiding problems of corrosion. Shaft rotation speed is very low, and the potential for wear and damage is consequently reduced. The motor/gearbox is a stock item with a service life more than 15 years in this application.
- Removable lids (HotRot 1811 and 3518 models) permit access to the inside of the unit to facilitate maintenance such as the replacement of bent or damaged tines, or servicing of the central bearing (where fitted).

## Compliance with standards and auditability

- The sophisticated monitoring and feedback systems of the HotRot system ensure that accurate and timely data reports can be generated. These reports can significantly reduce the amount of testing required, especially with respect to vector attraction reduction (VAR) and pathogen control.
- Temperatures, processing conditions and equipment status data are automatically recorded by the control system and can be relayed by a computer network or internet connection.
- Data can be stored within a database that can be accessed remotely via a secure web address. Custom software is also able to automatically interrogate the database and produce processing reports, including time/temperature profiles. These processing reports can be automatically sent via fax or email to the plant operator or interested regulatory authority.
- Process faults can also be sent as text messages or emails to operational or maintenance personnel.

## Land use

- In-vessel composting utilises significantly less land area than windrow composting or vermiculture.

- Compost produced by the HotRot system is stable and mature and can be often used in broad-acre applications with little or no storage or maturation; significantly reducing the overall footprint of the facility.
- Individual HotRot composting units can be sited close to one another utilising common walkways and feed systems. This ensures that the land area required for a HotRot plant is one of the most compact of any system currently available. However, it should be noted that when reviewing site requirements, it is important to include provision for vehicle access and movement as well as for curing or storage of product, screening and other activities. The land area required is more a feature of total plant design than of the HotRot composting unit component.

## Modularity

Individual HotRot units are available with nominal capacities<sup>5</sup> of:

- HotRot 1206 with bin-lifter: 0.2-0.35 tonnes per day
- HotRot 1206 with feed hopper: 0.3-0.5 tonnes per day
- HotRot 1811 with bin-lifter: 0.8-1.8 tonnes per day
- HotRot 1811 with feed hopper: 1.8-2.5 tonnes per day
- HotRot 3818: 9.5-12.0 tonnes per day

The 1206 is designed for smaller on-site applications. The HotRot 1811 can either be used singularly or in pairs, triplets or quads as an on-site solution or used in multi-unit installations for smaller municipalities and local waste management contracts.

The HotRot 3518 is designed for multi-unit installations for municipalities and larger waste management companies.

The modularity of the HotRot system allows a plant's capacity to be expanded as demand for its products or services increases.

## Appropriate installations for HotRot

HotRot composting systems are designed to deal with virtually all forms of organic waste and are the solution of choice for highly putrescible and/or bio-hazardous waste streams. The fully enclosed design means that odours, leachate and other adverse environmental impacts are eliminated. Due to its compact footprint the technology is also ideally suited to sites where available space is limited.

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<sup>5</sup> The daily throughput is dependent on residence time, bulk density and volatile solids content of the material in the unit, figures quoted here are based on a 10–12-day residence time and include waste and amendment/bulker.

HotRot is the only technology to offer an OdourFree Guarantee and we encourage you to contact us for more information.

## Other Information:

You might like to request the following documents:

- Part 1 – The science of organic waste disposal
- Part 3 – Understanding HotRot
- Amendments & bulkers
- Why is HotRot different
- HotRot units do not produce leachate
- HotRot - A new generation composting system
- Guidelines for Compost Storage and Utilisation
- HotRot – Environmental Discharges
- Generic Specifications for use
- Odour Free Guarantee Contract Version