buyers' guide

The Composters' Guide to Buying Equipment and Services

THE Composters' Buying Guides provide readers with an insight into the world of buying technology and expertise, as well as providing a directory of the products and services currently available from members of the Composting Association. The series will continue through future editions of *Composting News* and over time will cover all aspects, scales and areas of composting technology and expertise. If there is any particular area you would like to see covered in a future edition, please contact Tony Breton E: tony@compost.org.uk

Following on from the Guides to Shredders / Grinders and Screens (*Composting News* Vol 9 Issues 1/2), this first part of the Guide to Site Construction is written by Steve Last, Technical Manager at Enviros (E: steve.last@enviros.com), and looks at Composting Pads and Drainage Systems.

No. 3 Composting Pads & Drainage Systems

WHEN deciding on the type and size of composting area there are a number of different factors to consider: these include the maximum quantity of feedstock on site at anyone time, the length of the composting process, windrow size and amount of space required for vehicle movement both between windrows and around site. To calculate the size of the active composting pad please see Box 1 or visit www.compost.me.uk, readers should note that additional sealed areas maybe required for feedstock reception and product maturation / storage.

Once a decision has been made on slab area requirements for the required compost throughput, and each operator will have his own preferred loading ratio, somewhere in the range from half a tonne per m^2/annum to three times that amount, it will be necessary to consider the design of composting area slabs, and drainage. Largely out of sight, these all important elements of any successful facility often receive far less thought than composting processes, plant and machinery, but "getting it wrong" in this area can disrupt businesses and entail hefty repair bills well within the anticipated life of slabs and drains. This is where this edition's Buyers' Guide hopes to help.

Box 1

Composting Pad Area Calculation

1. Raw materials and daily volumes
Calculate your maximum material daily volume (m^3)

2. Calculate pad volume. This is the total volume of material on the pad at one time.
Pad volume (m^3) = composting period (days) * daily volume (from step 1)

3. Windrow/pile calculations
Length = **x** metres, Height = **y** metres, Width = **z** metres
Windrow/pile volume (m^3) A = **2/3 * z * y * x**

4. Number of windrows/piles = pad volume (step 2) / windrow/pile volume (step 3)

5. Windrows/piles layout and spacing (dependent on method and equipment used).

- Bucket loader turned windrows and piles 0.6 metres between windrows and a 6 metre gap for turning
- Self propelled windrow turners 1 – 1.5 metres between windrows
- Tractor-assisted windrow turners (2 passes) 1.8 – 2.4 metres between windrows
- Individual aerated static piles and extended aerated static piles only require enough space to manoeuvre the loaders.

6. Pad width, length and area
Width of windrows/piles (m) = number of windrows/piles * width of each

Total pad width (m) = width of windrows/piles + aisle space + Perimeter space

Pad length (m) = windrow/pile length + perimeter space
Total Pad area (m^2) = pad width x pad length

This calculation is based on the information given in the Environment Agency's Technical Guidance on Composting Operations October 2001. The pad size only covers the active composting area; operators should also consider the additional requirements for feedstock reception areas and product maturation / storage.

One element, which the above calculation does not cover, or explain, is the 'shrinkage factor'. This is the proportion that describes the volume change during composting. To calculate the shrinkage factor, you must assume that at any time the total amount of material will be halfway between the initial and final volumes. As an example, if the final volume will be 50% of the original volume, the total 'shrinkage factor' is 0.75, therefore the amount present will 'average' out at 75%.

buyers' guide

buyers' guide

Understanding your Ground Conditions

GROUND conditions vary enormously from undisturbed high bearing capacity and well drained granular sub-soils, to the very weakest clays, silts and even peat. Frequently the sites chosen for composting have poor ground, or are low lying. For slabs on known well-drained virgin ground it may be reasonable to omit a site investigation, but this is rare and not recommended.

If in doubt at all about the bearing capacity of the ground, and in all cases where any structure beyond simple hardstanding areas are planned, a trial pit site investigation (SI) will be a minimum requirement. Trial pit site investigations will be limited in the depth which can be investigated by the downward reach of the machine, and by health and safety considerations relating to the presence of unsupported excavations.

For heavier building structures and where complex geologies may be present, and where the loads imposed may alter the stress pattern in the underlying strata to a depth between two and four metres dependent on the vertical reach of the machine used, the SI will need to include deeper trial boreholes drilled and logged to below the depth of load influence.

For a good ground bearing site a trial pit SI may be undertaken within one day with a 360 degree excavator, and require no more than the presence of an experienced engineer to direct the machine driver, log, and photograph the strata encountered, water seepages, and rest water levels and write a report on his findings. The engineer may also take simple in-situ soils strength (vane & SPT) tests, and send characteristic strength samples to a soils laboratory for strength testing. Plate bearing tests may also be undertaken to establish the CBR ("California Bearing Test") load rating of the site sub-soils.

For a poor ground condition site, the same exercise often requires the addition of boreholes driven from a specialist rig by a specialist SI Contractor, similarly logged and reported, and may take several days to complete. Again, this work is likely to include off site laboratory soil strength analysis. Spending on an adequate SI is expensive but very important. History is littered by examples of those that thought they understood their ground conditions, but didn't.

See our listings for Design Consultants, Site Investigation Contractors, and Geotechnical Laboratories.

Drainage

Drainage may be required for three purposes; sub-soil drainage ("French drains"), surface water drainage, and compost run-off/leachate drainage.

- **Sub-soil drainage:** The need for sub-soil drainage, and in particular for a permanently drained sub-base below the slab, should be identified by the SI. In principle sub-base and slab design will be based on the assumption that these materials will at all times be drained. If water is present and the inter-granular spaces are filled with water beneath a slab a "pore water pressure" will develop. Pore water pressure in a soil effectively prevents each particle transferring its load by resting upon its neighbour in free air, and instead each particle begins to "float" in the water around it, greatly reducing the material strength. For this reason drainage failure is a primary cause of slab failure. Neglect site sub-soil drainage below low lying sites at your peril!

Sub-soil drainage may be either led to soakaway or discharged to surface water. Similar discharge quality and peak flow requirements will exist for any sub-soil drainage, as will apply to surface water discharges. (See Surface Water Drainage below.)

- **Surface Water Drainage:** Surface water (S/W) drainage will be required for estimation of peak storm flow rates and for drain sizing. Although a number of simplified methods are available designers should now ensure that the source for the storm data used is derived from the Institution of Hydrology Flood Estimation Handbook which has been updated to account for recent increases in storm intensity. This information is also available to Composting Association members at discounted prices, please contact the Association on 0870 1603270 for more details.

All S/W drains should be to a minimum nominal diameter of 150 mm, and should be laid to a minimum gradient of not less than 1 in 80, although steeper gradients are preferred. The provision of a suitable backfill stone pipe surround to all pipework is essential to avoid pipe ovality and loss of pipe capacity. Nevertheless, where site soils are suitably sized and granular, the backfill may comprise selected excavated material.

It may make economic and environmental sense to store run-off for dry periods when shredded materials will need additional wetting prior to commencement of windrowing or in later sanitisation stages.

Your local Environment Agency (EA) inspector will provide guidance on permissible peak flow rates for discharges to watercourses of clean uncontaminated surface water, and should be contacted at the commencement of the surface water drainage design. The EA will require that any discrete surface water discharge to watercourse is licensed, and regularly analysed, and will advise on suitable application terms.

Frequently the sites chosen for composting have poor ground, or are low lying.

See our Buyers' Guide listings for Drainage Pipe suppliers, Buried Tanks, Geotextiles. Some manufacturers (eg Wavin www.wavin.co.uk) also provide information on pipe sizing and flow calculation, and Tanks.

- **Compost Run-Off / Leachate Drainage:** It is normally preferable to keep access road drainage and roof drains separate from contaminated compost area flows, to minimise the quantity of contaminated water generated. The quantity and contaminant strength of this run-off varies enormously between different sites. MBT composting produces a far stronger "leachate" than green waste, and a careful watch needs to be kept on ammoniacal nitrogen (commonly referred to as just "ammonia") in this leachate. It is the most difficult contaminant to treat biologically and rapidly without creating process instability. Its presence in compost leachate can lead to severe treatment plant reliability problems – and resulting odours.

The amount of run-off from open slab composting varies enormously, as does the need to wet screenings in summer. Sites in the east of England will suffer substantial annual water deficits, whereas sites exist in the west of Ireland where they could never hope to store all winter excess leachate flows, and where in the absence of large local sewage treatment plants on-site leachate treatment may be needed.

Estimation of compost run-off leachate strength and volume is site-specific, and so variable, that no guidelines or good practice assumptions have yet been established. For slab extensions the best recourse is to monitor existing run-off and then extrapolate. For new facilities and process changes we recommend that operators seek out the experience of other members running comparable technologies in their region, or engage an experienced consultant.

For compost facilities which produce significant net annual excess leachate, the cost of disposal can be high. Contact your local Water Service PLC to find out whether (a) they will accept compost run-off discharges to sewer, or if not (b), allow your excess leachate/run-off to be tankered to a suitably licensed Sewage Treatment Works. Expect sewer discharges to be charged at between £0.35/m^3 and £1.25/m^3 dependent upon strength and region, and tankered leachate/run-off cost to be in the range £130 to £240/30,000 gallon tanker load.

buyers' guide

Reinforcement preparation

Casting a reinforced slab – image courtesy of Mackenzie Construction

On-site Leachate / Run-Off Treatment

Compost contaminated water can be readily treated biologically, however contaminant concentrations can be very high, and particular care is necessary with the possible high ammoniacal nitrogen. Normal water treatment (sewage) package plant suppliers usually decline to offer the provision of their systems for compost run-off due to the much higher contaminant (especially worst case ammoniacal nitrogen) concentrations, so bespoke designs are usually necessary.

Treatment is a last resort solution for composting sites, and is rarely needed nevertheless, it may be covered in a later Buyer's Guide. Meanwhile, consultants such as Enviros Consulting (www.leachate.co.uk) have been designing leachate treatment plants since 1980.

Slab Design

Slab design is normally based upon two or three structural components, which must act together in unison with the soils below. Weaker sub-soils require greater sub-base thicknesses. If any component fails the whole slab will fail. The components are:-

- sub-base; a compacted granular material (possibly recycled)
- slab or wearing course.

In the case of asphalt designs, in addition to the sub-base a third further layer may be provided below the wearing course, which is known as the base-course. See our listings for local and national construction contractors who will have trained gangs available which are highly skilled in specialist slab construction, and asphaltic pavement laying skills.

Concrete slabs will normally be reinforced by high yield steel mesh to spread point loads, and to prevent surface cracks.

Sub-base & Base Course: The purpose of these layers is to spread the loads from the activities above so that the bearing capacity of the underlying soils is never exceeded.

Wearing Course: This provides the running surface and needs to be capable of withstanding the high degree of scuffing, and scraping forces exerted by compost site plant. Special asphalts have been developed for composting surfaces to withstand not only the abrasion and potential corrosion experienced by compost slabs, but also to retain strength at the prolonged high temperatures beneath compost piles.

Asphaltic pavement systems will usually comprise a wearing course, a base course, and a sub-base; concrete systems usually comprise just the concrete slab plus a sub-base.

Concrete Slabs

Concrete slabs will normally be reinforced by high yield steel mesh to spread point loads, and to prevent surface cracks. Dowel bars are used to prevent differential vertical movement between bays while allowing the concrete bays both to shrink during curing and to expand and contract with temperature variations. A thin plastic (usually polythene) membrane is laid below the slab which prevents excessive moisture loss on the base of the slab during curing. It also forms a slip plane, allowing large slabs to shrink and move slightly in so doing, relative to the ground beneath, without cracking. The joint details are designed to allow for the necessary degree of movement, and dowel bars which are placed through movement joints will be de-bonded on one end to allow the necessary free movement for the joints to open and close slightly as ambient temperatures change.

The spacing of joints will be related to the degree of movement, and all these requirements are documented within the design codes, and other guidance used by the experienced engineer. Impact and abrasion resistance of concrete slabs can be enhanced by the addition of fibres, and air entrainment may be used to improve frost damage resistance (particularly when cement to concrete ratios are at a minimum - for economy).

Ensure that care is taken during hot and cold weather to protect from extremes of temperature, and cure each and every bay with care after casting, in accordance with good practice guidelines. Spray-on curing agents which are applied approximately 24 hours after casting, and seal the surface from desiccation, are essential. The appearance of a soft white sometimes powdery surface layer should be avoided as it indicates that the concrete surface has dried out before the essential cement to concrete hydration reaction has been able to complete. Long term serviceability depends on good curing.

An alternative to the traditional concrete slab construction is roller compacted concrete, which is a mix of several aggregates, which is then mixed with water to form a dry gravel mix.

An alternative to the traditional concrete slab construction is roller compacted concrete, which is a mix of several aggregates, which is then mixed with water to form a dry gravel mix. It costs less than traditional concrete mixes because it has a lower moisture content and requires less cement to achieve the same strength. The material is laid down on hardcore, rolled and is virtually dry on the same day, so large areas of concrete can be quickly created resulting in lower construction costs. Originally used in the US, it is designed to be quick drying and load bearing within days and has been used in the UK since 2002.

Corrosion of concrete for compost slabs is not normally a problem, although the designer should obtain worst case leachate quality data, and look for the main corrosive substances know to attach Ordinary Portland cement concrete, and to a much lesser extent the pozzolanic OPC replacement mixes readily available in the UK. Of these, the most important corrosive agent is sulphate. However, the most that will be required will be to adjust the concrete mix design in the event that stated threshold values for the mix category are exceeded. The mix design requirements are documented in the new Eurocodes European Standard BS EN 206 for concrete design. The Concrete Hardstanding Design Handbook (BP/107-August 2005) is the most current publication (available from the Concrete Bookshop (Tel: 01276 608778) or visit www.concretebookshop.com) and Ground Bearing Concrete Slabs, by John Knapton, (Thomas Telford, 2003, www.thomasytelford.com).

Asphalt

Asphalt solutions will normally be cheaper than concrete slab solutions, but just as in highways scheme uses, the longevity of asphalt paving is normally considered to be less than for concrete. Asphalt being a fully flexible pavement is susceptible to localised soft spots and "tramlining" whereas a concrete pavement is more forgiving as it will span localised sub-standard or saturated areas. The experience of front-end-loader drivers often reflects in the degree of scuffing of asphaltic surfaces.

It is recommended that the designer should obtain cost estimates for both the concrete slab and asphalt alternatives, and then carry out a cost benefit analysis based upon the design life and required duty for both options. Of course, for start-up projects initial capital cost may have to be minimised and in such cases the asphalt option may be selected for initial economy alone.

Other hard surfaces

It is possible to use surfaces other than concrete and asphalt where the base is proven to be sufficiently impermeable. Samples of clay, for instance, should be independently tested in a laboratory for permeability, linked to the geology of the area and a risk assessment undertaken to satisfy the EA. The roller compacted clay base should then be protected by a membrane before hardcore is added on top. The working surface can be finished off with crushed stone and a sacrificial layer of compost to avoid contaminating product with stones. This may be a method of getting started at lower cost but still involves a considerable amount of 'groundwork' to justify its use.

Slab Permeability Issues and EA requirements

The EA frequently require a very high degree of groundwater protection below composting sites. They are required to do

Finished rolled pad – image courtesy of Roller Compacted Concrete

Composting Pads			
Company	**Contact**	**Telephone**	**Web**
Agrivert Limited	Harry Waters	01608 677700	www.agrivert.co.uk
Roller Compacted Concrete Co Ltd	John Donnegan	01778 394400	www.rollercompactedconcrete.co.uk
J Breheny Contractors Ltd	Steve Goddard	01449 720282	www.breheny.co.uk
Contact us for all your civil engineering solutions			
Dean & Dyball Construction Ltd	John Laker	01425 470000	www.deandyball.co.uk
We have a proven track record in this type of construction			

Composting Pad Sealants			
Fosroc	Head Office	01827 262222	www.fosroc.com
Specialist construction joint sealants for slabs and concrete			

Draingage / liquor treatment			
Hytech-Water Limited	Mike Beaumont	01275 858386	www.hytech-water.co.uk
WRc plc (consultancy)	Adele Graham	01793 865081	www.wrcplc.co.uk

Facility Design Consultants			
Steve Last	Enviros Consulting	01743 284851	www.enviros.com
Tony Voong	Fichtner Consulting Engineers	0161 4760032	www.fichtner.co.uk
David Baldwin	Recogen Limited	01743 340630	www.recogen.com
Lee Robinson	Jacobs Babtie	0118 9881563	www.jacobsbabtie.com
Andrew Herbert	Capita Symonds Group Ltd	01342 327 161	www.symonds-group.com
Hugh Bulson	Organic Resource Agency Ltd	01684 585423	www.o-r-a.co.uk
Claudia Amos	RPS Planning & Environment	01291 621821	www.rpsplc.co.uk/waste
Craig Benton	Celtic Composting Systems Limited	00 353 214621721	www.celticcomposting.com
Chris Field	The Composting Company Ltd	01763 836205	www.thecomposting.co.uk
Emmanuel Gentil	Golder Associates (UK) Ltd	0115 9371111	www.golder.com
Jenny Lamont	Wamcal	01382 477675	www.wamcal.co.uk

For more information about these companies please see www.compost.org.uk