Green Waste Composting: Technologies, Facility Design & Environmental Management

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- Basic Design Criteria
- Compost Process
- Environmental Management



Basic Design

Green waste composting is:

- In essence, the simplest form of composting
- Indoors or outdoors
- Homogenous feedstock
- Manual or automated
- Large or small scale
- Lower capital investment
- Good quality compost product



Basic Design

Facility Design:

- Reception & weighing area
- Shredding & mixing area
- Windrow composting area
- Post-composting screening area
- Compost storage area
- Optional bagging/loading area



Basic Design: Kilberry







Site requirements:

- Surface area required- 1m²/ tonne of green waste
- 50,000tonnes of green waste requires approx. 5ha
- Less area if using forced aeration
- Reasonable distance from sensitive receptors
 e.g. 200m
- Close proximity to origin of waste
- Good access to transport routes



Basic Design

Design features:

- Impermeable surface- concrete hardstand or asphalt
- Surface water/ leachate collection & storagedrains/ gullies, storage tanks/lagoons, re-circulation
- Security fencing- entrance gate, CCTV, lighting
- Landscaping- screen planting, bunds
- Staff accommodation- office, welfare facilities, storage, optional lab facilities
- Machinery/ vehicle storage- security, maintenance



Basic Design: Kilberry









Windrows at Kilberry





Surface water/ leachate collection





Drainage grill





Leachate lagoon





Site bunding & security fencing

Basic Design

Main Equipment:

- Shredder
- Front-end loader
- Windrow-turning machine
- Sieving/ screening equipment
- Aeration systems- built-in or above-ground pipework
- Tarpaulin/geo-textile covers
- Temperature & oxygen probes



Weighbridge/ wheelwash





Green waste shredder





Front-end loader mixing input material





Windrow turner





Compost sieving





Aerated static piles





Tarpaulin covered windrows

Basic Design

Green waste feedstock & input material:

- Tree branches
- Hedge clippings
- Grass cuttings
- Leaves
- Shrubs & plants
- Brewery waste
- Saw dust







Green waste feedstock





Input material- Brewery waste

Basic Design

Sources of un-contaminated green waste:

- Local authority parks departments
- Civic amenity sites
- Landscape gardeners
- Garden centres
- Tree surgeons
- General public

Appropriate monitoring required to ensure the quality of the green waste supply





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Compost Process

Operation parameters:

Moisture Content

- Aerobic decomposition best between 40% & 60%
- Below 40% microbial activity slows down
- Above 60% anaerobic conditions can occur
- Carbon:Nitrogen Ratio
 - Target ratio of between 20-30:1
 - C:N ratio too high (too much C) then decomposition slows down
 - C:N ratio too low (too much N) then there will be bad odours
 - Grass clippings 12-25:1
 - Leaves 35-85:1
 - Pine needles 60-110:1
 - Sawdust, weathered 2 months 625:1

Compost Process

Operation parameters:

Temperature

- Operational temperature range 45°C to 70°C
- Optimum operation temperature of 65°C
- High temperatures essential for destruction of insect eggs & weed seeds
- High temperatures vaporize ammonia reducing odours

Particle size

- Optimum particle size of between 5mm & 50mm
- Smaller the particle size, the greater surface area for microbial activity
- Important to ensure adequate porosity for air & moisture distribution





Operation parameters:

Aeration & Turning

- Sufficient air space required to ensure adequate oxygen supply, removal of CO2 & ensuring uniform moisture content
- Keep oxygen levels above 5%; below this & pile will go anaerobic
- -Turning essential to regulate oxygen levels
- -Turn regularly during initial composting period, first 10-15 days

Pile size

-Typical windrow has a triangular cross section

-Usually 3-4m wide & 1-2m tall

- -Any length is acceptable; limited by space available
- -Space at sides for machinery access
- -Windrow turner limits width & height of pile

Environmental Management

Site management

- Day-to-day running of the facility
- Ensuring that the composting process is going smoothly
- Daily testing of the compost process

Environmental management

- Regulatory requirements
- Required by local authority permit & EPA waste licence
- Quarterly & annual monitoring
- Annual environmental report



Environmental Management

Daily site management

- Temperature measurement- temperature probe
- Oxygen measurement- oxygen probe
- Moisture content- small on-site laboratory
- Record keeping- daily testing, weights of material coming in and of compost product going out
- Essential machinery maintenance- shredder, sieve, turner
- Record of incidents & complaints
- Nuisance control-birds, vermin, flies, dust & odours







Environmental monitoring points





Temperature measurement





Oxygen measurement





Vermin control

Environmental Management

Regulatory monitoring

- Dust monitoring
 - 30 day composite sample
 - Bergerhoff gauges
 - Emission limit of 350mg/m²/day
- Noise monitoring
 - Daytime & nighttime monitoring
 - Calibrated noise monitor
 - Monitored over 30 minute intervals
 - Daytime emission limit= $55dB(A)L_{eq}$
 - Nighttime emission limit= 45dB(A)L_{eq}







Dust monitor





Noise monitoring

Environmental Management

Regulatory monitoring

- Surface water & groundwater monitoring
 - Taking samples & testing in certified laboratories
 - Samples taken from water bodies & groundwater wells
 - Quarterly reporting of pH, suspended solids & mineral oils
 - Quarterly, bi-annual or annual reporting of BOD, Ammonia, Chloride, Sulphate, Phosphate, metals, petroleum pollutants & pathogens
- Compost monitoring
 - Taking samples & sending for testing
 - Samples taken from finished compost body
 - Monitoring depend on amount of compost produced
 - Maturity- C:N ratio O₂ take-up, germination rate
 - Foreign matter- over 2mm in size, max. 25mm, ≤1.5%
 - Trace elements- metals e.g. copper, mercury, lead, etc.
 - Pathogens- faecal coliforms, salmonellae





Groundwater monitoring





Compost sampling

Regulatory monitoring

- Odour monitoring
 - Olfactometeric measurements
 - Analysis of hydrogen sulphide, ammonia, mercaptans & amines
 - Odour modeling
- Bioaerosol monitoring
 - Andersen sampler
 - Measurement of total bacteria & Aspergillus fumigatus
 - Bioaerosol modeling
- Meteorological monitoring
 - Weather station
 - Wind speed & direction, ambient temperature







Bioaerosol monitoring





Meteorological station

<u>Wrap Up</u>

Advantages

- Simplest form of composting
- Relatively low capital investment
- Capacity to handle high volumes of material
- Good stabilized compost product

Disadvantages

- Not space efficient
- Equipment maintenance costs can be high
- Securing volumes of green waste
- Effected by weather





Cré- Composting Association of Ireland Teo

Bord na Móna

