

Compost specifications for organic biofiltration

Introduction

This document is one of a set of six specifications for the application of recycled organics in the following settings:

- 1. Horticulture**
- 2. Sporting fields and turf production**
- 3. Compost blankets for erosion control**
- 4. Biofilter establishment**
- 5. Pastures**
- 6. Landscaping**

These specifications have incorporated the NSW Resource Recovery Orders (RROs) and Resource Recovery Exemptions (RREs) for compost and pasteurised garden organics, which specify legal requirements in NSW under which it is permitted to use these recycled organic wastes on land. The conditions and limits stipulated in these regulations have been included. Note that the resource recovery orders and exemptions (RROs and RREs) only apply in NSW.

The basis of these specifications is Australian Standard AS 4454-2012 Composts, soil conditioners and mulches. This standard specifies the general physical and chemical characteristics of composted products that should be used as a minimum basis for selecting products. These specifications use AS4454 as the basis and recommend additional criteria where it is directly relevant to optimising performance.

These specifications provide guidance on the characteristics of composted recycled organics, and include information on:

- general characteristics and minimum acceptable contamination levels, for the six mentioned applications
- performance characteristics
- appropriate use and application recommendations.

These do not include specifications or details for other recycled organics products such as uncomposted manures, biosolids, compost made with biosolids or solid or liquid food wastes.*

What is biofiltration?

Biofiltration is the process of improving water or air quality by filtration through a biologically influenced media. These specifications refer to water biofiltration.

A typical biofiltration system consists of a vegetated swale or basin, overlaying a filter medium (usually soil-based) with a drainage pipe at the bottom. The design configuration of biofilters is flexible, and possible variations include removal of the underdrain (to promote exfiltration into the surrounding soil) and the inclusion of a permanently wet, anoxic zone at the bottom (to further enhance nitrogen removal).

* Composts made with biosolids are managed under the Biosolids Order and have particular conditions that may not be suitable for use under the scope of these brochures.



Organic biofiltration media referred to in the rest of this section refers to biofiltration media that contains at least 25% organic matter¹. Fit for purpose organic matter used in organic filter media must comprise of more than 85% stable organic materials to prevent unacceptable leaching. Some labile carbon content up to 15% can be used to assist plant establishment without sustaining harm to the environment through leaching.

General specifications

General physical and chemical properties for organic biofiltration media

The table below lists the fundamental properties to ensure organic biofiltration media is fit for purpose. More specific requirements can be found in the following sections.

Table 1 General physical and chemical properties for organic bio-filtration media

Property	Units	Specification
Hydraulic Conductivity	mm/hr	<300 (Laboratory test) <1,200 (Field test K _{sat})
pH	Units	6.5-8.0
EC	dS/m	<1.2
Bioassay	mm	60
Wettability	Mm/m	<5
Dispersion	Category	Emerson Class No. 8
Effective Cation Exchange Capacity	Cmol/Kg	>10
Exchangeable Na	% of ECEC	<10
Exchangeable Ca	% of ECEC	40-80
Ca:Mg	Ratio	≥ 2:1
K:Mg	Ratio	≤1.5:1
Total Phosphorus	mg/kg	<100
Total Nitrogen (TN)	mm/kg	<1,800
Organic Carbon	% w/w	2 - 5
Leaching	dS/m	EC < 0.45 after 0.35mm rainfall
Ponding	Hours	Fully drains within 6 hours
Moisture content (air dried)	%	>10% and <50%
Inherent Retention Capacity	%	>25%

Performance characteristics

Pollutant Retention Performance Requirements for Organic Biofiltration Media

Organic biofiltration media must be able to remove or retain targeted levels of pollutants through the biofiltration process. The organic filter media must be able to maintain this minimum requirement throughout the life of the asset. Table 2 provides the minimum threshold for water pollutant concentrations that are considered acceptable. The maximum values given in Table 2 indicate the threshold where additional water treatment may be required.

Table 2 Pollution retention performance for organic biofiltration media

Pollutant Category	Pollutant	Units	Outflow Target ¹		Removal (%)
			Concentration ²		
			Minimum	Maximum	
Solids	Total Suspended Solids (TSS)	mg/L	<15	<50	>85
	Dissolved Oxygen (DO)	mg/L	<6.5	Not Standardised	>80
	Biological Oxygen Demand (BOD)	mg/L	<5	<20	>60
Hydro - carbons	Oil and Grease (O&G)	mg/L	<50	<100	>90
	Total Petroleum Hydrocarbons (TPH)	mg/L	<10	No Maximum	>80
	Total Polycyclic Aromatic Hydrocarbon (PAH)	mg/L	<0.15	No Maximum	>80
Metals	Copper (Total/ dissolved Cu)	µg/L	<5	<50	>90
	Lead (Total/ dissolved Pb)	µg/L	<5	<100	>90
	Zinc (Total/ dissolved Zn)	µg/L	<5	<2,000	>90
	Iron (Total/ dissolved Fe)	µg/L	<10	<1,000	>90
	Aluminium (Total/ dissolved Al)	µg/L	<20	<100	>90
Nutrients	Total Phosphorus	mg/L	<0.01	<2	>45
	Nitrate/nitrite	mg/L	<10	<50	>60
	Ammonium	mg/L	<0.05	<1	>60
	Total Nitrogen (TN)	mg/L	<15	<25	>45
Micro - organisms	E. coli	MPN/ 100mL	<1,000	10,000	>90
	Total Coliform		<1,000	10,000	>90

¹ If the pollutant outflow concentration is lower than the minimum target concentration value, the need for pollutant removal is considered unlikely. If the pollutant outflow concentration is higher than the maximum target concentration value, then additional treatment measures may be required e.g. treatment trains.

² ANZECC guideline provides the trigger limits above which pollutant treatment is required. This standard also identifies the upper limits for pollutant concentrations suitable for stand-alone bio filtration methods beyond which additional treatment measures may be required.

Hydraulic conductivity requirements for organic biofiltration media

Organic biofiltration media will also need to meet the minimum hydraulic conductivity specifications listed in Table 3. Hydraulic conductivity must be regularly accessed at frequencies stipulated in Table 3.

Table 3 Hydraulic conductivity specifications for organic biofiltration media

Property		Units	Standard	Monitoring Frequency
K _{sat}	Compacted	mm/hr	<300	Every 5 years
	Field		>100 and <1,200	Every 5 years
Nutrient Leaching		dS/m	EC <03300 dS/m after 0.35mm rainfall	Yearly
Inherent Water Retention		%	25% to 50%	Alternate years
Dispersion		%	Emerson Class No. 8	Every 5 years
Ponding		hours	Stagnant water fully drained from surface within 6 hours from rainfall secession	Alternate years

Vegetation integrity for vegetated biofiltration systems

When meeting the general property requirements in Table 3, organic biofiltration media can support robust vegetation establishment and growth. High inherent water holding capacity and natural microbial activity helps create a favourable growing environment and improves resilience in times of climatic stress.

Table 4 provides the performance standards that can be used to ensure that vegetated stormwater management assets are performing efficiently.

Table 4 Vegetation integrity and assessment

Property	Units	Criterion	Standard
Establishment	Plant/m2	Plant density	6 to 20 plants/m2, depending on plant species
	%	Establishment period of 6 months	At least 95% of survival rate shall be achieved at the end of establishment period
	% or m2	Vegetation coverage	Denude area <5% of total area of <3 m2 (whichever is smaller) at all times
Attrition/Mortality	%	Survival rate	>95%
Plant Life Span	Years	--	5-25 years with >90% natural survival rate
Inherent Moisture Retention Capacity	Days	--	Moisture content of sample >30% after a dry period
Resilience	--	Extreme Weather Resilience	Survival rate >95% during, Heat spells: < 3days at 40°C Max Nuisance flooding:< 3 days
Root Measurement	kgs/ grams	Roots Shoots Ratio	Root:Shoot ratio between 1:5 to 1:6

Use

Water biofiltration is most commonly used in improving stormwater and wastewater quality prior to runoff into a water catchment area or the natural waterway system.

Monitoring and Maintenance

The following tables (Table 5 and Table 6) provide recommended monitoring and maintenance tasks for vegetated biofiltration media and their frequencies. Regular monitoring and maintenance are required to ensure a well-performing biofiltration system.

Table 5 Monitoring tasks and their recommended frequencies

Object	Tasks	Frequency
Media	Solids Pollutants removal	Half-yearly
	Hydrocarbons removal	Yearly
	Metals removal	Yearly
	Nutrients removal	Half-yearly
	Micro-organism removal	Yearly
Assets	Life-span prediction	Before start of project
	Periodical assessment	At least once every 5 years
	Damage or failure	On reporting
Vegetation	Establishment	At least twice 6 to 9 months from planting
	Attrition	At least twice 6 to 9 months from planting
	Aesthetics	At least once every 3 years
	Species effects	At least once every 3 years
	Resilience	At least once every 5 years, or once a year during dry spells
	Extreme weather events	On event

Table 6 Maintenance tasks and their recommended frequencies

Object	Tasks	Frequency
Media	Replacement	Non-vegetated system: Every 10 years; or >50% of the pollutants' outflow concentrations are higher than limits (Table 13), whichever comes first
		Vegetated system: Every 15 years; or > 50% of the pollutants' outflow concentrations are higher than limits (Table 13); or plants are not healthy due to possible low nutrient level, whichever comes first
	End-of-life span	Every 20 years

Object	Tasks	Frequency
Assets	Routine maintenance	Every 5 years
	Failure replacement	On reporting
	End-of-life span replacement	Varied for each asset, usually approximately every 50 years
Vegetation	Replant and replace	Survival rate < 85%; or denude area > 5% of total area; or > 3 m ² , whichever comes first
	Watering	If no precipitation or <5 mm for 6 months, water once a month
	Trimming and harvesting	Half yearly trimming. Yearly harvesting or whenever fruiting.

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Disclaimer

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Glossary

Terminology	Definition
AS 4454	Australian Standard 4454-2012: <i>Composts, soil conditioners and mulches</i>
EC	Electrical conductivity
NSW EPA	New South Wales Environment Protection Authority
RO	Recycled organics
RRE	Resource recovery exemption
RRO	Resource recovery order

NSW Environment Protection Authority

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