Compost specifications for landscape applications

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, composts made with biosolids or solid or liquid food wastes.*

General Specifications

Many of the criteria listed in AS4454 are relevant to composts for landscaping applications, as they specify the basic suitability of compost for land application. These characteristics apply equally to the wide range of landscaping application.

Landscape applications rely on high quality materials (plants and media) to produce a long-lasting and attractive garden or park. Composts used in this setting need to perform immediately and reliably. Landscaping composts need to be consistent in character and available in large volumes.

The general product specifications for composts to be used in pastures are presented in Table 1.

* 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.

Table 1 General product characteristics for compost used for landscape applications (Source: AS4454)

Characteristic	Unit	Target / typical range	Advice
pH (1:5 water)	pH units	Range 5.5 – 8.0	If >8.0 determine total $CaCO_3$ content
Electrical Conductivity (EC)	dS/m	< 6	High EC may limit application rates
Organic Carbon	% dry matter	15 - 25	Generally higher organic carbon is preferable for composts of equivalent maturity
Carbon: Nitrogen Ratio	(C:N)	Typically 20:1 – 25:1	A higher C:N is generally preferred

Acceptable contamination levels

Composts used in landscaping should be as free as possible from all types of contamination. Compost not meeting the limits in Table 2 should be rejected due to possible environmental, animal and human health risks. Most producers will supply a sample of their products if requested.

Table 2 Maximum acceptable level of contaminants for landscaping use

Biological Contamination			
Plant Propagules	Unit	Recommendation	
Viable Plant Propagules	Number	Nil after 21 Days	
Vermicast Sieve Test	% Volume	Nil after 21 days for the fraction ≥ 90% passing the 1.18 mm sieve	
Microbial Contaminant	Unit	AS4454 Limit[1]	RRO Limit[2]
E. coli	MPN/g	-	<100
Salmonella	cfu/g	Absent in 50g	Absent in 25g
Faecal Coliforms	MPN/g	<1,000	<1,000

Physical Contaminants			
Material	Unit	Recommended Limit	AS4454 limit[3]
Glass, Metal and Rigid Plastic > 2mm	% dry matter (dm) (w/w)	≤ 0.25	<0.5
Plastic - light, flexible or film > 5mm	% dm (w/w)	≤ 0.025	<0.05
Stones and Lumps of Clay	% dm (w/w)	≤ 2.5	<5

1 As specified in Australian Standard AS4454-2012

2 NSW Compost Order 2016

3 Compost Order 2016 and the Pasteurised Garden Organics (PGO) order both require these limits for rows 1 and 2. PGO Order at: **www.epa.nsw.gov.au**

Chemical Contaminants					
Heavy Metals	Unit	AS4454	Other Chemicals	Unit	AS4454
Arsenic	mg/kg	20	DDT/DDD/DDE	mg/kg	0.5
Cadmium	mg/kg	1	Aldrin	mg/kg	0.02
Boron	mg/kg	100	Dieldrin	mg/kg	0.02
Chromium	mg/kg	100	Chlordane	mg/kg	0.02
Copper	mg/kg	150	Heptachlor	mg/kg	0.02
Lead	mg/kg	100[4]	HCB	mg/kg	0.02
Mercury	mg/kg	1	Lindane	mg/kg	0.02
Nickel	mg/kg	60	BHC	mg/kg	0.02
Selenium	mg/kg	5	PCBs	mg/kg	0.2
Zinc	mg/kg	300			

Performance characteristics

Beyond the quality characteristics specified in AS4454 there are several more characteristics that impact upon compost performance in the field. These performance characteristics differ slightly with each type of application due to planting and situation requirements and can also be modified and amended after the composting process to create 'fit-for-purpose' composts suited to specific uses. Table 3 provides recommendations for nutritional characteristics of composts designed for use in planted landscapes.

Composts may be used as stand-alone bedding material or blended with virgin excavated material (VENM) to create a potting or planting media. The requirement to blend will depend on the application and factors such as:

- plant material requirements and characteristics
- drainage requirements
- slope to terrain characteristics
- whether use is on ground surface or planting beds.

4 Note that this differs from AS4454 limit of 150mg/kg. Clause 43 of the Biosecurity Regulation 2017 sets 100mg/kg as the maximum allowed concentration for lead (Pb) in a fertiliser. Fertilisers include composts. Clause 44 of the Biosecurity Regulation 2017 also refers to label requirements on fertilisers that exceed 'trigger levels' for lead, cadmium and mercury of 20, 1 and 0.2mg/kg respectively. The label requirements advise that use of the product may result in the accumulation of those metals in the receiving soils. **legislation.nsw.gov.au**

Table 3 Recommended characteristics for compost designed for use in landscape applications.

Characteristic	Unit	Typical range or desirable level	Advice for landscaping uses		
			In planting beds	On ground surface	As landscape mulch
pH (water 1:5)	pH units	5.5 - 8.0	Compost has a natural pH buffering effect due to the high organic matter content. This can counter-balance the acidifying effects of some fertilisers. If blending with VENM, conduct soil test results and use higher pH or lime-amended compost for very acid soils and an unamended or lower pH compost for neutral to alkaline soils. This test will guide the choice of compost but is unlikely to be a limiting factor.		
Total CaCO3 Equivalent		6.5-8.0 Report only when pH>8	Compost acts as a pH buffer to maintain desired pH.. Lime can be added to composts after production and prior to land application to increase the liming effect if required.		
Electrical Conductivity (EC)	dS/m	<6	High EC may limit application rates and impact on salt intolerant plant species.		
Nitrogen (N) – Total	% dry mass	[3]1.55 for composts claiming to be providing plant nutrition Typical range: 0.8 - 1.9	About 25-30% of total N in composts is likely to be available in the first year, and about 10% and 5% available in the subsequent 2nd and 3rd years. Therefore, 10 wet tonnes (at 50% moisture) of typical compost can contribute 8 -19 kg N which is approximately equivalent to 15 - 35 kg Urea. The remainder remains unavailable to plants in the long term. In colder climates, these proportions are reduced.		
			Composts with higher total N have a greater potential of releasing N over time thus providing a long-term source of N. Typical N requirement for 100-200 kg N/ha /yr. As a guide, compost is unlikely to supply sufficient N, at least during periods of high N demand such as immediately after planting and in the first year of growth and establishment.		
Nitrogen – Ammonium	mg/L in solution	<100 for mature composts Typical range: 10 - 200	Ammonium is a readily plant available form of nitrogen. Mature composts should have low levels of ammonium.		
Nitrogen – Nitrate	mg/kg dry mass	>50 for composts claiming to be providing plant nutrition Typical range: 5-300	Nitrate nitrogen (NO3) is a readily plant available form of nitrogen. Mature composts should have high levels of nitrate. Generally, composts will not provide sufficient crop N without the compost being amended with additional N by including manures, biosolids or another high N source.		

Characteristic	Unit	Typical range or desirable level	Advice for landscaping uses
Phosphorus (P) – Total	% dry mass	>0.5 for composts claiming to be providing plant nutrition Typical range: 0.1 - 1.1	About 40% of the total P in compost will be available in the first year after application under different climate and soil types. Therefore, at 0.5% P content, 10 wet tonnes of compost (at 50% moisture) would contain 20 kg P. This would provide 8 kg of plant available P and be equivalent to 65 -90kg of super-phosphate. The availability in subsequent years is about 20% in the second year and 10% in the third year of compost application. High application of compost (>20 t/ha) may impact phosphorus sensitive species.
			Compost with low P is desirable in soil with high P reserves (>150mg/kg) or for majority Proteaceous plantings, P may limit compost application rate, particularly if fertilising history includes poultry manure application. Generally, application rates determined to satisfy plant N demands are sufficient to cover P requirements.
Phosphorus – Soluble	mg/L	>200 for compost claiming contribution to plant nutrition Typical range: 15 - 350	Soluble P contributes significantly to plant nutrition and the level is used to calculate compost application rate and nutrient budgeting. Generally, plant requirements for soluble P range from 50 to 75 mg/kg for medium to high production. Levels of soluble P in excess of this may leach from the soil and cause environmental issue in waterways. Compost with higher P needs to be used at lower rates in soil with high P to avoid this and plant P toxicity.
Potassium (K)	% dry mass	>0.8 for composts claiming to be providing plant nutrition Typical range: 0.5 - 1.0	About 80% of compost applied K will be available in the first year after application and the remaining K will be available in the second year after application. At 0.8% K content, 10 wet tonnes of compost would provide 28kg K. This would be approximately equivalent to 70kg potassium sulphate.
Sulphate (S)/ Sulphur	% dry mass	Typical level: >0.3	Sulphur is rarely a concern as a deficient nutrient except in sandy soils. Composts generally supply sufficient S to cover plant requirements. Over supply of S is rarely an issue and compost only contain elevated sulphur levels when feedstock contains high amounts.
Sodium	% dry mass	Recommended level: <1	Some composts, in rare occasions, may have elevated levels of salts, particularly NaCl depending on feedstock. Lower sodium levels are preferable, particularly in areas with sub-soil salinity.
Chloride	mg/kg dry mass	Recommended level: <600	Chloride levels also should be as low as possible. Compost with low chloride should be used on land with sub-soil salinity. Generally, sodium and chloride are not an issue when EC is low (<4 dS/m).

Characteristic	Unit	Typical range or desirable level	Advice for landscaping uses		
Trace elements			Composts can provide very useful levels of trace elements. These are generally immediately available in composts with neutral pH. Demands for trace elements vary widely with plant species, however most composts contain adequate amounts of these trace elements.		
Physical characteristics					
Particle size		70- 80% < 16mm 10- 20% > 25mm	98% < 12mm 1% > 25mm	As planting media - 90% < 12mm 5% > 25mm As topdressing – 100% <12mm	99% > 25mm
Stability and Maturity		See Table 4	Pass at least 4 maturity tests (Table 4)		

Compost maturity and stability

The maturity and stability of composted products impacts the performance of the product once it is placed on the soil surface or incorporated. If a compost is applied before it is biologically stable and mature the composting process can continue in the field.

The maturity of compost refers to the degree of phytotoxicity. Immature compost will contain more growth-inhibiting compounds that are associated with the early stages of the composting process than mature compost. More mature compost exhibits lower levels of phytotoxicity and a higher degree of stability.

In vegetable production it is particularly important that compost is properly composted and stable. Immature and unstable compost will deplete the soil of plant nutrients required for the crop.

Table 4 below shows how AS4454 differentiates between composted (immature) and mature compost products using various technical measures of compost maturity:

- composted product must meet three of the criteria with at least one from Group A (Biological Activity) and one from Group B (Plant Growth)
- mature composts must meet four of the criteria with at least two from Group A (Biological Activity) and two from Group B (Plant Growth).

Only mature compost should be used in landscape applications.

Table 4 Maturity criteria for composts

Parameter		Composted product	Mature compost
Group A - Biological Stability		**Pass at least 1 out 3**	**Pass at least 2 out of 4**
Solvita® Maturity Index		≥ 5 or 6	≥ 7 or 8
Nitrogen Drawdown Index (NDI)		>0.2	> 0.5
Specific oxygen uptake rate (mg O_2/g BVS/hr) at 30°C		< 3	≤ 1
Carbon dioxide respiration (mg CO_2/g BVS/day) at 30°C		≤ 12	≤ 8
Dewar self-heating (°C)		≤ 20°C	≤ 10°C
Group B - Plant Growth Tests		Pass at least 1 out of 3	Pass at least 2 out of 4
Ammonium N (mg/kg)		< 200	< 100
Plant growth test (Bioassay)	Root length (mm)	> 60mm	N/A
	In-vitro germination and root elongation (% of control)	> 80%	> 90%
	Seedling emergence (% of control)	Emergence >80%, Vigour >85%	Emergence > 90%, Vigour > 95%
Ammonium to Nitrate ratio		< 3.0	< 0.5
Volatile Fatty Acids (moles/g dry mass)		< 1,000	< 200
NH_3 volatile ammonia (gas) (ppm/4-hour test)		< 800 (≥ Solvita® 4)	< 100 (≥ Solvita® 5)

Use

The following are recommendations for the variety of landscape applications to obtain consistent and optimal benefits (Table 5).

Table 5 Recommendations for use

Application	Coverage/application rate	Notes	Additional fertiliser application
Planter Box Media	Blend with VENM 1:1	Courser compost required to improve drainage yet have sufficient water holding capacity	Blend required fertiliser into compost/soil mix
Garden/flower bed planting media	Blend with VENM 30:70	Disturb underlying surface to ensure rough texture to avoid shining and prevent water repellence.	Blend required fertiliser into compost/soil mix
Mulch applications	25-75mm depth to supress weeds	Apply as soon as possible after planting.	
Plant/garden maintenance (topdressing)	20-50mm depth, lightly incorporated	Water in well after application.	Apply fertiliser to surface prior to compost
Grass/lawn bedding	50-70mm depth as underlay	Disturb underlying surface to ensure rough texture top avoid shining and prevent water repellence.	
Lawn topdressing	5-10mm depth, lightly worked over	Water in well after application.	
Tree establishment	Blend with onsite excavated soil 1:3 – sandy soils 1:4.5 loamy soils 10:1 clay soils	Excavate planting hole equal in depth but 2-3 times the width of the root ball.	Apply fertiliser to surface after planting

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Disclaimer

Glossary

Terminology	Definition
AS 4454	Australian Standard 4454-2012: *Composts, soil conditioners and mulches*
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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