

## Information Sheet No. 3-5

### Commercial Laboratory Testing for Quality

#### Recommended tests and how to select an independent laboratory

Information Sheet No. 3-5  
Third Edition 2007

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#### When is commercial laboratory testing necessary?

Periodic commercial laboratory testing by an independent laboratory is necessary to ensure that products manufactured conform to customer requirements or pre-designed specifications.

Commercial laboratory (off-site) testing complements field and on-site testing performed at a composting facility to achieve good *process control* (see Information Sheet Nos. 3-3 and 3-4).

Testing by an off-site laboratory (e.g. Plate 1) provides manufacturers and customers with assurance that products generated are of a certain quality.

On-site testing, such as that performed in the field and in an on-site laboratory are critical components of a good process control system at a composting facility.

Process control is defined as the stringent and documented monitoring of all critical control points in a composting operation so as to minimise defects and make products which can be guaranteed to customers (Recycled Organics Unit, 2002).

Testing done on-site, particularly on final products, however, should be verified by an independent off-site laboratory.

Self-declaration of product quality may not be sufficient to provide consumers with purchasing confidence. This is particularly true for products suited to emerging agricultural markets.

Commercial laboratory testing of products manufactured is required if product certification under an Australian Standard is sought (see Information Sheet No. 3-2).

**Plate 1.** Photograph of a commercial off-site environmental laboratory, capable of testing composts, soil conditioners, mulches, potting mixes and soils.



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Periodic off-site testing is necessary if the composting facility is to apply for *quality management system* certification (see Information Sheet No. 3-2). Quality system certification is a consumers guarantee of the manufacturer's commitment to quality.

In some cases, off-site testing may be done periodically if a purchaser requires a batch of product to meet a given standard.

Production of quality compost is necessary not only to build a large client base, but also to expand the market for, and profitability of manufacturing compost and products containing recycled organics.

Please note that sample handling and management guidelines for consistent analysis of product quality for use by laboratories are provided in Information Sheet No. 3-11.

### Recommended off-site tests for quality

Off-site testing is often performed on new *feedstocks* that are considered being processed on-site, and on the final products manufactured.

Tests on feedstocks that have not been previously processed on-site is necessary to determine whether the material is of sufficient quality so as to not affect the performance characteristics of final products manufactured.

Tests performed will depend on the source of the feedstock and required characteristics and quality of products manufactured.

For new feedstocks being considered for use, basic tests that should be performed include:

- total carbon;
- total nitrogen;
- pH;

- electrical conductivity; and
- chemical contamination (e.g. heavy metals and chlorinated hydrocarbons)

Note that pH and electrical conductivity tests can easily be performed on-site. Methods are described in Information Sheet No. 3-4.

### Total carbon and total nitrogen

Total carbon and total nitrogen are used to calculate the carbon to nitrogen ratio (g carbon per g nitrogen on a dry weight basis, or *C:N ratio*) of a feedstock.

Determining the C:N ratio of a feedstock is important as this is a measure of the ability of microorganisms to initiate and complete the composting process.

Woody garden organics, for example, have a high C:N ratio (e.g. 100-300:1) — meaning that they are high in carbon and low in nitrogen.

Woody materials such as these are not easily degraded by microorganisms because they contain little nitrogen. Microorganisms need nitrogen so that they can make proteins and other substances to grow and divide.

For this reason, woody *garden organics* (for example) may have to be blended with other feedstocks that have a low C:N ratio — that is, materials high in nitrogen, such as food organics, manure or biosolids.

The optimum C:N ratio for good composting is between 25 and 35:1, depending on the type of composting system employed (Standards Australia AS 4454, 2002).

### pH

*pH* is a measure of how acid or alkaline a material is. pH influences

## Definitions

### Process Control

Stringent and documented monitoring of all critical control points in a composting operation so as to minimise defects and make products which can be guaranteed to customers.

### Quality Management System

A set of procedures an organisation establishes to guarantee its products will satisfy consumers.

### Feedstock

Organic materials used for composting or related biological treatment systems. Different feedstocks have different nutrient concentrations, moisture, structure and contamination levels (physical, chemical and biological).

### C:N Ratio

The ratio of the weight of organic carbon (C) to that of total nitrogen (N) in an organic material.

### Garden Organics

Any garden derived organic (plant) materials generated by domestic, C&D and C&I sources. Garden organics is defined by its component materials including: putrescible garden organics (grass clippings); non-woody garden organics; woody garden organics; trees and limbs, and stumps and rootballs. Garden organics is one of the primary components of the compostable organics stream.

### pH

A measure of the concentration of hydrogen ions in a solution. pH is expressed as a negative exponent. Material that has a pH of 8 has ten times fewer hydrogen ions than a material with a pH of 7. The lower the pH, the more hydrogen ions are present, and the more acidic the material is. The higher the pH, the fewer hydrogen ions present, and the more basic it is. A pH of 7 is considered neutral.

### Electrical Conductivity

A measure of a solution's ability to carry an electrical current; varies both with the number and type of ions contained in the solution. Usually measured in deci-siemens per metre (dS m<sup>-1</sup>).

the availability of nutrients and plants vary in their tolerance to pH.

New feedstocks processed at a facility should be tested for pH to determine whether they can be composted in their present condition. Such tests will establish whether amendments need to be added to adjust pH.

Most feedstocks processed at composting facilities tend to have a pH between 6 and 8.

### Electrical conductivity

*Electrical conductivity* is a measure of how salty a material is. Composts high in salts can kill plants by causing water stress and specific ion toxicity.

Electrical conductivity increases as the concentration of soluble salts increases.

New feedstocks processed at a facility should be tested for electrical conductivity to determine whether they can be composted and formulated into quality products.

Such a test may indicate that highly saline feedstocks (e.g. >2 dS/m) cannot be composted as they will raise the electrical conductivity of the final product to an unacceptable level.

The maximum electrical conductivity of a feedstock accepted at the gate will depend on the nature of products manufactured by the facility and customer requirements.

### Chemical contamination

Testing may be required to ensure feedstocks do not contain significant loadings of chemical or organic contaminants (e.g. heavy metals and chlorinated hydrocarbons) that are toxic to plants and animals (e.g. biosolids and some industrially-produced organics).

Standards Australia (AS 4454, 2002) states that all pasteurised and composted products should comply with the National Health Standards (ARMCANZ, 1995) or existing biosolids guidelines (e.g. NSW EPA, 1997), whichever is more stringent for chemical and organic contaminants. In NSW, the NSW EPA biosolids guidelines are more stringent than ARMCANZ (1995).

A range of additional tests may be required on the final product(s) manufactured to confirm the quality of the material.

Tests used will depend on the type of product manufactured and its intended use.

Recommended tests for products containing recycled organics, such as composts, soil conditioners, mulches, potting mixes, soils for landscaping and garden use, and mulches used for playground surfacing — can be found in the following Australian Standards and in the subsequent Information Sheets:

- AS/NZS 4422 (1996). Playground surfacing—specifications, requirements and test method (Information Sheet No. 3-7);
- AS 4454 (2002). Composts, soil conditioners and mulches (Information Sheet No. 3-8);
- AS 3743 (2002). Potting mixes. (Information Sheet No. 3-9);
- AS 4419 (2002). Soils for landscaping and garden use (Information Sheet No. 3-10).

Note that to demonstrate compliance with an Australian Standard under a product certification scheme, and/or in a registered quality management system, type testing and regular auditing is performed by an independent third party.

Auditing is done to ensure that products conform to specifications and standards, and that a company's operations are consistently capable of producing quality products.

### Sampling and sample preparation

Sampling procedures to follow for off-site laboratory testing will depend of the range of test(s) to be performed and the type of testing procedures.

General batch and in-process sampling procedures for compost or related products can be viewed in Information Sheet No. 3-3.

Advice on specific sampling requirements can be obtained from an off-site laboratory.

In general, all samples should be put into a tough polythene bag, clearly labelled (e.g. type of sample, date of sampling and client name) on the outside with a waterproof marker; taped or tied securely, and despatched to the laboratory by postal bag or courier on the same day of sampling for testing.

Further information is provided in Information Sheet No. 3-11.

### How to select a laboratory

To obtain high quality service — that is, prompt testing, results and interpretations that are consistently reliable — an independent and quality assured laboratory should be used that has expertise in the area of testing required.

As a minimum requirement, recognised laboratories with ISO 9000:2000 certification should be used for testing.

Laboratories with ISO 9000:2000 certification have an audited and registered quality management system — a customers guarantee the company has a commitment to quality.

Laboratories that just have ISO 9000:2000 certification, however, do not undergo comprehensive technical evaluation, meaning that they may not be properly equipped to undertake certain testing procedures, although they do have a quality management system in place.

Laboratories accredited by the National Association of Testing Authorities (NATA), however, are technically assessed for testing proficiency on a regular basis.

Technical accreditation through NATA is the most definitive indication of a testing facility's specific technical competence. It identifies capability and proficiency in the relevant sampling and testing procedures, which are not identified or evaluated under ISO 9000:2000 certification. The logo is shown in Figure 1.

**Figure 1.** NATA accredited laboratory logo.



This type of accreditation system enables people who want a product, material or instrument to be checked or calibrated to find a reliable testing or calibration service able to meet their needs.

Such accreditation also provides clients with confidence in results.

The accreditation process involves a thorough evaluation of all the elements of a laboratory that contribute to the production of accurate and reliable data. These elements include staffing, staff qualifications, training, supervision, quality control, sample management, equipment, recording and reporting

of test results and the environment in which the laboratory operates.

Importantly, laboratory accreditation provides formal recognition to competent laboratories, thus providing a ready means for customers to access reliable testing and calibration services.

When selecting a provider of laboratory services, consideration should be given to whether the laboratory is accredited to undertake the required tests.

Tests used for a range of products should be based on those reported by Standards Australia.

Use of standard testing methodologies is the key to gaining reliable and useful results that can help an operator maintain quality at a composting site.

### How to interpret a laboratory report

Certified or accredited laboratories do not always provide written interpretation of testing performed on samples of material submitted for analysis.

This is because they do not possess suitably qualified staff to offer such services.

Interpretation services are very helpful because it is difficult for non-specialists to determine the meaning of test results, and assess how they can be applied in the field to improve a process or the quality of a product manufactured.

All laboratory services should report test results in standard units. Standard units of measurement are used when laboratories base their testing methodologies on particular Australian Standards.

Confusion over the meaning of test results often occurs when

laboratories do not use standard units for reporting.

Laboratories that do not report test results in standard units (e.g. mS instead of dS/m when measuring the electrical conductivity of an organic product) should be avoided.

When test results (based on an Australian Standard) are reported in standard units and in an appropriate format, the Australian Standard can be used to make further interpretations and sound recommendations for action.

A relationship with a suitably certified or accredited laboratory is necessary for a composting operation to be quality orientated.

### Case studies

#### Example of a poor laboratory report

An example of a poor laboratory report is shown in Figure 2.

Critical comments are noted in Figure 2.

#### Example of a good laboratory report

An example of a good laboratory report is shown in Figures 3 and 4.


Critical comments are noted in both figures.

**Figure 2.** Example of a poor laboratory report. Comments are noted in the call-out boxes.

## Laboratory Services #1

190 Thompson St  
Savannah NSW 0000

Tel: (02) 0000 1111  
Fax: (02) 0000 0111



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### TEST REPORT: Nutrient assessment of compost

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Date sample received: 12/12/2002  
Client: Mr John Citizen  
Quality Compost Products Pty. Ltd.  
101 Thine Rd  
Timber NSW 0101

TEST	UNIT	RESULT
pH	pH units	7.4
Conductivity	µS	1555
Ammonium-N	ppm	110
Ammonium-N + Nitrate N	ppm	112
Total N	%	0.71

Signed:  
  
*Tony L James*  
  
Consultant

No job number specified – possible indicating that no internal records are kept.

No quality system specified – no guarantee of quality.

No info regarding condition of sample received.

No comparison to a standard and no interpretation provided.

How many pages are in this report? Are there pages missing?

What methods of testing were used?

Was the analysis checked by a second person? No internal quality control.

No summary or recommendations provided.

Non-standard units - µS should be dS/m and ppm should be mg/L. Difficult to compare these results with a standard.

**Figure 3.** Example of a good laboratory report. Note that page 2 of this example is shown in Figure 4. Comments are noted in the call-out boxes.


### Laboratory Services #2

ABN 000 000 000

*Specialising in the Analysis of Compost and Products Containing Recycled Organics*

124 King St  
Travell NSW 1111

Tel: (02) 0000 1111  
Fax: (02) 0000 0111



Laboratory Services #2 is a NATA accredited laboratory with expertise in testing to AS 4454, AS 3743, AS 4419 and AS 4422.

Note: All results and recommendations assume that samples(s) provided are representative of bulk material.

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#### TEST REPORT: Nutrient assessment of compost

Date sample received:	12/12/2002
Sample identification:	1109-2002
Sample condition:	Compost, moist (fresh as required)
Client:	Mr John Citizen Quality Compost Products Pty Ltd 101 Thine Rd Timber NSW 0101
Test(s) required:	Basic nutrient assessment
Product compliance requirements:	Composted soil conditioner
Testing methodology:	Australian Standard AS 4454 (2002)

TEST	UNIT	RESULT	QC(%) <sup>1</sup>	AS4454	COMMENTS
pH	pH units	7.4	101	5.0-7.5	Pass
Conductivity	dS/m	1.55	97	No limit	<sup>2</sup> Pass
Ammonium-N	mg/L	110	98	<300	Pass
Nitrate-N	mg/L	47	100	>10	<sup>3</sup> Pass
Total N	%	0.71	99	>0.8	See note 4

**Notes:**

- Tests were performed with reference to an internal standard for quality control (QC) purposes. QC results within 3% of the range of internal standard (97-103%) are acceptable.
- See *Summary and Recommendations* on page 2.
- See *Summary and Recommendations* on page 2.
- See *Summary and Recommendations* on page 2.

Signed:  
*Robin F Thomas*  
Chemist

Checked by:  
*Sue Smith*  
Quality Manager

\*\*\* Customer Support Line 1800 000 222 \*\*\*

Page 1 of 2

Sample identification provided. Evidence of internal record keeping.

Testing methods specified.

Analysis checked by a second person

NATA accreditation. Laboratory has a quality system in place and has expertise in required tests.

Necessary limitations of test is specified.

Sample condition specified

Type of test required, product type, level of compliance and methodology used.

Comparison to standard provided. Standard units are used. Internal QC results reported. Interpretation of results based on standard.

Additional customer support available.

Summary and recommendations provide (page 2).

Size of report specified. No pages missing.

**Figure 4.** Page 2 of the good laboratory report example as shown in Figure 3. This page provides an interpretation of the laboratory results and recommendations based on the testing done. Comment noted in the call-out box.

Good clear interpretations and recommendations provided to the client.

## Laboratory Services #2

ABN 000 000 000


*Specialising in the Analysis of Compost and Products Containing Recycled Organics*

124 King St  
Travell NSW 1111

Tel: (02) 0000 1111  
Fax: (02) 0000 0111

Laboratory Services #2 is a NATA accredited laboratory with expertise in testing to AS 4454, AS 3743, AS 4419 and AS 4422.

Note: All results and recommendations assume that samples(s) provided are representative of bulk material.



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### SUMMARY AND RECOMMENDATIONS

The sample supplied meets the tested criteria for a composted soil conditioner as specified in AS 4454 (2002) Composts, Soil Conditioners and Mulches. For compliance to AS 4454, a full test would need to be performed.

Note 2: There is no electrical conductivity (EC) requirement for a soil conditioner to pass AS 4454. However, for soil conditioners with and EC greater than 1 dS/m, application rates to soil need to be limited and be stated on the primary package. Based on the sample analysed, application rate should be limited to <15 L/m<sup>2</sup> for sensitive plants and <60 L/m<sup>2</sup> for tolerant plants.

Note 3: Ammonium levels are acceptable but nitrate levels are low. This indicates that the composted soil conditioner is not fully mature. Storage under aerated conditions would improve nitrate levels. To pass AS 4454, this is not required.

Note 4: Total N is less than that required in AS 4454 if a claim to plant nutrition is claimed. In this case, a claim to plant nutrition cannot be made on the primary package.

Signed:  
*Robin F Thomas*  
Chemist

Checked by:  
*Sue Smith*  
Quality Manager

\*\*\* Customer Support Line 1800 000 222 \*\*\*

Page 2 of 2

**Notes:**

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*Important references*

- ARMCANZ Water Technology Committee (1995). Australian Guidelines for Sewage Systems—Biosolids Management. Occasional Paper WTC No. 1/95.
- NSW EPA (1997). Environmental Guidelines: Use and Disposal of Biosolids Products. NSW Environment Protection Authority, Chatswood, NSW.
- Recycled Organics Unit (2002). Guide to Developing a Process Control System for a Composting Facility. Second Edition. Recycled Organics Unit, internet publication: [www.recycledorganics.com](http://www.recycledorganics.com)
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- Standards Australia (2002). AS 3743—Potting mixes. Standards Association of Australia, Homebush, NSW, Australia.
- Standards Australia (2002). AS 4419—Soils for landscaping and garden use. Standards Australia, Homebush, NSW.
- Standards Australia (2002). AS 4454—Composts, soil conditioners and mulches. Standards Australia, Homebush, NSW.

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