Environment Agency

Evidence

Material comparators for end-of-waste decisions

Materials applied to land: soil improver

Report – SC130040/R2

Version 2

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Executive summary

This report details work carried out to characterise certain soil improvers, a key non-waste comparator. This information will inform end-of-waste assessments for waste-derived materials intended to replace soil improvers that are applied to land.

The Waste Framework Directive (Article 6) provides criteria for identifying when a waste material has become a product and no longer needs to be regulated as a waste. Through Article 6 the case law requires us to consider the environmental and human health impacts from materials in comparison with their non-waste material alternatives.

> *... "It should be enough that the holder has converted the waste material into a distinct, marketable product, which can be used in exactly the same way as a [non-waste material], and with no worse environmental effects..."*

Market research was used to define soil improver as an ordinary comparator and a literature review was used to identify any existing published data.

A limited number of suitable pre-existing datasets were found during the literature review.

Twenty-two samples of soil improver were collected from various suppliers across England. Analytical data from these samples are presented in this report.

We recommend comparing the concentrations of analytes in the comparators dataset to the concentrations in the waste-derived material, paying attention to the higher values. This comparison does not constitute a pass/fail test or an end of waste view. It will provide an indication of whether the waste material contains similar levels of analytes to non-waste materials and whether an end-of-waste application may be appropriate or that further analysis or improved treatment processes may be warranted.

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Contents

1 Introduction

To define end-of-waste criteria, the Environment Agency requires a set of ordinary material comparator data for use as a benchmark against which to assess other materials and wastes.

Article 6 of the Waste Framework Directive provides criteria for identifying when a waste material has become a product and no longer needs to be regulated as a waste. Through Article 6 the case law requires the environmental and human health impacts from materials to be considered in comparison with their non-waste material alternatives. In particular the Court of Appeal judgement in OSS Group Ltd v Environment Agency (2007) contained the statement:

> 'It should be enough that the holder has converted the waste material into a distinct, marketable product, which can be used in exactly the same way as a [non-waste material], and with no worse environmental effects.'

The purpose of this report is to provide an evidence base of the composition and characteristics (beneficial and potentially unbeneficial) of soil improver which is defined as an ordinary material comparator that is currently permitted for beneficial application to land. The report presents the results from the primary analysis of 22 soil improver samples.

Six other reports cover ordinary material comparators applied to land:

- manufactured fertilisers
- non-waste biochar
- non-waste wood
- PAS 100 compost
- peat
- straw

2 Definition

2.1 Definition and uses

2.1.1 Whole digestate

Whole digestate is defined as whole digestate that is compliant with PAS 110 and the Quality Protocol for anaerobic digestate (WRAP and BSI 2010a, WRAP and Environment Agency 2009a). Whole digestate can be used in the following designated market sectors:

- agriculture

- forestry
- soil/field-grown horticulture as a fertiliser or soil improver

The whole digestate can only be used where it does not pose a risk to the environment and does not compromise the future sustainability of the soil.

2.1.2 Primary gypsum

Primary gypsum is defined as gypsum from natural sources. Primary gypsum in the form of agricultural gypsum is applied to land.

2.1.3 Liming materials

An agricultural liming material is defined as a material that contains calcium and magnesium compounds that are capable of neutralising soil acidity. These materials include limestone, chalk, quicklime, hydrated lime, marl, shells and by-products such as slag.

2.2 Properties

2.2.1 Whole digestate

Whole digestate contains substantial quantities of readily available plant nutrients, especially nitrogen, and can improve soil organic matter content. Test parameters and upper limit values for use on land are detailed in PAS 110 and the Quality Protocol for anaerobic digestate. Seven Potentially Toxic Elements (PTEs) are identified with upper limits specified. Other undesirable properties include the potential presence of high levels of *Salmonella* and *Escherichia coli*, volatile fatty acids, residual biogas potential and physical contaminants.

2.2.2 Primary gypsum

Gypsum corrects soil acidity in highly acidic soils, improves soil organic matter stability and can be used to reclaim saline soils. Gypsum can be used as a soil conditioner – improving structure and tilth. It can re-flocculate clay particles and is a source of calcium and slow-release sulphur. Gypsum has a small liming effect (around 10% neutralising value) and is very effective at neutralising subsoil acidity.

2.2.3 Liming materials

The effectiveness of a liming material depends on its neutralising value, the fineness of grinding, reactivity and the relative hardness of the parent rock. The effective neutralising value of a lime is the ability for a unit mass of lime to change soil pH. This value takes into account the chemical composition, particle size distribution (percentage by weight) and the solubility of the lime.

Agricultural lime increases the availability of major nutrients nitrogen, phosphate and potassium by:

- increasing nitrogen fixing in legumes and free-living bacteria
- increasing nitrogen, potassium and phosphorous release from organic matter through higher microbial activity
- releasing phosphate from iron and aluminium
- reducing potassium loss from leaching

Agricultural lime increases the availability of minor nutrients (sulphur, calcium and magnesium) by:

- increasing sulphur, calcium and magnesium release from organic matter through higher microbial activity
- reducing calcium and magnesium loss by reducing leaching
- supplying calcium and magnesium

3 Comparator sub-types

To provide primary data for this project, 22 soil improver samples were taken from a variety of locations across England and from a variety of sub-types. Three of the 22 samples were whole digestate, three were primary gypsum and 16 were liming materials (Figure 3.1). The liming materials sub-type can be further divided as shown in Figure 3.2.

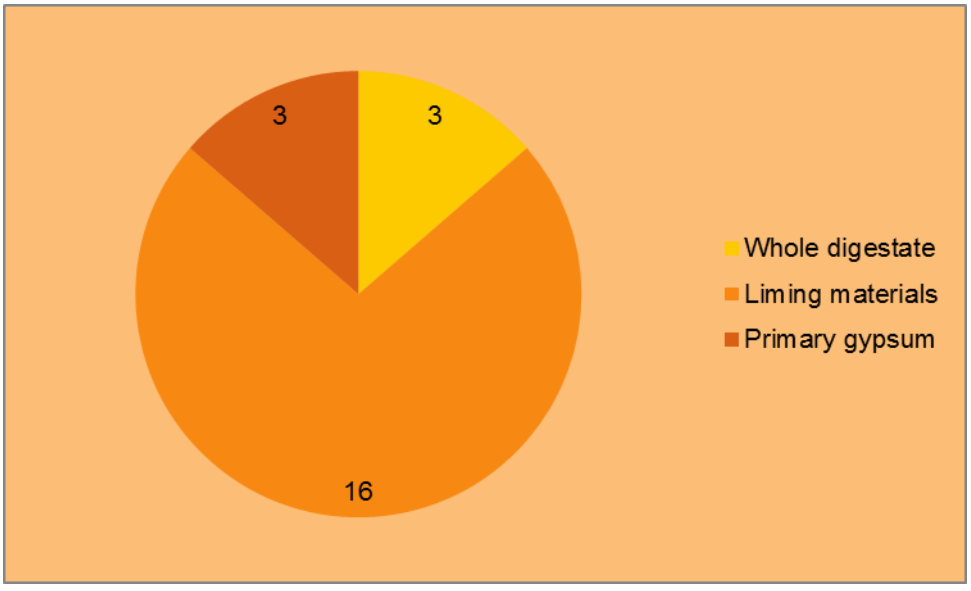

Figure 3.1 Soil improver sub-types

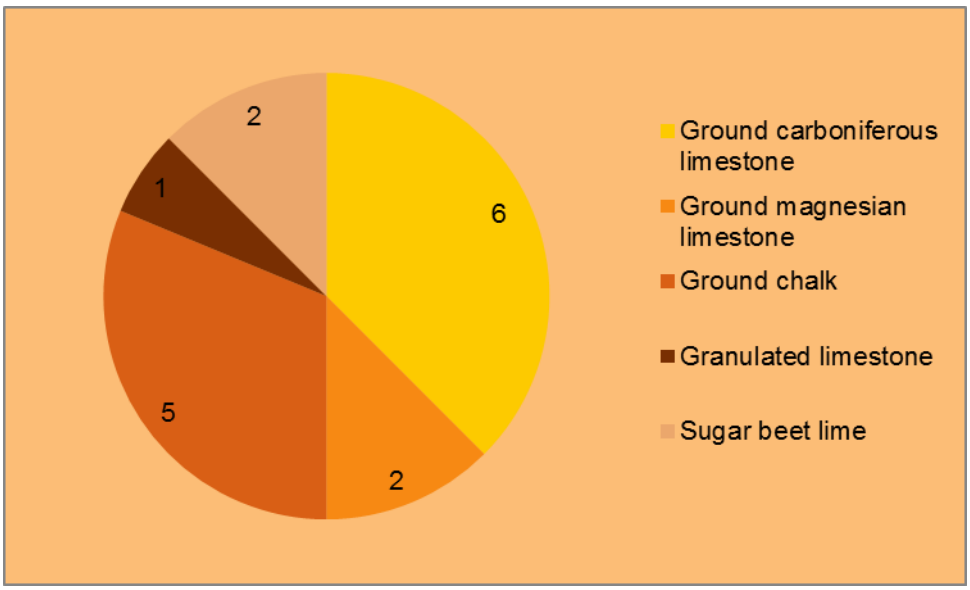

Figure 3.2 Liming material sub-types

4 Material sources

4.1 Whole digestate

Whole digestate samples were requested from a number of facilities listed in the directory of members of the Biofertiliser Certification Scheme (http://www.biofertiliser.org.uk/members).

4.2 Primary gypsum

Primary gypsum suppliers were identified from the *Directory of Mines and Quarries* (BGS 2010). Primary gypsum samples were requested from quarries listed in the directory.

4.3 Liming materials

Lime samples were requested from a number of lime producers listed in a directory published by the Agricultural Lime Association (http://www.aglime.org.uk/suppliers/index.php).

5 Sampling procedure

Samples were taken from a variety of producers across England and to provide a geographical spread.

5.1 Whole digestate

Whole digestate was sampled in accordance with PAS 110 (WRAP and BSI 2010a).

5.2 Primary gypsum

Primary gypsum was sampled in accordance with BS EN 1482-1:2007 (BSI 2007).

5.3 Liming materials

Liming materials were sampled in accordance with BS EN 1482-1:2007 (BSI 2007).

6 Analytical parameters

The main parameters determined are summarised in Tables 6.1 to 6.10. All laboratory work was carried out by the Environment Agency's National Laboratory Service (NLS).

Testing was carried out in accordance with relevant NLS documented in-house methods which meet the requirements of the performance standards of the Environment Agency's monitoring certification scheme (MCERTS). Specific tests used are outlined in the tables. Other test methods are available.

In the tables, 'LE' refers to the NLS Leeds laboratory and SAL refers to Scientific Analysis Laboratories Ltd.

Table 6.1 Analysis: beneficial properties

Parameter/ determinand	Test method used	Unit
pH	LE I pH and EC 01 pH and conductivity – water extracted, determined by specific electrode from 'as received' sample	–
Conductivity	LE I pH and EC 01 pH and conductivity – water extracted, determined by specific electrode from ''as received' sample	µS/cm
Dry solids @ 30°C	LE P soil preparation 01 – sample air dried at <30ºC in a controlled environment until constant weight is achieved	%
Dry solids @ 105°C	LE I dry solids and LoI 01 dry solids (105ºC) and loss on ignition (500ºC) – thermally treated, determined by gravimetry	%
Loss on ignition (LoI) @ 500°C (organic matter content)	LE I dry solids and LoI 01 dry solids (105ºC) and loss on ignition (500ºC) – thermally treated, determined by gravimetry	%
Carbon, organic as C	LE I TOC 01 – combusted with oxygen, thermal conductivity detection	%
Nitrogen as N	LE I nutrients (Kone) 01 NH_4, TON, NO_2 – 2M KCl extraction, determined colorimetrically by discrete analyser on 'as received' sample	mg/kg (DW)
Carbon	LE I TOC 01 TC % TN – combusted with oxygen, thermal conductivity detection	mg/kg (DW)

Parameter/ determinand	Test method used	Unit
C:N	Calculated value, carbon divided by nitrogen as N	n/a
Neutralising value as calcium oxide	SAL determination of neutralising value – sample is dried and ground. Material is extracted with known volume of hydrochloric acid. A test aliquot from the extraction is titrated against phenolphthalein to the endpoint. The result is calculated from the difference in titres against a blank where the same sample has been extracted without acid.	%

EC = electrical conductivity; TOC = total organic carbon; TON = total organic nitrogen; TN = total nitrogen; DW = dry weight

Table 6.2 Analysis: primary nutrients

Parameter/ determinand	Test method used	Unit
Total nitrogen (N) Kjeldahl test	Parameter by calculation	mg/kg (DW)
Total P	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Total K	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Ammoniacal nitrogen as N	LE I nutrients (Kone) 01 NH_4, TON, NO_2 – 2M KCl extraction, determined colorimetrically by discrete analyser on 'as received' sample	mg/kg (DW)
Nitrate as N	Parameter by calculation	mg/kg (DW)

ICP-OES = inductively coupled plasma optical emission spectrometry

Table 6.3 Analysis: secondary nutrients

Parameter/ determinand	Test method used	Unit
Ca	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Mg	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Total sulphur	SAL determination of total sulphur – dried and ground aliquot of the sample is weighed into a ceramic crucible. The sample is then oxidised in the analyser's combustion chamber and any organic sulphur present is converted to sulphur dioxide. The sulphur dioxide in the combustion gases is measured by an infra-red detector.	%

Table 6.4 Analysis: trace nutrients

Parameter/ determinand	Test method used	Unit
B	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Cu	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Fe	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Mn	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Mo	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Zn	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Chloride	LE I halides chloride, bromide and sulphate – water extracted determined directly by ion chromatography on ‘‘as received’ sample	mg/kg (DW)

Table 6.5 Analysis: other elements found in plants which may not be essential for growth

Parameter/ determinand	Test method used	Unit
Co	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Na	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Ni	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Se	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)

Table 6.6 Analysis: Potentially Toxic Elements (PTEs)

Parameter/ determinand	Test method used	Unit
Cd	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Cr	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Cu	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Hg	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)

Parameter/ determinand	Test method used	Unit
Ni	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Pb	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Zn	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)

Table 6.7 Analysis: other potential contaminants

Parameter/ determinand	Test method used	Unit
V	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)

Table 6.8 Analysis: metals

Parameter/ determinand	Test method used	Unit
Al	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Ag	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
As	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Ba	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Be	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Li	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Sb	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Sn	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES.	mg/kg (DW)
Sr	LE I metals (ICP-OES) 01 -– digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Ti	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)
Tl	LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux, determined by ICP-OES	mg/kg (DW)

Table 6.9 Analysis: other analytes

Parameter/ determinand	Test method used	Unit
Bromide	LE I halides chloride, bromide and sulphate – water extracted determined directly by ion chromatography on 'as received' sample	mg/kg (DW)
Cr VI	LE I Cr (VI) 01 chromate – alkaline extracted determined by comparator disc colorimetry on 'as received' sample	mg/kg (DW)
Fluoride	LE I fluoride – 1M H_2SO_4 extraction, determined by ion selective electrode on 'as received' sample.	mg/kg (DW)
Nitrite as N	LE I nutrients (Kone) 01 NH_4, TON, NO_2 – 2M KCl extraction, determined colorimetrically by discrete analyser on 'as received' sample.	mg/kg (DW)
Sulphate	LE I halides chloride, bromide and sulphate - water extracted determined directly by Ion Chromatography on 'as received' sample.	mg/kg (DW)
Total oxidised nitrogen as N	LE I nutrients (Kone) 01 NH_4, TON, NO_2 – 2M KCl extraction, determined colorimetrically by discrete analyser on 'as received' sample.	mg/kg (DW)
Visible contaminants (>2 mm)	SAL determination of percentage stones – the % >2 mm fraction of the soil sample (that is, the fraction of the sample which does not pass through the 2 mm sieve)	%

Table 6.10 Analysis: GCMS semi-volatile screen

Parameter/ determinand	Test method used	Unit
Various	NLS O SV screens – solvent extracted, determined by GCMS (scan mode)	mg/kg (DW)

O SV = organic semi-volatile; GCMS = gas chromatography–mass spectrometry

7 Existing data

A limited number of the existing datasets related to soil improvers identified during the literature review had sufficient provenance to be included in this project.

Some data were found on other online sources. However, these data did not meet the quality assurance criteria required for this project and are not reproduced here.

7.1 Whole digestate

Data from PAS 110 for whole digestate are given in Table 7.1. Table 7.2 gives the nutrient content of various digestate products taken from a partial financial assessment for the introduction of the Quality Protocol for anaerobic digestate (WRAP and Environment Agency (2009b).

Table 7.1 Minimum whole digestate quality [1,2]

	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Upper limit	1.5	100	200	200	1	50	400

Notes: [1] All units mg/kg (DW)
[2] Test parameters, upper limit values and declaration parameters for validation
Source: WRAP and BSI (2010a)

Table 7.2 Example nutrient content of selected digestate products

Analyte	Dry matter %	Total nitrogen (kg/tonne)	Available nitrogen (kg/tonne)	Organic nitrogen left (kg/tonne)	Phosphate (kg/tonne)
Digested cow slurry	7	5.47	3.29	2.18	1.02
Digested pig slurry	5	5.05	3.78	1.27	1.21
Mixed digester output	4	5.15	4.12	1.03	1.16

Source: WRAP and Environment Agency (2009b)

7.2 Primary and recycled gypsum

Table 7.3 shows values for Potentially Toxic Elements in primary gypsum taken from a WRAP research report (WRAP 2007).

Table 7.3 PTEs analysis of agricultural gypsum

Analyte	Units	Value
Ca	%w/w	18.5
S	%w/w	16
Sulphate	%w/w	48.1
As	mg/kg	1.2

Analyte	Units	Value
Cd	mg/kg	0.1
Cr	mg/kg	3.9
Cu	mg/kg	2
Pb	mg/kg	4.2
Mg	mg/kg	0.1
Mo	mg/kg	0.4
Ni	mg/kg	2.2
Se	mg/kg	1.6
Zn	mg/kg	18.5

Source: WRAP (2007)

7.3 Liming materials

Neutralising values of selected fertiliser and liming materials are given in Table 7.4.

Table 7.4 Neutralising value

	Neutralising value (%)
Ground chalk or limestone	50–55
Magnesian limestone	50–-55
Hydrated lime	70
Burnt lime	80
Sugar beet lime	22–32

Source: Defra (2010)

8 Primary data

8.1 Statistical analysis of data

The mean, median, minimum and maximum values for each analyte were calculated. When the sample size was sufficient (that is, ≥10), the 90th percentile was also calculated. All analytical values determined as 'less than (<)' values were taken as the values themselves.

Box plots are used to graphically represent groups of quantitative data (Figure 8.1). The sample minimum, lower quartile (Q1), median (Q2), upper quartile (Q3) and sample maximum are used. The median is indicated by the horizontal line that runs across the box (Figure 8.1). The top of the box is the 75th percentile (upper quartile or Q3). The bottom of the box is the 25th percentile (lower quartile or Q1). The interquartile range is represented by the height of the box (Q3 – Q1). A smaller interquartile range indicates less variability in the dataset while a larger interquartile range indicates a variable dataset. Whiskers extend out of the box to represent the sample minimum and maximum. Outliers are plotted as asterisks and are defined as data points that are 1.5× the interquartile range. The box and whisker plot of

manganese concentration in lime shown in Figure 8.1 demonstrates the issue of outliers in the dataset.

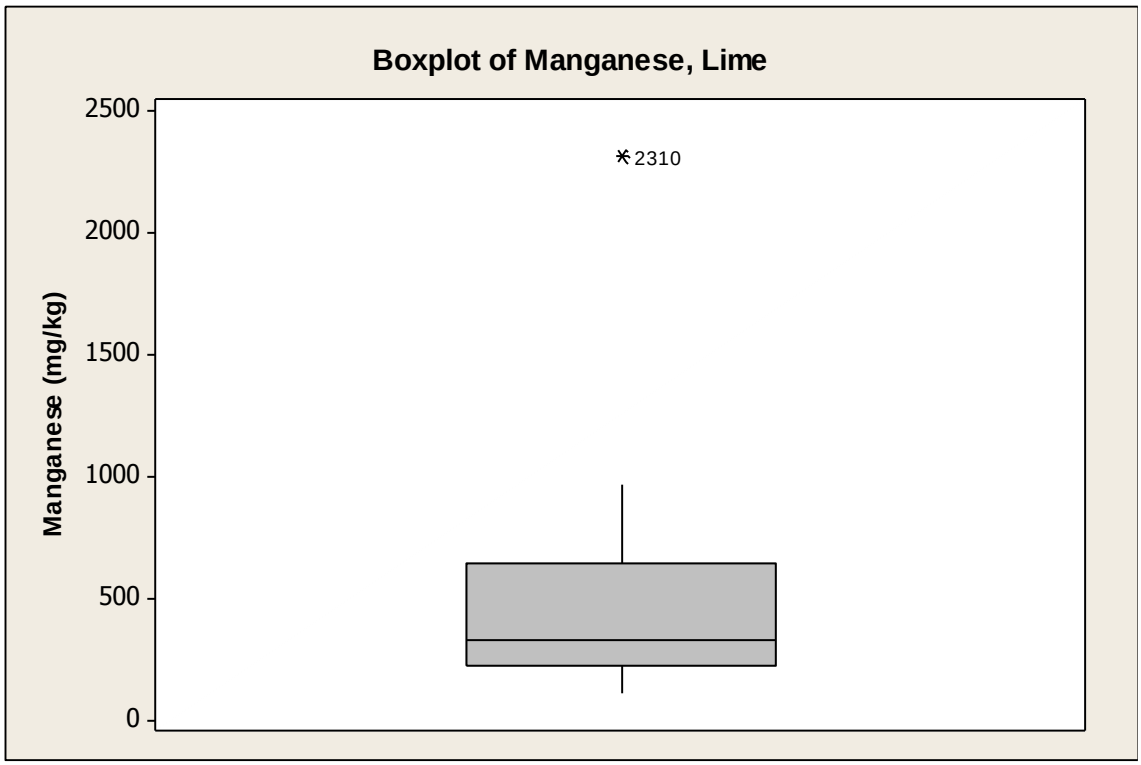

Figure 8.1 Box plot of manganese concentration in lime

Outliers can adversely affect the statistical analysis by:

- giving serious bias or influence to estimates that may be of less interest
- increasing the error variance and reducing the power of statistical tests
- decreasing normality (if non-random) and altering the odds of type I and II errors

8.2 Using the data tables

The analytical data are provided for:

- beneficial properties
- primary, secondary and trace nutrients
- other elements found in plants which may not be essential for growth, Potentially Toxic Elements (PTEs) and other potential contaminants
- other metals and analytes
- GCMS semi-volatile screen

We recommend comparing the concentrations of analytes in the comparators dataset to the concentrations in the waste-derived material, paying attention to the higher values. This comparison does not constitute a pass/fail test or an end of waste view. It will provide an indication of whether the waste material contains similar levels of

analytes to non-waste materials and whether an end-of-waste application may be appropriate or that further analysis or improved treatment processes may be warranted.

Due to difficulties encountered during sample preparation the limit of detection for some analytes was higher than the target limit of detection.

8.3 Primary data tables

8.3.1 Whole digestate

Primary data are shown in Tables 8.1 to 8.5.

8.3.2 Primary gypsum

Primary data are shown in Tables 8.6 to 8.10.

8.3.3 Liming materials

Primary data are shown in Tables 8.11 to 8.15.

Table 8.1 Primary data for whole digestate: beneficial properties

Sample ID	pH	Conductivity	Dry solids @ 30°C	Dry solids @ 105°C	LoI @ 500°C (organic matter content)	Carbon, organic as C	Nitrogen as N	Carbon	C:N [1]
		µS/cm	%	%	%	%	mg/kg (DW)	mg/kg (DW)	
Whole digestate 01	7.93	0.01	1.83	18.6	95.1	26.0	54,200	378,000	6.97
Whole digestate 02	8.12	8.24	3.37	2.36	69.8	34.0	46,800	370,000	7.91
Whole digestate 03	7.98	9.46	3.78	27.8	96.4	31.0	51,600	339,000	6.57
Mean	8.01	5.90	2.99	16.3	87.1	30.3	50,867	362,333	7.15
Median	7.98	8.24	3.37	18.6	95.1	31.0	51,600	370,000	6.97
Minimum	7.93	0.01	1.83	2.36	69.8	26.0	46,800	339,000	6.57
Maximum	8.12	9.46	3.78	27.8	96.4	34.0	54,200	378,000	7.91
No. of samples	3	3	3	3	3	3	3	3	3
90th percentile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LOD	0.2	10	0.5	0.5	0.5	0.3	200	1,000	n/a

Notes: [1] Calculated value
n/a = not applicable

Table 8.2 Primary data for whole digestate: primary, secondary and trace nutrients [1]

Sample ID	Primary nutrients					Secondary nutrients			Trace nutrients							
	Total nitrogen (N) Kjeldahl test	Total P	Total K	NH_3 as N	Nitrate as N	Ca	Mg	Total sulphur	B	Cu	Fe	Mn	Mo	Zn	Chloride
Whole digestate 01	<54,200	14,700	32,600	405	<3.00	30,200	2,200	0.29	19.1	36.0	2,210	130	6.33	197	79,800
Whole digestate 02	<46,800	10,500	51,000	140	<90.0	24,800	1,550	<0.05	23.9	29.1	1,630	143	2.85	147	38,500
Whole digestate 03	51,600	9,770	76,100	130	<18.5	35,200	1,990	<0.05	24.9	25.8	6,340	206	4.19	98.4	47,400
Mean	50,867	11,657	53,233	225	37.2	30,067	1,913	0.13	22.6	30.3	3,393	160	4.46	147	55,233
Median	51,600	10,500	51,000	140	18.5	30,200	1,990	0.05	23.9	29.1	2,210	143	4.19	147	47,400
Minimum	46,800	9,770	32,600	130	3.00	24,800	1,550	0.05	19.1	25.8	1,630	130	2.85	98.4	38,500
Maximum	54,200	14,700	76,100	405	90.0	35,200	2,200	0.29	24.9	36.0	6,340	206	6.33	197	79,800
No. of samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
90th percentile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LOD	n/a	10	50	2	n/a	60	20	0.05	1.0	0.1	1	2	1	2	3

Notes: [1] All units mg/kg (DW) apart from total sulphur for which the units are % (DW).

Table 8.3 Primary data for whole digestate: other elements found in plants which may not be essential for growth, Potentially Toxic Elements (PTEs) and other potential contaminants [1]

Sample ID	Other elements found in plants which may not be essential for growth									PTEs		Other potential contaminants
	Co	Ni	Se	Na	Cd	Cr	Cu	Pb	Hg	Ni	Zn	V
Whole digestate 01	1.20	7.20	1.96	48,000	<0.25	9.38	36.0	7.10	<2	7.20	197	2.07
Whole digestate 02	5.03	12.1	2.13	29,300	1.200	10.8	29.1	2.48	<2	12.1	147	1.78
Whole digestate 03	2.63	5.72	1.41	31,200	<0.25	5.57	25.8	2.90	<2	5.72	98.4	1.65
Mean	2.95	8.34	1.83	36,167	0.567	8.58	30.3	4.16	2.00	8.34	147	1.83
Median	2.63	7.20	1.96	31,200	0.250	9.38	29.1	2.90	2.00	7.20	147	1.78
Minimum	1.20	5.72	1.41	29,300	0.250	5.57	25.8	2.48	2.00	5.72	98.4	1.65
Maximum	5.03	12.1	2.13	48,000	1.200	10.8	36.0	7.10	2.00	12.1	197	2.07
No. of samples	3	3	3	3	3	3	3	3	3	3	3	3
90th percentile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a [2]	n/a	n/a	n/a
LOD	0.1	0.6	1	10	0.20	0.5	1	1	2.00	0.6	2	0.1

Notes [1] All units mg/kg (DW).

[2] The Hg LOD achievable during laboratory testing (2 mg/kg) was greater than the PAS 110 limit of 1 mg/kg. It is therefore suggested that this PAS 100 limit is a more appropriate benchmark.

Table 8.4 Primary data for whole digestate: other metals and analytes [1]

Sample ID	Metals														Other analytes	
	Al	Sb	As	Ba	Be	Li	Ag	Sr	Tl	Sn	Ti	Cr VI	Fluoride	Bromide	Sulphate	Nitrite as N	TON as N
Whole digestate 01	2,060	<10	1.54	23.6	<0.01	<6	<10	50.0	<3	<20	17.5	<20	<1000	<3	11,200	<0.1	<3
Whole digestate 02	921	<10	1.18	17.1	<0.01	<6	<10	41.8	<3	<20	9.74	<60	<20	<9	2,640	<3	<90
Whole digestate 03	586	<10	1.28	26.2	<0.01	<6	<10	53.3	<3	<20	9.22	<10	659	<3	3,380	<3	18.5
Mean	1,189	10.0	1.33	22.3	0.01	6	10.0	48.4	3.00	20.0	12.2	12.0	560	5.00	5,740	2.03	37.2
Median	921	10.0	1.28	23.6	0.01	6	10.0	50.0	3.00	20.0	9.74	10.0	659	3.00	3,380	3.00	18.5
Minimum	586	10.0	1.18	17.1	0.01	6	10.0	41.8	3.00	20.0	9.22	6.0	20.0	3.00	2,640	0.10	3.00
Maximum	2,060	10.0	1.54	26.2	0.01	6	10.0	53.3	3.00	20.0	17.5	20.0	1,000	9.00	11,200	3.00	90.0
No. of samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
90th percentile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LOD	50	1	0.5	0.5	0.1	1	1	1	1	1	3	0.3	20	0.3	5	0.1	3.00

Notes [1] All units mg/kg (DW).

Table 8.5 Primary data for whole digestate: GCMS semi-volatile screen [1,2]

Sample ID	(3.alpha,5.beta) cholestan-3-ol	2-methyl butanoic acid	2,6-dimethylphenyl isocyanate	3-methyl butanoic acid	7- methyl 1H-indole	benzeneacetic acid	β sitosterol	butanoic acid	cholestanol	d-limonene	*n*-hexadecanoic acid	*p*-cresol	phenol	squalene	stigmastanol
Whole digestate 01	37		44			120			21			87			13
Whole digestate 02	40	13	13	21	14	130	16	20	11	10	46	20	30	14	
Whole digestate 03						14									

Notes: [1] Analytes >10 mg/kg (DW) only; analytes not detected or those with <10mg/kg (DW) have not been reported.
[2] The full GCMS screen data with <10 mg/kg values will be included in the comparator spreadsheet tool. The compounds identified at concentrations greater than the detection level during the GCMS screen are believed to be, in the vast majority of cases, naturally occurring substances within the sample matrix, rather than pollutants.

Table 8.6 Primary data for primary gypsum: beneficial properties

Sample ID	pH	Conductivity	Dry solids @ 30°C	Dry solids @ 105°C	LoI @ 500°C (organic matter content)	Carbon, organic as C	Nitrogen as N	Carbon	C:N [1]	Neutralising value as CaO
		µS/cm	%	%	%	%	mg/kg (DW)	mg/kg (DW)		%
Gypsum 01	8.62	2.17	90.9	88.8	17.1	<0.3	<200	3,400	17.0	4.70
Gypsum 02	8.44	2.31	97.5	94.3	15.5	0.58	420	11,100	26.4	7.60
Gypsum 03	8.16	1.58	100	96.5	16.6	<0.3	260	1,370	5.27	1.50
Mean	8.41	2.02	96.1	93.2	16.4	0.6	340	5,290	16.2	4.6
Median	8.44	2.17	97.5	94.3	16.6	0.6	340	3,400	17.0	4.7
Minimum	8.16	1.58	90.9	88.8	15.5	0.6	260	1,370	5.3	1.5
Maximum	8.62	2.31	100.0	96.5	17.1	0.6	420	11,100	26.4	7.6
No. of samples	3	3	3	3	3	1	2	3	3	3
90th percentile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LOD	0.2	10	0.5	0.5	0.5	0.3	200	1,000	n/a	0.1

Notes [1] Calculated value

Table 8.7 Primary data for primary gypsum: primary, secondary and trace nutrients [1]

Sample ID	Primary nutrients					Secondary nutrients			Trace nutrients						
	Total nitrogen (N) Kjeldahl test	Total P	Total K	HN_3 as N	Nitrate as N	Ca	Mg	Total sulphur	B	Cu	Fe	Mn	Mo	Zn	Chloride
Gypsum 01	195	100	1,200	2.00	5.19	186,000	4,130	17.0	10.0	10.0	2,750	68.9	10.0	20.0	133
Gypsum 02	420	100	733	2.00	3.00	206,000	2,580	21.0	12.4	10.0	2,000	52.9	10.0	23.4	81.9
Gypsum 03	260	50.0	200	2.00	2.80	242,000	729	25.0	5.00	5.00	4,000	10.0	5.0	10.0	30.0
Mean	292	83	711	2.0	3.7	211,333	2,480	21	9.1	8.3	2,917	43.9	8.3	17.8	81.6
Median	260	100	733	2.0	3.0	206,000	2,580	21	10.0	10	2,750	53	10	20	82
Minimum	195	50	200	2.0	2.8	186,000	729	17	5.0	5	2,000	10	5	10	30
Maximum	420	100	1,200	2.0	5.2	242,000	4,130	25	12.4	10	4,000	69	10	23	133
No. of samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
90th percentile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LOD	n/a	10	50	2	n/a	60	20	0.05	1	0.1	1	2	1	2	3

Notes [1] All units mg/kg (DW) apart from total sulphur for which the units are % (DW).

Table 8.8 Primary data for primary gypsum: other elements found in plants which may not be essential for growth, Potentially Toxic Elements (PTEs) and other potential contaminants [1]

Sample ID	Other elements found in plants which may not be essential for growth			PTEs							Other potential contaminants
	Co	Se	Na	Cd	Cr	Cu	Pb	Hg	Ni	Zn	V
Gypsum 01	1.24	<10	<100	<2	<5	<10	<10	<2	<6	<20	10.9
Gypsum 02	<1	<10	252	<2	<5	<10	<10	<2	<6	23.4	5.98
Gypsum 03	<0.5	<5	<50	<1	<2	<5	<5	<1	<3	<10	3.91
Mean	0.9	8.3	134	1.7	4.0	8.3	8.3	1.7	5	17.8	6.9
Median	1.0	10	100	2	5	10	10	2	6	20.0	6.0
Minimum	0.5	5	50	1	2	5	5	1	3	10.0	3.9
Maximum	1.2	10	252	2	5	10	10	2	6	23.4	10.9
No. of samples	3	3	3	3	3	3	3	3	3	3	3
90th percentile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LOD	0.1	1	10	0.2	0.5	1	1	0.2	0.6	2	0.1

Notes [1] All units mg/kg (DW).

Table 8.9 Primary data for primary gypsum: other metals and analytes [1]

Sample ID	Metals												Other analytes				
	Al	Sb	As	Ba	Be	Li	Ag	Sr	Tl	Sn	Ti	Cr VI	Fluoride	Bromide	Sulphate	Nitrite as N	TON as N
Gypsum 01	2,810	<10	<5	40.8	<1	<10	<10	1,190	<10	<10	<30	<0.4	24.8	<0.3	3,210	<0.1	5.19
Gypsum 02	1,990	<10	<5	38.9	<1	<10	<10	645	<10	<10	38.5	<0.3	313	1.16	47.2	<0.1	<3
Gypsum 03	395	<5	<2	41.6	<0.5	<5	<5	1,620	<5	<5	<10	<0.3	<20	3.42	3,070	0.20	<3
Mean	1,732	8	4	40.4	1	8	8	1,152	8	8	26	0.3	119	1.63	2,109	0.13	4
Median	1,990	10	5	40.8	1	10	10	1,190	10	10	30	0.3	25	1.16	3,070	0.1	3
Minimum	395	5	2	38.9	1	5	5	645	5	5	10	0.3	20	0.30	47.2	0.1	3
Maximum	2,810	10	5	41.6	1	10	10	1,620	10	10	38.5	0.4	313	3.42	3,210	0.2	5
No. of samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
90th percentile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LOD	50	1	0.5	0.5	0.1	1	1	1	1	1	3	0.3	20	0.3	5	0.1	3

Notes [1] All units mg/kg (DW).

Table 8.10 Primary data for primary gypsum: GCMS semi-volatile screen [1,2]

Sample ID	hydrocarbons indicating a refined, heavy, specialised oil	di(2-ethylhexyl) phthalate (DEHP)	di-*n*-butyl phthalate	stigmastane-3,5-dione (5.alpha)
Gypsum 01	Yes			
Gypsum 02	Yes			
Gypsum 03				13

Notes: [1] Analytes >10 mg/kg (DW) only; analytes not detected or those with <10mg/kg (DW) have not been reported.
[2] The full GCMS screen data with <10 mg/kg values will be included in the comparator spreadsheet tool. The compounds identified at concentrations greater than the detection level during the GCMS screen are believed to be, in the vast majority of cases, naturally occurring substances within the sample matrix, rather than pollutants.

Table 8.11 Primary data for liming materials: beneficial properties

Sample ID	pH	Conductivity	Dry solids @ 30°C	Dry solids @ 105°C	LoI @ 500°C (organic matter content)	Carbon, organic as C	Nitrogen as N	Carbon	C:N [1]	Neutralising value as CaO
		µS/cm	%	%	%	%	mg/kg (DW)	mg/kg (DW)		%
Lime 01	9.37	0.08	97.4	97.6	0.50	<0.3	200	12,600	63.0	94.9
Lime 02	9.41	0.05	98.0	98.6	1.41	<0.3	200	120,000	600	94.6
Lime 03	9.21	0.46	97.3	97.2	2.68	1.74	200	120,000	600	85.2
Lime 04	9.51	0.12	99.6	99.6	0.60	<0.3	760	120,000	158	91.3
Lime 05	9.59	0.08	95.4	95.8	0.50	<0.3	430	121,000	281	93.5
Lime 06	7.95	1.69	99.4	99.5	3.51	1.72	200	133,000	665	95.1
Lime 07	8.79	0.07	87.8	88.0	0.68	<0.3	440	114,000	259	91.5
Lime 08	8.88	0.05	84.8	84.5	0.69	<0.3	200	119,000	595	95.1
Lime 09	8.99	0.04	89.7	89.7	0.50	<0.3	200	119,000	595	96.9
Lime 10	8.79	0.05	84.2	83.6	0.68	<0.3	200	117,000	585	95.9
Lime 11	8.73	0.14	94.2	94.1	0.50	<0.3	200	117,000	585	94.3
Lime 12	8.58	0.19	99.5	99.4	1.01	<0.3	200	87,800	439	75.9
Lime 13	9.42	0.14	96.6	96.8	2.24	3.81	230	127,000	552	93.6
Lime 14	9.45	0.26	96.5	96.8	3.05	4.08	210	128,000	610	87.3
Lime 15	7.54	4.18	81.3	74.6	12.6	6.46	4770	132,000	27.7	56.2
Lime 16	8.06	1.81	82.8	59.6	11.6	3.47	4730	99,200	21.0	43.5
Mean	8.89	0.59	92.8	91.0	2.67	1.52	835.6	111,663	415	86.6
Median	8.94	0.13	96.0	96.3	0.85	0.30	200	119,500	569	93.6
Minimum	7.54	0.04	81.3	59.6	0.50	0.30	200	12,600	21.0	43.5
Maximum	9.59	4.18	99.6	99.6	12.6	6.46	4770	133,000	665	96.9
No. of samples	16	16	16	16	16	16	16	16	16	16
90th percentile	9.48	1.75	99.5	99.5	7.56	3.95	2745	130,000	605	95.5
LOD	0.2	10	0.5	0.5	0.5	0.3	200	1,000	n/a	0.1

Notes [1] Calculated value

Table 8.12 Primary data for liming materials: primary, secondary and trace nutrients [1]

Sample ID	Primary nutrients					Secondary nutrients			Trace nutrients						
	Total nitrogen (N) Kjeldahl test	Total P	Total K	NH_3 as N	Nitrate as N	Ca	Mg	Total sulphur	B	Cu	Fe	Mn	Mo	Zn	Chloride
Lime 01	<195	<60.0	296	<2	4.48	389,000	1,440	0.05	<1	1.44	597	241	<2	27.5	<30
Lime 02	<200	<60.0	355	<2	<3.00	369,000	1,320	0.15	<1	2.92	1,100	290	<2	48.6	<30
Lime 03	<195	1260	858	<2	<5.13	212,000	97,900	0.12	3.65	9.71	12,700	2,310	<2	22.8	344
Lime 04	<760	<200	<1,000	<2	<3.00	414,000	1,660	<0.05	<20	<20	<4,000	110	<20	50.8	<30
Lime 05	<430	<200	<1,000	<2	<3.00	405,000	4,210	<0.05	<20	<20	<4,000	711	<20	<40	<30
Lime 06	<200	<200	<1,000	<2	<3.00	384,000	1,600	0.17	<20	<20	<4,000	178	<20	<40	<30
Lime 07	<440	637	<1,000	<2	<3.00	384,000	1,290	<0.05	<20	<20	<4,000	418	<20	<40	<30
Lime 08	<200	336	<1,000	<2	<3.00	402,000	1,170	<0.05	2.81	2.87	<4,000	329	<2	12.3	<40
Lime 09	<200	367	<1,000	<2	<3.00	413,000	1,070	<0.05	1.85	2.06	<4,000	387	<2	10.6	<30
Lime 10	*	657	<1,000	<2	*	400,000	1,110	<0.05	2.03	1.31	<4,000	411	<2	12.7	<40
Lime 11	<200	443	<1,000	<2	<2.28	396,000	1,090	0.05	3.62	1.50	<4,000	328	<2	17.3	<30
Lime 12	<200	113	1,050	<2	<3.00	306,000	1,940	<0.05	4.06	2.30	6,290	113	<1	23.4	19.9
Lime 13	<230	18.7	140	<2	<3.00	301,000	65,400	<0.05	<1	2.60	2,720	960	<1	56.7	123
Lime 14	<210	44.9	340	<2	<3.00	219,000	131,000	<0.05	<5	<5	4,620	865	<5	28.2	196
Lime 15	<4,770	7,310	1,340	9.69	<4.00	310,000	6,670	0.09	<5	13.8	<4,000	281	<5	58.3	13.9
Lime 16	<4,730	6,740	704	461	<4.00	246,000	3,870	0.18	<5	15.5	<4,000	214	<5	42.7	11.3
Mean	877	1,165	818	31.2	3.33	346,875	20,171	0.08	7.25	8.81	4,252	509	6.94	33.2	64.3
Median	200	268	1,000	2.00	3.00	384,000	1,630	0.05	3.86	3.96	4,000	329	2.00	34.1	30.0
Minimum	195	18.7	140	2.00	2.28	212,000	1,070	0.05	1.00	1.31	597	110	1.00	10.6	11.3
Maximum	4,770	7,310	1,340	461	5.13	414,000	131,000	0.18	20.0	20.0	12,700	2,310	20.0	58.3	344
No. of samples	15	16	16	16	15	16	16	16	16	16	16	16	16	16	16
90th percentile	3,142	4,000	1,025	5.85	4.29	409,000	81,650	0.16	20.0	20.0	5,455	913	20.0	53.8	160
LOD	n/a	10	50	2	n/a	60	20	0.05	1	0.1	1	2	1	2	3

Notes [1] All units mg/kg (DW) apart from total sulphur for which the units are % (DW).
* Sample unsuitable

Table 8.13 Primary data for liming materials: other elements found in plants which may not be essential for growth, Potentially Toxic Elements (PTEs) and other potential contaminants [1]

Sample ID	Other elements found in plants which may not be essential for growth			PTEs						Other potential contaminants
	Co	Se	Na	Cd	Cr	Cu	Pb	Hg	Ni	Zn	V
Lime 01	<0.3	<1	68.9	1.640	4.49	1.44	33.7	<2	1.64	27.5	3.73
Lime 02	0.75	<1	57.4	2.030	4.61	2.92	58.6	<2	4.14	48.6	5.07
Lime 03	1.11	<1	377	<0.25	4.98	9.71	13.0	<2	9.25	22.8	10.6
Lime 04	<2	<20	<200	<4	11.4	<20	41.5	<4	<10	50.8	6.94
Lime 05	<2	<20	<200	<4	10.6	<20	<20	<4	<10	<40	5.54
Lime 06	<2	<20	425	<4	<10	<20	32.4	<4	<10	<40	4.96
Lime 07	<2	<20	226	<4	<10	<20	<20	<4	<10	<40	7.88
Lime 08	1.00	<1	<200	<0.25	0.67	2.87	<1	<2	3.04	12.3	1.06
Lime 09	1.39	<1	<200	<0.3	0.62	2.06	<1	<2	3.05	10.6	1.62
Lime 10	0.88	<1	242	0.469	1.26	1.31	<1	<2	2.31	12.7	3.69
Lime 11	0.75	<1	258	0.313	1.53	1.50	<1	<2	1.96	17.3	3.51
Lime 12	1.15	<1	144	<0.2	8.30	2.30	2.23	<0.2	6.46	23.4	12.5
Lime 13	0.22	<1	158	0.713	5.24	2.60	4.34	<0.2	3.03	56.7	4.75
Lime 14	1.80	<5	409	<1	<3	<5	8.40	<1	<3	28.2	1.06
Lime 15	0.55	<5	189	<1	9.38	13.8	10.3	<1	<3	58.3	9.85
Lime 16	<0.5	<5	169	<1	6.42	15.5	7.96	<1	<3	42.7	5.96
Mean	1.15	6.50	220	1.573	5.78	8.81	16.0	2.09	5.24	33.2	5.55
Median	1.05	1.00	200	1	5.11	3.96	9.35	2	3.05	34.1	5.02
Minimum	0.22	1.00	57.4	0.2	0.62	1.31	1.00	0.20	1.64	10.6	1.06
Maximum	2.00	20.0	425	4	11.4	20.0	58.6	4	10.0	58.3	12.5
No. of samples	16	16	16	16	16	16	16	16	16	16	16
90th percentile	2	20	393	4	10.3	20	37.6	1[2]	10.0	53.8	10.2
LOD	0.1	1	10	0.2	0.5	1	1	0.2	0.6	2	0.1

Notes [1] All units mg/kg (DW).
[2] The PAS 100 limit for Hg has been used due to sample clean-up problems

Table 8.14 Primary data for liming materials: other metals and analytes [1]

Sample ID	Metals														Other analytes	
	Al	Sb	As	Ba	Be	Li	Ag	Sr	Tl	Sn	Ti	Cr VI	Fluoride	Bromide	Sulphate	Nitrite as N	TON as N
Lime 01	292	<10	<1	15.5	<0.01	<6	<10	257	<3	<20	<0.1	<0.3	<20	<3	19.8	0.13	4.61
Lime 02	639	<10	1.21	30.5	<0.01	<6	<10	268	<3	<20	0.33	<0.3	<20	<3	14.5	<0.1	<3
Lime 03	2,010	<10	15.7	711	0.052	<6	<10	78.1	<3	<20	7.41	<0.3	667	4.58	174	<0.1	5.13
Lime 04	806	<20	<10	<10	<2	<20	<20	294	<20	<20	<60	<0.3	23.9	<3	14.6	<0.1	<3
Lime 05	888	<20	<10	13.2	<2	<20	<20	267	<20	<20	<60	<0.3	<20	<3	26.4	<0.1	<3.0
Lime 06	607	<20	<10	212	<2	<20	<20	235	<20	<20	<60	<0.3	25.8	<3	225	<0.1	<3
Lime 07	3,150	<20	<10	20.9	<2	<20	<20	677	<20	<20	<60	<0.3	148	<3	54.9	<0.1	<3
Lime 08	661	<10	1.19	<10	<0.01	<6	<10	417	<3	<20	4.54	<0.3	68.4	<3	22.8	<0.1	<3
Lime 09	425	<10	<1	<10	<0.01	<6	<10	511	<3	<20	1.92	<0.3	86.2	<3	11.3	<0.1	<3
Lime 10	484	<10	2.42	16.4	<0.01	<6	<10	844	<3	<20	6.36	<0.3	132	<3	13.2	-	-
Lime 11	810	<10	2.18	12.9	<0.01	<6	<10	923	<3	<20	5.17	<0.3	141	<3	143	0.72	<3
Lime 12	3,120	<1	6.47	12.8	<0.1	5.47	<1	291	<1	<1	4.29	<0.3	46.8	<0.3	124	<0.1	<3
Lime 13	391	<1	1.12	49.7	<0.1	3.60	<1	147	<1	<1	<3	<0.3	49.4	1.03	3260	<0.1	<3
Lime 14	780	<5	1.82	11.9	<0.5	5.44	<5	18.4	<5	<5	<20	<0.3	47.7	2.25	157	<0.1	<3
Lime 15	3,750	<5	<3	28.8	<0.5	6.21	<5	245	<5	<5	39.8	<0.3	54.6	<4	812	<0.1	<4
Lime 16	1,830	<5	2.00	17.6	<0.5	<5	<5	200	<5	<5	36.4	<0.3	41.3	<4	904	<0.1	<4
Mean	1,290	10.4	4.94	74.0	0.61	9.23	10.4	355	7.38	14.8	23.1	0.30	99.5	2.89	374	0.14	3.38
Median	793	10.0	2.30	16.0	0.10	6.00	10.0	268	3.00	20.0	6.89	0.30	48.6	3.00	89.5	0.10	3.00
Minimum	292	1.00	1.00	10.0	0.01	3.60	1.00	18.4	1.00	1.00	0.10	0.30	20.0	0.30	11.3	0.10	3.00
Maximum	3,750	20.0	15.7	711	2.00	20.0	20.0	923	20.0	20.0	60.0	0.30	667	4.58	3260	0.72	5.13
No. of samples	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	15	15
90th percentile	3135	20	10	131	2	20	20	761	20	20	60	0.3	145	4	858	0.12	4.37
LOD	50	1	0.5	0.5	0.1	1	1	1	1	1	3	0.3	20	0.3	5	0.1	3

Notes [1] All units mg/kg (DW).

Table 8.15 Primary data for liming materials: GCMS semi-volatile screen [1,2]

Sample ID	presence of diesel/heating oil or, specialised heavy refined oil	nothing unusual found	*p*-cresol (4-methylphenol)	phenol	stigmast-7,25-dien-3-ol, (3.beta.,5.alpha.)	stigmast-7-en-3-ol, (3.beta,5.alpha)
Lime 01						
Lime 02	Yes					
Lime 03						
Lime 04						
Lime 05						
Lime 06						
Lime 07		Yes				
Lime 08						
Lime 09		Yes				
Lime 10						
Lime 11						
Lime 12						
Lime 13						
Lime 14	Yes					
Lime 15						
Lime 16						

Notes: [1] Analytes >10 mg/kg (DW) only; analytes not detected or those with <10mg/kg (DW) have not been reported.
[2] The full GCMS screen data with <10 mg/kg values will be included in the comparator spreadsheet tool. The compounds identified at concentrations greater than the detection level during the GCMS screen are believed to be, in the vast majority of cases, naturally occurring substances within the sample matrix, rather than pollutants.

9 Conclusions

Data are presented for 22 samples of non-waste soil improver. Physical properties and chemical analyses are provided. These data can be used by companies and individuals to assist in the process of applying for end-of-waste status for their products, either by confirming their product's comparable composition or identifying problems to be rectified before such status can be achieved.

Whilst published data were identified and collected, they were not in a form that could be added to these data.

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List of abbreviations

AAS	atomic absorption spectrometry
1M	1 molar
2M	2 molar
Ag	Silver
Al	Aluminium
As	Arsenic
B	Boron
Ba	Barium
Be	Beryllium
C	Carbon
Ca	Calcium
CaO	Calcium oxide
Cd	Cadmium
Chromium VI	Chromium Hexavalent
Co	Cobalt
Cr	Chromium
Cu	Copper
DW	dry weight
EC	electrical conductivity
Fe	Iron
GCMS	gas chromatography–mass spectrometry
H_2SO_4	Sulphuric acid
Hg	Mercury
ICP-AES	inductively coupled plasma atomic emission spectroscopy
ICP-OES	inductively coupled plasma optical emission spectrometry
K	Potassium
KCL	Potassium chloride
LE	Leeds laboratory of NLS
Li	Lithium
LOD	limit of detection
LoI	loss on ignition

Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
N	Nitrogen
Na	Sodium
NH_3 as N	Ammoniacal nitrogen
NH_4	Ammonium
Ni	Nickel
NLS	National Laboratory Service [Environment Agency]
NO_2	Nitrogen dioxide
O SV	Organic semi volatile
P	Phosphorus
PAS	Publically Available Standard
Pb	Lead
PTEs	Potentially Toxic Elements
SAL	Scientific Analysis Laboratories Limited
Sb	Antimony
Se	Selenium
Sn	Tin
Sr	Strontium
TC	total carbon
Ti	Titanium
Tl	Thallium
TN	total nitrogen
TOC	total organic carbon
TON	total organic nitrogen
V	Vanadium
Zn	Zinc

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