DEFRA

WR0110 CHARACTERISATION OF RESIDUES FROM INDUSTRIAL PROCESSES AND WASTE TREATMENT

ANNEX A – WASTE SAMPLING

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ANNEX A CONTENTS

A1 INTRODUCTION

The results from Defra project WR0110 (Characterisation of residues from industrial processes and waste treatment) have been summarised in a SID 5 Research Project Final Report (WR0110). This report refers to several Annexes which provide further details on specific topic areas, of which this is one such Annex.

Project WR0110 involved the collection of a wide variety of organic and inorganic wastes many of which had been treated in waste treatment processes such as mechanical biological treatment (MBT), composting, mechanical heat treatment (MHT), anaerobic digestion (AD), gasification and physico-chemical processes.

This annex provides details of the waste sample collection exercise. Two approaches were taken:

- The organic waste programme required collection of a wide range of organic residues to provide additional correlation data for the new BM100 and DR4 biodegradability tests and to check their performance for materials with very different basic characteristics. For the initial test programme single snapshots were needed from a comprehensive set of processes, as opposed to repeat sampling for a smaller number of residues. To ensure compatibility between sample types and sampling events a generic sampling plan was produced that could be used anywhere, for any process, at any time, and by anyone for this project or for future sampling events. The sampling plan was supported by site-specific sampling records.

- In contrast the inorganic waste programme was focused on collecting more comprehensive data for a smaller number of waste streams. Specific detailed sampling plans were provided for each stream after detailed discussions and/or site visits with the plant operator.

The use of sampling plans and records is required by Framework Standard EN 14899:2005 and background information on their use is provided by ESART's Practitioners Guide (2004).

This annex provides details of the waste samples collected including: waste type, waste source, sampling procedure, treatment process if treated, sample code given to the waste within this project, and the rational for selection of the waste for inclusion within this project.

The report introduces the organic wastes collected in A2 as either specific organic wastes or as mixed biodegradable waste derived from municipal solid waste (biodegradable municipal waste, BMW). A generic sampling plan and sampling records for most wastes are provided in A3 and A4. Sampling plans for the inorganic wastes collected are reproduced in A4.

A2 SUMMARY OF ORGANIC WASTES

Unless specified below, the minimum sample weight collected was 20 kg, most field samples being in excess of 50 kg. The bulky materials (e.g. feathers and packaging wastes) were collected in two bulk (1 m^3) bags.

A2.1 Specific organic waste streams

Control cellulose: sample code - Cellulose control

A large 10 kg batch of commercially available alpha-cellulose (cat no. C8001) was purchased. This material is considered as a pure material of known composition and has previously been used as a control substrate in DR4 and BM100 biodegradation tests (Annex B).

Mixed waste wood (pre and post MHT treated)

a) Un-treated mixed wood waste: sample code - wood pkg _autoclave_in

About 240 kg of chipped mixed waste wood (pallets, chipboard, timber, fibreboard and some tree branches) was collected (Sample collection details Annex A4.1). Of this about 10 kg was retained as the untreated mixed wood sample with the remainder being subsequently treated. This material was collected as an example of a high C/N ratio organic waste which is assumed would biodegrade slowly and be composed largely of lignin-cellulose. Wood waste is also a material of interest in the UK as large amounts of wood waste are produced by the construction industry and recovery as fuel has been highlighted by the recent Waste Strategy for England 2007 (Defra 2007).

b) MHT mixed wood waste: sample code - wood pkg_autoclave_out

About 220 kg of the chipped mixed waste wood was then subjected to mechanical heat treatment (MHT) using a pilot autoclave. This was carried out to assess the impact of the autoclave treatment on the characteristics of the wood waste especially its biodegradability. Details of the autoclave treatment are provided in Annex A4.2.

Packaging (wet cardboard) waste (pre and post MHT treated)

a) Un-treated packaging waste: sample code - card pkg_autoclave_in

Residual wet packaging waste consisting mainly of cardboard and plastic was collected (Annex A4.3). The waste was residuals from an on-site packaging waste recovery process. It was selected as it would consist mainly of processed cellulose and lignin and therefore be different from the wood waste with presumed greater biodegradability although having a similar high C/N ratio.

b) MHT treated packaging waste: sample code - card pkg_autoclave_out

Part of the company's packaging waste was also subjected to MHT treatment in the pilot autoclave to investigate the impact of autoclave treatment (Annex A4.4). It was assumed that the autoclaving might improve the overall biodegradability of the packaging waste by converting some of the crystalline cellulose to amorphous cellulose which should be more amenable to cellulose hydrolysis.

Greenwaste samples

a) Chipped fresh greenwaste: sample code - greenwaste<10cm

A sample of chipped fresh greenwaste was collected from a selected waste collection site (Annex A4.5). This sample was collected as an example of untreated fresh domestic greenwaste which is a major component of MSW derived BMW.

b) Partially composted greenwaste: sample code - greenwaste<10cm_comp_2wks

The chipped greenwaste at the waste collection site is stored as a large static pile on-site where it is partially composted over a 2 week period. The partially composted greenwaste is screened with the screened material being taken off-site for application to agricultural land following further composting. The oversized material is re-chipped and added to the pile of freshly chipped greenwaste. A sample of the screened material, representing partially composted greenwaste was taken (Annex A4.6).

c) Fully composted greenwaste <10 mm: sample code - greenwaste_comp_10wk<10mm

This is one of the principal organic waste streams.

A sample of fully composted greenwaste screened to <10 mm was selected to provide an example of fully stabilised greenwaste for comparison with the fresh greenwaste taken (Annex A4.7). This material and another sample, greenwaste_comp_10wk<25mm (below), formed part of research studies on the plant growing media and soil conditioning benefits of treated organic wastes .

d) Fully composted greenwaste <25 mm: sample code -greenwaste_comp_10wk<25mm

A similar sample of fully composted greenwaste screened to <25 mm was also obtained (Annex A4.8).

Mixed food and greenwaste

a) Shredded mixed food and greenwaste: sample code - food&greenwaste_comp_in

This sample consisted of a shredded mixture of household food and garden greenwaste (Annex A4.9). This material is collected separately from local households and is therefore a component of the BMW arisings. This material was selected as it comprised an untreated waste component of BMW enriched with food waste.

b) Partially composted mixed food and greenwaste: sample code - food&greenwaste_comp_4d

This sample consisted of a shredded mixture of household food and garden greenwaste that had been composted for 4 days in composting halls with active aeration (Annex A4.10). The waste had been composted in two stages of two days each to comply with the requirements of the animal by-products regulations. This material was selected as it comprised a partially treated waste component of BMW.

c) Fully composted mixed food and greenwaste: sample code - food&greenwaste_comp_9wk

This sample consisted of a shredded mixture of household food and garden greenwaste that had been composted for 4 days in composting halls with active aeration and then composted for a further 8 weeks in outside windrows (Annex A4.11). This material was selected to provide a comparison with the partially treated (food&greenwaste_comp_4d) and un-treated (food&greenwaste_comp_in) mixed food and greenwaste.

Turkey feathers

a) Un-treated turkey feathers: sample code - feathers_autoclave_input

This sample consisted of waste turkey feathers from a turkey farm (Annex A4.12). This waste was selected as the turkey feathers are of animal origin and comprise mainly the structural protein keratin and therefore would have a very different composition to most plant-derived organic wastes, specifically no cellulose, lignin and hemicelluloses and a low C/N ratio due to its high N content. This would provide an extreme contrast for the waste testing methods.

b) MHT treated turkey feathers: sample code - feathers_autoclave_output

This sample consisted of the turkey feathers (feathers_autoclave_input) mechanical heat treated (MHT) in the pilot autoclave. This sample was included to assess impact of autoclaving on the characteristics of an animal waste for comparison with the other autoclaved mixed wood and packaging wastes. A sampling record is not available for this sample.

Pizza waste: sample code - foodwaste_cmcl_pizza

This sample consisted of pizza waste from a pizza manufacturing facility. It was selected as it represented a particular predominantly plant-based foodwaste that was perceived as proving difficult to compost when composting was being considered as a treatment option. A sampling record is not available for this sample.

Fish waste

a) Raw fish waste: sample code - foodwaste_cmcl_fish

A sample of raw fish waste was collected as an example of an animal-derived organic waste that is collected for treatment by composting. This material would represent a more general mixture of animal organic materials (fats, proteins, carbohydrates) than the more defined turkey feathers. A sampling record is not available for this sample.

b) Fish waste compost input: sample code - compost_org wastes_in

This sample was a mixture of the fish waste with, peat, wood and greenwaste a preparation used commercially to compost the fish waste to produce a valuable compost product. A sampling record is not available for this sample.

c) Partially composted fish waste mix: sample code - compost_org waste_out1

This sample was taken from a composting fish waste mixture that had been composted for a number of days. It therefore represents an intermediate stage in the composting process. A sampling record is not available for this sample.

d) Fully composted fish waste mix: sample code - compost_org wastes_out2

This sample was the final fully composted fish waste mixture that had been composted for more days than the partially composted fish waste mix (compost_org waste_out1) and therefore represents the fully treated fish waste mixture. A sampling record is not available for this sample.

Anaerobically digested sewage sludge cake: sample code - sewage sludge_AD_fcake

This is one of the five principal organic waste streams.

A 10 kg sample of anaerobically digested sewage sludge cake was provided by plant operators of a sewage treatment works. Exact details of the sludge treatment are not known. This sample was selected as an example of an organic waste currently recycled to land with which to compare other organic wastes that may be recycled to land.

A2.2 Mixed MSW derived BMW

Several MSW-derived BMW samples were also collected. These included some samples taken before and after AD and composting as part of MBT systems.

Organic fibre from MHT treatment of MSW

a) Fibre from MHT treated MSW: sample code - MSW_autoclave+40day AD_in

A sample of about 10 kg of fibre derived from the MHT of MSW in a pilot autoclave system was supplied for inclusion in this project. This sample consists of a brown, fibrous compost-like material which is assumed to be composed mainly of BMW-derived organic matter. The exact details of the source of this material are not known although typically this process steam heats the MSW to about 160^{o}C under pressure. Significant amounts of the BMW material are broken down into the brown fibrous compost-like output. The treated MSW is passed through a mechanical separation section which recovers recyclables and the compost-like fibre as separated output streams. This material was selected as an example of an MHT (autoclaved) organic waste.

b) Anaerobically digested fibre: sample code - MSW_autoclave+40d AD_out

A 10 kg sample of digested fibre from an AD trial of MSW was supplied for inclusion in this project. The exact details of the AD treatment conditions are not known but it is understood that the AD treatment was carried out over an extended period in excess of a typical AD residence time of 20 days.

BMW from short period composting MBT process (MBT plant 1)

Two visits were undertaken to collect various treated and untreated samples from a selected waste MBT facility. Briefly, this MBT plant carries out a three-stage brief composting of the shredded MSW. This is undertaken in a tower in-vessel composting facility where the MSW is composted for two days in each of the three stages of the tower. The partially composted material is then mechanically separated into several outputs including a brown compost-like output.

a) Untreated shredded input MSW derived BMW: sample code - MSW_MBT1_input1 (collected 6/12/05) and MSW_MBT1_input2 (collected 15/12/05)

Two samples of shredded MSW as input to the MBT facility were collected. The samples were taken after shredding and prior to entry into the top composting stage of the three stage composting tower. These samples were taken as typical untreated MSW for comparison with other treated MSW derived BMW.

b) Partially composted shredded MSW: sample code - MSW_MBT1_compost_output (collected 6/12/05)

This is one of the five principal organic waste streams.

One sample of partially (6-day) composted MSW (before mechanical separation) was collected on the first visit to the MBT facility. This was collected as a very short time composted MSW sample.

c) Reject treated MSW: sample code - MSW_MBT1_comp_CLO_reject (collected 6/12/05)

One sample of the output stream comprising large particle sized reject material was also collected on the first visit. This material is normally landfilled.

d) Compost like output: sample code - MSW_MBT1_comp_sorted CLO1 (collected 6/12/05) and MSW_MBT1_comp_sorted CLO2 (collected 15/12/05)

Two samples of the organic compost-like output were collected. The sample collected on 15/12/05 corresponded to the input sample collected (MSW_MBT1_input1).

Extended composting MBT samples (MBT plant 2)

Samples of input and output material were collected from an MBT facility which includes composting halls where MSW undergoes extended composting for about 5 weeks as aerated windrows that are also frequently turned. Material may then be further matured in additional composting hall facilities.

a) Input untreated shredded MSW: sample code - MSW_MBT2_comp_in

A sample of the untreated but shredded MSW used as input to the MBT plant was collected as another example of raw BMW.

b) MSW derived matured compost like output: sample code - MSW_MBT2_comp_out

This is one of the principal organic waste streams.

A sample of previously prepared compost like output (CLO) derived from MSW was also taken from a bin used to store demonstration material. The age of this material was unknown and it was assumed that this represented a fully matured CLO from an MBT facility (Annex A4.16).

c) Immature MSW derived compost like output: sample code - MSW_MBT2_comp_out_refd

During a second visit to the site, a sample of CLO derived from screening the 5 week composted input material (MSW_MBT2_comp_in) was taken. This material had not undergone extensive maturing and represents a young but well stabilized MSW derived CLO (Annex A4.17).

Anaerobically digested MSW

A sample of the input and output of an AD plant treating MSW were also taken as examples of AD treatment of MSW.

a) MSW input to AD (MBT plant 3): sample code - MSW_MBT3_AD_input

A sample of the input MSW to the AD plant was taken. This material had undergone extensive preparation and screening prior to AD digestion and therefore represents a processed but un-degraded BMW.

b) AD treated MSW: sample code - MSW_MBT3_AD_output

This is one of the five principal organic waste streams.

A sample of AD treated MSW was also collected from the plant. This material had undergone some dewatering and so may have lost some soluble components in the effluents from dewatering. However it represents an actual AD treated MSW output that might be considered for recycling to land.

MSW composting samples from Ireland1

Samples of the MSW before and after composting were collected from a waste treatment facility in Ireland as further examples of MSW treatment by composting.

Sample code input MSW - **MSW_comp_input_IRL**

Sample code composted MSW - **MSW_comp_output_IRL**

Sample code screened MSW - **MSW_comp_out_screen_IRL**

MSW composting samples from Ireland2 (MBT plant 4)

Samples of the MSW before and after composting were collected from a waste treatment plant in Ireland. The composted sample had been screened to <15 mm.

Sample code input MSW - **MSW-MBT4_compost_input**

Sample code composted MSW <15 mm - **MSW-MBT4_compost_output**

A3 GENERIC SHORT-FORM SAMPLING PLAN FOR ORGANIC WASTES FROM A STOCKPILE

SAMPLING PLAN	
GENERAL INFORMATION	
Project Code: DEFRA Waste Characterisation - 14253-0	
Sampling Plan completed by: Jane Turrell	On behalf of: DEFRA
Site Name and operator: Site Specific Contact: Site Specific Tel: Site Specific	Material producer: Site Specific Contact: Site Specific Tel: Site Specific
Other involved parties: No need to involve the regulator for characterisation and no other parties involved.	
Sampling to be carried out by: WRc	Specify name of sampler: A Godley
SPECIFY THE OBJECTIVE OF THE TESTING PROGRAMME	
Overall Sampling Objective: To undertake a comparison of the basic composition and properties of a wide range of organic wastes, to firstly continue the validation process for the DR4 and BM100 biodegradability tests and secondly produce an initial benchmark calibration of the range of values that might be expected from the various generic types of organic residue. The approach taken was to maximise the number of wastes included in the programme to provide as many points as possible on the calibration line rather than undertake duplicate testing. It will be important to re-address this issue more fully in the future, to gain confidence that the observed variability between streams is not exceeded by the within stream differences (from a single process or a separate other plant). It is intended that two such checks will be carried out within this programme of work. **Technical Goal:** To collect a sample of each waste that represents a single day's operation. It is intended that the chosen day should be representative of operating conditions at each facility over an annual period. A measure of average quality characteristics is required rather than information on the extremes.	
DEVELOPING THE PRACTICAL INSTRUCTION	
MATERIAL	
• **Type of material**: Site Specific	Location: (address) Site Specific
Form and nature of arising: Short-term storage stockpiles for each designated residue stream generated at the end of process conveyor belt. This limits the potential for settling of fines or sample degradation prior to the sampling process.	
Background information: The plants and samples were selected as being typical of the type of product from facilities operating in the UK. Interviews with site staff indicate that we have no reason to expect any substantial quality differences in the wastes being produced day to day/ week to week/ or month to month. As we have no reason to suspect that one day is different to any other, a site visit was arranged on a date that was mutually convenient to WRc and the site operator. Each set of samples represents a spot sample in time, and should provide a sample that is acceptably representative of the average properties of each residue.	
Identify access problems that may affect sampling programme: Site Specific	
SAMPLING METHODOLOGY	
Scale: Each sample to be collected from a volume of waste required to fill a 40 tonne truck.	
Sampling population: Sampling to be carried out for wastes generated over a single operating day.	
Specify detailed sampling location Samples to be collected from the moving face of the stockpile (as it is systematically added to from a conveyor or exposed during excavation and removal) at a time when input loads can be quantified.	
Specify date and time(s) of sampling: Sampling day chosen at random. Random time selected to collect the first sample. Further samples to be collected across the operating day as a stockpile is systematically added to or exposed.	

Specify persons to be present: Site Specific
Identify equipment: Stainless Steel Spade.
Specify no. of samples to be collected: approximately 40 bags.
Specify no. of increments per sample: 10
Specify increment size/sample size: Spadeful
Description of sampling event: Sampling was carried out over a time period that is equivalent to a lorry load of material being added to or taken away from a pile (i.e. the chosen scale). It takes approximately 40 grab or excavator shovels to fill a 40 tonne truck from a stockpile. Take 10 incremental spade-fulls across the area of the exposed face or excavated bucket a total of 40 times. Where a pile is being added to, sample from the outside face of the pile, and up to the full height of the pile. This should be repeated as each bucket equivalent is added to the pile until the equivalent of 40 buckets have been sampled. Where a pile is too high to be sampled in this way it should be levelled out prior to commencement of sampling.
Detail requirements for on-site determinations: Visual examination only.
Identify sample coding methodology: Each sample should have an indelible label on the outside of the bag and a paper label sealed inside a polythene bag placed inside the main collection bag pre-sealing. The following coding should be adopted: Residue code: Site or producer: Identification of any treatment: Sample collection number: Time (of sample collection): Date: Initial of Sampler.
Identify safety precautions: Sampling must only be carried out when the conveyor is stopped.
SUB-SAMPLING
Detail procedure: Approximately 40 bags are collected for each sample. These require full mixing before sample splitting is carried out to meet the analytical schedule. On a clean tarpaulin, mix the material by forming a conical heap, take a spade of the material and put it on the top of the preceding one. The size of the scoop or spade should be of such size that this action should be repeated on at least 20 occasions in order to transfer the full amount of material. Now transfer the material from this first cone and form a new cone. Deposit each spadeful on the peak of the new cone in such a way that the sample runs down all sides of the cone and is evenly distributed so that different particle sizes become well mixed. Repeat. Flatten the third cone by inserting the shovel repeatedly and vertically onto the peak of the cone to form a flat heap, which has a uniform thickness and diameter. The height should be less than or equal to the height of the shovel or spade used. Quarter the flat heap along two diagonals intersecting at right angles using a shovel inserted vertically into the material. Produce the necessary number of laboratory samples by taking spadefuls from alternate quarters. And transfer each sub-sample to a new sample container.
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT REQUIREMENTS
Packaging: Use clean, robust 30 litre polythene bags.
Preservation: The addition of chemical additives is not required.
Storage: A cold store can be used for interim short-term storage during sample processing. Store in a freezer prior to sample testing.
Transport: Deliver the samples to the WRc Swindon laboratory in person within 24 hours of sample collection
ANALYTICAL LABORATORY
WRc, OU, Cranfield, STL. WRc to undertake all sub-sampling and despatch of test samples to participating laboratories. Contact: A Godley/ Saimon Malhotra/ Tina Onu Delivery Date: Sample Specific

A4 SAMPLING RECORDS FOR ORGANIC WASTES

EN 14899 requires the completion of a Sampling Record and chain of custody form on completion of sampling.

The sampling record should document all procedures undertaken and any observations from the sampling exercise. It will reiterate much of the sampling plan but contains space for recording visual observations made in the field and any deviations from those procedures identified in the sampling plan. Further information can be found in ESART (2004).[1]

The sampling records for the organic wastes are presented on the following pages: p

Note: new sample codes were assigned at a later date to protect plant/operator anonymity. They have been included in the sample records to facilitate cross-referencing.

[1] Environmental Services Association Research Trust, A practitioner's guide to testing waste for onward reuse, treatment or disposal acceptance. www.esauk.org/publications/reports/ESART_Practioners_Guide.pdf

A4.1 UNTREATED MIXED WASTE WOOD

SAMPLING RECORD	
Sample code(s): wood pkg _autoclave_in	
Date and Time of sampling: 27/9/05 10.00-14.00	
GENERAL INFORMATION	
Material producer:	Project Ref. No.: 14253-0
Site Address:	Carried out by (Company): WRc plc Sampler: A. R. Godley
Sampling Objective: To undertake a comparison of the basic composition and properties of a wide range of organic wastes, to firstly continue the validation process for the DR4 and BM100 biodegradability tests and secondly produce an initial benchmark calibration of the range of values that might be expected from the various generic types of organic residue.	
MATERIAL DETAILS	
Material Type: Mixed waste wood chips	
Description: Various waste woods – pallets, fibreboard, chipwood, and some green-waste. The material is generally a light woody colour, but some darker areas reflect material that is older and undergoing early biodegradation. The material is dry and has little odour. The particle size ranges from a fine dust to chips up to 10cm long. Occasional contamination from plastics, glass and metals was noted.	
Background: Treatment was undertaken in the autoclave facility. The presence of recycled fibreboard in these materials, makes re-use in board making unfeasible. The chipped material is taken to a composting plant for six months prior to spreading on local farmland.	
Describe the process generating the material to be sampled: The input waste wood is sourced from all areas of the UK. Incoming material is deposited on a concrete base and chipped within a few hours. There is no pre-sorting of input loads and the material is fed into the chipper in rotation as needed by a mechanical grab. Chipped wood is deposited as a large short-term storage pile. At the time of sampling the stockpile was approximately 5m high by about 20m diameter. The stockpile age consisted primarily of very recently chipped wood (days), although a small proportion (<5%) was up to 1 month old.	
Describe nature of arising to be sampled: Static stockpile which is constantly being depleted as material is sent for composting and renewed as new chipped waste added.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled: Wood waste arrives from all parts of the UK 12 hours a day, Monday to Friday. The input loads are roughly mixed as they are processed through the chipper and therefore the chipped product is reasonably well mixed. The source stockpile effectively represents a few days production of wood chip at any one time. The plant manager considers the composition of the stockpile to be fairly constant on a day by day, week by week, month by month and therefore sampling on a single day would produce a sample that is typical of the material produced from the facility.	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: Normal running conditions applied at the time of sampling.	
Location and point of sampling: Samples were collected to a spades depth at points on all sides of the stockpile. The quick turnover of the pile and constant removal and addition of material made it un-necessary to level out the stockpile and sample from what was effectively the middle of the pile.	
Access problems that limit areas or volumes of material that can be sampled: Unable to sample the inside or top of stockpile but not considered to bias the sample due to constant mixing of the mass as described above.	
Record persons present: A. R. Godley	

Equipment used: Stainless steel spade
Describe sampling procedure (i.e. how were the samples collected): The stockpile was constantly being topped up from the chipper and removed by a JCB shovel. A shovel was used to fill a total of 40 plastic bags from different points from the perimeter of the pile, and from a volume that represented a 40 tonne lorry. Two bags were reserved as the "untreated" sample. The remaining bags were reserved for autoclave treatment.
Number of samples collected: 40 (each of approximately 10 increments per bag). 38 samples sent to Estech for autoclaving – total weight of chipped wood 217.8 kg. 2 samples retained as pre-treatment samples.
Estimated increment size/sample size: 5-6kg
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.) Some variation in colour with darker colour areas indicative of older decomposing material. The inclusion of some greenwaste in waste wood would enhance chance of decomposition.
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken: None undertaken on site.
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Plastic bags
Preservation: None
Storage: Room temperature during transport. Stored at 4^{o}C at WRc for initial mixing prior to being frozen
Transport: Samples driven by WRc to the laboratory within 20 hours
DEVIATIONS FROM SAMPLING PLAN
None.
Signature of sampler:

A4.2 MHT MIXED WOOD WASTE

SAMPLING RECORD	
Sample code(s): wood pkg_autoclave_out	
Date and Time of sampling: 4/10/05	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.: 14253-0
Site Address:	Carried out by (Company): xxxx + Robert Oliver (WRc) Sampler: Robert Oliver
Reason samples required (sampling objective): Sample of mixed chipped wood waste treated by the Autoclave process	
MATERIAL DETAILS	
Material Type: Autoclaved chipped mixed wood waste	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Fibrous dark brown woody waste with some larger recognisable wood particles.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Source - Mixed wood chips obtained from xxxx Heated to 160^{o}C under pressure by steam for 30 minutes. Overal processing time is 1 hour. Fibre collected separately from larger reject partcles. These were combined in this case. The amount of material autoclaved was 217.8 kg which is a low load for the pilot plant capacity.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) Samples taken from end of batch process. All material processed collected.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): 19 sample bags collected Total weight of material collected = 216 kg	
Was the process operating under ‘standard’ running conditions for the sub-population to be sampled, record any deviations or ‘out of norm’ conditions: Yes	
Location and point of sampling: Fibre collection point for fibres Residue collection point for oversize residual wood	
Access problems that limit areas or volumes of material that can be sampled:	
Record persons present: xxxx staff, Robert Oliver WRc	
Equipment used: Shovel and bags	
Describe sampling procedure (i.e. how were the samples collected): Mixed the fibre and oversize particles in a pile outside of equipment Shovelling material from process into bags (19).	

Note: Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: 19
Estimated increment size/sample size: 10-12 kg
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Green garden waste bags
Preservation: None
Storage: Room temperature during transport and storage at 4^{o}C at WRc
Transport: road (van)
DEVIATIONS FROM SAMPLING PLAN
Detail: None – all material processed was collected.
Signature of sampler:

A4.3 UNTREATED PACKAGING WASTE

SAMPLING RECORD	
Sample code(s): card pkg_autoclave_in	
Date and Time of sampling: 5/10/05	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:14453-0
Site Address:	Carried out by (Company): the Company Sampler:
Reason samples required (sampling objective): Example organic waste for treatment by autoclave	
MATERIAL DETAILS	
Material Type: Packaging wastes	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Mainly cardboard box waste material. Includes significant amounts of associated plastics.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Cardboard packaging waste is supplied by a subsidiary. The company mixes the packaging waste with kerbside collected newspaper and magazines to produce new cardboard. Characterisation of packaging waste is critical to process. The process above produces a reject waste stream containing incompletely solubilised fibre and plastics. The waste source will contain other solid waste materials as well. About 15000 t/a (approx 50% moisture).	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) Sample (about 6 m^3) from a large skip used to collect the process solid waste and transported for treatment trial.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): The sample was sub-sampled by taking 6 random bags of about 7 – 9 kg weight.	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: Yes	
Location and point of sampling:	
Access problems that limit areas or volumes of material that can be sampled:	
Record persons present:	
Equipment used:	
Describe sampling procedure (i.e. how were the samples collected): **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.	
Number of increments/samples collected: 6 samples collected	

Estimated increment size/sample size: 7-9 kg per sample
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Plastic rubble bags
Preservation: None
Storage: Room temperature and 4^{o}C at WRc
Transport: To WRc by van
DEVIATIONS FROM SAMPLING PLAN
Detail: None
Signature of sampler:

A4.4 MHT PACKAGING WASTE

1.1.2 SAMPLING RECORD	
Sample code(s): card pkg_autoclave_out	
Date and Time of sampling: 5/10/05	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.: 14453-0
Site Address:	Carried out by (Company): xxxx + Robert Oliver (WRc) Sampler: Robert Oliver
Reason samples required (sampling objective): Sample of packaging waste treated by the Autoclave process	
MATERIAL DETAILS	
Material Type: Autoclaved packaging waste	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse)	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Source – Waste packaging material Autoclave plant. Heated to 160^{o}C under pressure by steam for 30 minutes. Overal processing time is 1 hour. Fibre collected separately from larger reject particles. The amount of material autoclaved was 444 kg which is a low load for the pilot plant capacity. Products were 310 kg fibre, 133 kg residues, 5 kg metals. The sample collected was re-constituted from these fractions.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) Samples taken from end of batch process. Collected 11 sub-samples of re-constituted fractions = Total weight collected 190 kg	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): 11 sample bags collected Total weight of material collected = 190 kg	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: Yes	
Location and point of sampling: Fibre collection point for fibres. Not sure if sample was of fibre or includes the plastics?	
Access problems that limit areas or volumes of material that can be sampled:	
Record persons present: xxxx staff, Robert Oliver WRc	
Equipment used: Shovel and bags	
Describe sampling procedure (i.e. how were the samples collected):	

Shovelling material from process into bags (11). **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: 11
Estimated increment size/sample size: 14-20 kg
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Rubble plastic bags
Preservation: None
Storage: Room temperature during transport and storage at 4^{o}C at WRc
Transport: road (van)
DEVIATIONS FROM SAMPLING PLAN
Detail: None – all material processed was collected.
Signature of sampler:

A4.5 CHIPPED FRESH GREENWASTE

SAMPLING RECORD	
Sample code(s): greenwaste<10cm	
Date and Time of sampling: Various dates	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): WRc Sampler: A.R. Godley
Reason samples required (sampling objective): **General greenwaste sample for DEFRA (organic) waste characterisation. The waste sample is to be fully characterised by laboratory testing. There is no requirement to have a sample that is typical of the greenwaste at the time of year.**	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Chipped greenwaste. – from the temporary pile at the end of the chipper conveyor. The material is variable in particle size from small fines of leaf like material to larger poorly chipped fragments of wood up to 20 cm in length.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Greenwaste from public bring collections, commercial greenwaste and County Council municipal parks are brought to site and piled up to one side of the chipping machine. The collections arrive ad hoc throughout the day and the weights are recorded at the site entrance weighbridge. The greenwaste is then passed to the chipper by a mobile grab tractor and chipped. The chipped waste is then moved by another grab-tractor to a pile of chipped greenwaste where it is stored for a short period of about 1 – 2 weeks during which some composting occurs. This pile was very large (~10 m high) and would contain material of different ages and, as the waste was compacted, different degrees of aeration. Note that after such storage the pile is sieved with the sieved material collected and transported offsite for spreading to land. The oversize fragments are re-chipped and added to the new pile of greenwaste. Also general spilled greenwaste from around the greenwaste area is routinely picked up, chipped and added to the stockpile. This material may be of variable state and age.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) On the sampling day a composite sample of about 6-8 kg was collected by hand from the chipper pile surface. The samples were taken after the chipper was observed to have been chipping fresh greenwaste only (not recycled oversize material). The samples were taken from the chipper following the chipping of three grab-fulls of greenwaste, i.e. approximately 2 kg sample from each grab-full. Samples were collected on three days over a three-week sampling period and the samples are to be combined as a single composite sample.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): Samples collected from small pile at end of chipper by hand grab-fulls and placed into rubble bags. Sample size about 6-8 kg wet weight. The stockpile was only present for about 1 hour before being removed to the large storage pile.	

It was unsafe to sample the freshly chipped material on the main pile due to this material being deposited on the top by tractor.
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: Yes – on the first and third week the chipper was also being fed with oversize sieved greenwaste for recycling. On the second week the chipper was only been fed with newly arrived greenwaste.
Location and point of sampling: From the temporary pile of chipped greenwaste under the chipper conveyor
Access problems that limit areas or volumes of material that can be sampled: None – the temporary pile from the chipper is freely accessible but care is required from operational heavy traffic.
Record persons present: A. Godley
Equipment used: Gloves
Describe sampling procedure (i.e. how were the samples collected): Hand collected grab samples of most recently chipped greenwaste on surface of temporary chipper pile. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: Hand grab-fulls of about 200g from freshly chipped greenwaste. Approx number 30 grab-fulls per sample.
Estimated increment size/sample size: 3 samples collected to form composite of about 20 kg sample size wet weight
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.) The sample from the second week was visibly high in leaf content whilst the other samples (first and third week) were more mixed greenwaste material (leaves, twigs, branches)
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken: No on-site sample size reduction.
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Plastic rubble bags
Preservation: None
Storage: Samples stored overnight outside
Transport: Transported to Lab the next day and frozen for long term storage prior to testing
DEVIATIONS FROM SAMPLING PLAN
Detail: The sampling plan was developed ad hoc during the first site visit (first sampling week). It was maintained during the subsequent sampling days. As the objective was to obtain a greenwaste sample and not to characterise the local site operation in details the sampling plan was considered sufficient for the objectives. The pile of chipped greenwaste takes about 10 days to prepare and a sampling plan designed to give a representative sample of the whole pile was beyond the scope of this study.
Signature of sampler:

A4.6 PARTIALLY COMPOSTED GREENWASTE

SAMPLING RECORD	
Sample code(s): greenwaste<10cm_comp_2wks	
Date and Time of sampling: Various dates	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): WRc Sampler: A.R. Godley
Reason samples required (sampling objective): **Partially composted greenwaste sample for organic waste characterisation for DEFRA project**	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Processed partially composted and sieved chipped greenwaste. Material dark brown in colour with high woody fragment content. Particle size from fines to small woody twig like fragments of up to 5 cm in length.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Greenwaste from public bring collections, commercial greenwaste and County Council municipal parks are brought to site and chipped in a chipper for further processing. These are combined with oversize screenings of partially composted greenwaste, which are re-chipped in the same chipper. The material is stockpiled in large heaps for an unfixed time of between 1 to 2 weeks during which some partial composting occurs. The material is screened with the oversize samples and re-chipped and recycled whilst the screened material is transported off-site for application to agricultural land. The samples were of the freshly screened material stockpiled for transport to farmland.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) The samples were taken from the stockpile of screened material of partially composted greenwaste. Samples were collected on two days two weeks apart in time when it was known that the greenwaste pile was being processed to obtain a composite sample over period.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): Samples collected from small pile at end of screening equipment by hand grab-fulls and placed into rubble bags. Sample size about 5-7kg wet weight.	
Was the process operating under ‘standard’ running conditions for the sub-population to be sampled, record any deviations or ‘out of norm’ conditions: Yes – the screening equipment was in use and operating under normal conditions on both sampling days.	
Location and point of sampling: Samples were taken from the surface of the screened partially composted greenwaste pile at the end of the screening equipment.	
Access problems that limit areas or volumes of material that can be sampled: Samples could be collected of freshly screened material from the surface of the pile. It was not possible to sample the whole pile as this was very large. Therefore it was not possible to obtain samples of the whole screened material.	

Record persons present: A. Godley
Equipment used: Gloves
Describe sampling procedure (i.e. how were the samples collected): Hand collected grab samples of most recently screened partially composted greenwaste on surface of pile. The samples were collected from around the pile and probably represented several hours of screened material. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: Samples collected on two days to give a combined sample of about 15 kg.
Estimated increment size/sample size: Each hand grab-full was about 200 g in size.
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.) The samples were warm and had clearly undergone partial decomposition. The material was visibly partially decomposed organic matter with some woody materials remaining.
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken: No sample size reduction was undertaken on-site.
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Plastic bags
Preservation: None
Storage: Kept overnight outside
Transport: Transported to Lab the next day and frozen for long term storage
DEVIATIONS FROM SAMPLING PLAN
Detail: The sampling plan was devised during the brief first site visit. The objectives were not to monitor the local site but to obtain a sample of partially composted greenwaste. The screening of the pile of partially composted greenwaste takes the operators about 5 days to complete. A sampling plan covering this whole period would be required to obtain a representative sample which was beyond the scope of this study.
Signature of sampler:

A4.7 FULLY COMPOSTED GREENWASTE <10 MM

SAMPLING RECORD	
Sample code(s): greenwaste_comp_10wk<10mm	
Date and Time of sampling: 3/11/05. 9-11 am	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): Reading University Sampler: xxxxxx
Reason samples required (sampling objective): To use for growing media in glasshouse experiments and to be characterised/analysed for properties and material content.	
MATERIAL DETAILS	
Material Type: Fine grade greenwaste compost	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Sieved to <10 mm, black/dark brown in colour, no odour, fine particles with some larger wood and plastic fragments. Diverse particle size from very fine to 10 mm. Material been through windrow and screening process.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Open windrow composting. Input greenwaste. Composted for 12 weeks and then screened to 10 mm after which sample was taken.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) After windrow and screening process material is bagged for sale. Samples collected were the usual commercial bags. Sample for testing was grab samples taken from 7 commercial bags.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): Material not taken from stockpile	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: Standard running conditions	
Location and point of sampling: After windrow and screening prior to stockpiling?	
Access problems that limit areas or volumes of material that can be sampled: Run by xxxx staff. Volume of material no problem but access to sampling difficult due to site safety precautions.	
Record persons present: xxxx	
Equipment used: Packing process as normal	
Describe sampling procedure (i.e. how were the samples collected): Bags of commercial material collected from stockpile of bags **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible	

a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: 7 x 40 litre bags
Estimated increment size/sample size: 40 litre
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.) None- but variation in particle size
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken: Sub-sample taken from each bag and supplied to WRc on 8/2/06
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Heavy duty compost bags
Preservation: N/A
Storage: Outside in locked area at Reading University
Transport: Reading University van
DEVIATIONS FROM SAMPLING PLAN
Detail: None
Signature of sampler:

A4.8 FULLY COMPOSTED GREENWASTE <25 MM

SAMPLING RECORD	
Sample code(s): greenwaste_comp_10wk<25mm	
Date and Time of sampling: 3/11/05. 9-11 am	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): Reading University Sampler: xxxx
Reason samples required (sampling objective): To use for growing media in glasshouse experiments and to be characterised/analysed for properties and material content.	
MATERIAL DETAILS	
Material Type: Coarse grade greenwaste compost	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Sieved to <25 mm, black/dark brown in colour, no odour, fine particles with some larger wood and plastic fragments. Diverse particle size from just out of composting process.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Open windrow composting. Input greenwaste. Composted for 12 weeks and then screened to 10 mm after to produce saleable greenwaste compost which sample was taken. Theses samples taken prior to 10 mm screening and were screened to 25 mm.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) After windrow treatment – samples taken straight away and not from stockpile.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): Material not taken from stockpile	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: Standard running conditions	
Location and point of sampling: After windrow prior to stockpiling and screening?	
Access problems that limit areas or volumes of material that can be sampled: Run by xxxx staff. xxxx staff take samples from windrow process on completion of composting as site is dangerous due to machinery/trucks constantly moving.	
Record persons present: xxxx	
Equipment used: Shovel, PPE, compost bags lined with black bin bags.	
Describe sampling procedure (i.e. how were the samples collected): Material shovelled from end of windrow process (12 weeks), prior to screening and bagging. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of	

being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: 7 x 40 litre bags
Estimated increment size/sample size: 40 litre
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.) Variation in particle size, bags warm once material collected but cooled after short while.
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken: Sub-sample taken from each bag and supplied to WRc on 8/2/06
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Heavy duty compost bags lined with black bin liners
Preservation:
Storage: Bags opened for air circulation and stored outside in locked area at Reading University
Transport: Reading University van
DEVIATIONS FROM SAMPLING PLAN
Detail: None
Signature of sampler:

A4.9 UN-TREATED MIXED FOOD AND GREENWASTE

SAMPLING RECORD	
Sample code(s): food&greenwaste_comp_in	
Date and Time of sampling: Various dates	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): WRc Sampler: A.R. Godley
Reason samples required (sampling objective): **Chipped Household collected biodegradable waste for DEFRA project**	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Chipped organic waste collected from households – mostly greenwaste but with some kitchen waste. The shredded waste contains some plastic and biodegradable bin liners/bags. Material is collected every two weeks so may be partially decomposed during storage by householders. Chipped material consists mostly of particle sizes up to about 10 cm in length but with some oversized branches.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Household biodegradable waste is collected every other week from households in County Council's area. The waste is mostly garden greenwaste but also contains kitchen waste (animal and vegetable). The material is composted in a plant that complies with the Animal By-Products Order. The process is to 1. Shred the waste on arrival. 2. Store the shredded waste in the first bay until a full load is prepared. The period stored here is probably no more than two days old at most after shredding. 3. Transfer to another bay and compost for 48 hours at a temperature of at least 60ºC. 4. Transfer to another bay and compost for a further 48 hours at a temperature of at least 60ºC 5. Transfer to a turned windrow for final maturing for at least 8 weeks. The material sampled is the household biodegradable waste after being chipped and shredded ready for composted. It is taken from the front face of the storage bay and comprises the most freshly chipped household greenwaste.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) The samples were taken from the stockpile of shredded waste from the storage bay. Samples were collected on three days over a three week period to obtain representative sample composite sample over period. The samples in week 1 and 2 were freshly chipped/shredded waste whilst that collected in week 3 had been shredded the day before and stored overnight in the bay.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): Samples collected by hand grabfulls and placed into rubble bags. Sample size about 7-9 kg wet weight.	

Was the process operating under ‘standard’ running conditions for the sub-population to be sampled, record any deviations or ‘out of norm’ conditions: Yes
Location and point of sampling: The storage bay 1
Access problems that limit areas or volumes of material that can be sampled: Only the face of the stored material was available for sampling. To obtain sub-samples of the whole batch would require access during the whole time the bay was being filled.
Record persons present: A. Godley
Equipment used: Gloves
Describe sampling procedure (i.e. how were the samples collected): Hand collected grab samples of most recently chipped waste on surface face of pile in the bay **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: About 200 g samples collected from across the pile front face to give a ~7 kg sample.
Estimated increment size/sample size:
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.) The material on week 1 and 2 was clearly freshly shredded organic material whilst that of the third week showed distinct visible signs of decomposition.
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken: No on site size reduction.
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Plastic bags
Preservation: None
Storage: Left outside overnight
Transport: Transported to Lab the next day and frozen
DEVIATIONS FROM SAMPLING PLAN
Detail: Sampling plan was devised on first visit and used for other sampling days. Considered best to sample on several days rather than try to sample a single batch If a fully representative sample of a batch was required would need to be on-site during the whole of the bay 1 filling process.
Signature of sampler:

A4.10 PARTIALLY COMPOSTED MIXED FOOD AND GREENWASTE

SAMPLING RECORD	
Sample code(s): food&greenwaste_comp_4d	
Date and Time of sampling: Various dates	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): WRc Sampler: A.R. Godley
Reason samples required (sampling objective): **Partial composted household collected biodegradable waste for DEFRA study**	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Brownish black composted organic waste. Some contaminating bags although some may be biodegradable type. Most material showed as indistinct organic matter except for recognizable twigs and branches	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Household biodegradable waste is collected every other week from households in County Council area. The waste is mostly garden greenwaste but also contains kitchen waste (animal and vegetable). The material is composted as an aerated pile in a plant that complies with the Animal By-Products Order. The process is to 1. Shred the waste 2. Store the shredded waste in the first clamp/bay until a full load is prepared. 3. Transfer to another bay and compost for 48 hours at a temperature of at least 60ºC. 4. Transfer to another bay and compost for a further 48 hours at a temperature of at least 60ºC 5. Transfer to a turned windrow for final maturing for at least 8 weeks. The material sampled is the partially composted waste after the two composting periods. Samples taken from stockpile before transfer to windrow maturing.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) The samples were taken from the stockpile of partially composted waste taken from the composting bays after the two composting periods at 60ºC Samples were collected on three days to obtain composite sample over period.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): Samples collected by hand and grabfulls and placed into rubble bags. Sample size about 7kg wet weight.	
Was the process operating under ‘standard’ running conditions for the sub-population to be sampled, record any deviations or ‘out of norm’ conditions: Yes	
Location and point of sampling: Samples from week 1 and 3 were from recent material removed from bays in preparation for transfer to maturing windrow stage.	

Samples from week 2 were taken directly from bay as it was being emptied.
Access problems that limit areas or volumes of material that can be sampled: The pile sizes were very large so only the surface of the material could be sampled.
Record persons present: A. Godley
Equipment used: Gloves
Describe sampling procedure (i.e. how were the samples collected): Hand collected grab samples of most recently composted waste on surface face of pile. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: 200 g hand-grab samples collected from around the pile to give a composite sample of about 8 kg
Estimated increment size/sample size:
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.) The samples were warm indicating some extensive decomposition.
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Plastic bags
Preservation: None
Storage: kept outside overnight
Transport: Transported to Lab the next day and frozen
DEVIATIONS FROM SAMPLING PLAN
Detail: The sampling plan was devised during the first sampling visit and used for the two subsequent sampling days. It was considered acceptable to sample several batches rather than sample a whole batch.
Signature of sampler:

A4.11 FULLY COMPOSTED MIXED FOOD AND GREENWASTE

SAMPLING RECORD	
Sample code(s): food&greenwaste_comp_9wk	
Date and Time of sampling: Various dates	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): WRc Sampler: A.R. Godley
Reason samples required (sampling objective): Fully composted household collected biodegradable waste	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Brownish black composted organic waste. Some contaminating bags although some may be biodegradable type.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) Household biodegradable waste is collected every other week from households in County Council's area. The waste is mostly garden greenwaste but also contains kitchen waste (animal and vegetable). The material is composted in a as an aerated pile in a plant that complies with the Animal By-Products Order. The process is to 1. Shred the waste 2. Store the shredded waste in the first Clamp/bay until a full load is prepared. 3. Transfer to another bay and compost for 48 hours at a temperature of at least 60ºC. 4. Transfer to another bay and compost for a further 48 hours at a temperature of at least 60ºC 5. Transfer to a turned windrow for final maturing for at least 8 weeks. The material sampled is the final composted waste following the windrow maturing stage. The age of the compost is not known but is thought to be at least 8 weeks old. The samples were taken prior to sieving and screening the finished compost.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) The samples were taken from the stockpile of partially composted waste taken from the composting bays. Samples were collected on several days to obtain representative sample composite sample over period.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): Samples collected from by hand grabfulls and placed into rubble bags. Sample size about 5-7kg wet weight.	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: Yes	
Location and point of sampling:	
Access problems that limit areas or volumes of material that can be sampled: None	

Record persons present: A. Godley
Equipment used: Gloves
Describe sampling procedure (i.e. how were the samples collected): Hand collected grab samples of most fully composted waste on surface face of windrow of oldest edge. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected:
Estimated increment size/sample size:
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Plastic bags
Preservation: None
Storage:
Transport: Transported to lab and frozen
DEVIATIONS FROM SAMPLING PLAN
Detail:
Signature of sampler:

A4.12 UN-TREATED TURKEY FEATHERS

SAMPLING RECORD -	
Sample code(s):feathers_autoclave_input	
Date and Time of sampling: 27/9/05, 10.00-12.30	
GENERAL INFORMATION	
Material producer: Technical contact: Site contact:	Project Ref. No.: 14253-0
Site Address:	Sampling carried out by: WRc plc Sampler: R Oliver
Sampling Objective: To undertake a comparison of the basic composition and properties of treated feathers with other organic wastes. The sample was selected from a facility producing a product thought to be typical of material from other facilities in the UK. Treatment was undertaken in an autoclave facility. The feathers are currently landfilled.	
MATERIAL DETAILS	
Material Type: Washed turkey stag and hen feathers – White (breed unknown)	
Description: (colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) White, wet stag and hen feathers. The stag feathers are larger and have a higher quill to feather ratio than the corresponding smaller hen feathers. A low level of flesh, blood and fat still attached to the base of the feather following washing.	
Describe the process generating the material to be sampled: Turkeys are gassed using nitrogen and carbon dioxide. The carcasses are then soaked in a water bath to soften the feathers prior to mechanical brushing to strip the feathers. The mix of stag and hen birds varies with the product required on the processing line, but daily inputs are commonly in the range 19,000 stag and 18,000 hen birds.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream):	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week):	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: Normal running conditions applied at the time of sampling.	
Location and point of sampling:	
Access problems that limit areas or volumes of material that can be sampled:	
Record persons present	
Equipment used:	
Describe sampling procedure (i.e. how were the samples collected):. The remaining bags were reserved for autoclave treatment.	
Number of increments/samples collected:	
Estimated increment size/sample size:	
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)	
SUB-SAMPLING	
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken: None undertaken on site.	

PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Plastic bags (rubble bags)
Preservation: None
Storage: Room temperature during transport. Stored at 4^{o}C at WRc
Transport: Samples driven by WRc to the laboratory within 20 hours
DEVIATIONS FROM SAMPLING PLAN
None.
Signature of sampler:

A4.13 MBT SAMPLING 6/12/05

SAMPLING RECORD	
Sample code(s): (Reflect site location, material type and date of collection)	
Date and Time of sampling: 6/12/05 am	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): WRc and OU Sampler: A.Godley (WRc), A. Hobson (OU)
Reason samples required (sampling objective): Obtain samples of MBT input and output for Defra Waste characterisation project	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) 1. MBT input – typical MSW pre-shredded. Particle size variable and composition diverse. 2. MBT output – Partially composted shredded MSW, Brownish colour with more fines and partially decomposed organic matter. 3. Dense contras – large reject particles of mixed MSW destined for landfill. 4. Compost – compost like material, brown fibres with contaminating contras. Fine sized particles. Destined for maturing and use in landfill completion as sub-soil component.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day). General description – two parallel Civic 3-stage composting units with mechanical separation. Operated semi-continuously. MSW is shredded and fed by conveyer to top of reactor. Composted for 6 days (two days in each stage). Material discharged to mechanical separation giving various product streams. Fe metals, non-Fe metals, dense contras, light contras, compost, glass. Input MSW from general household sources plus some industrial MSW. Material stockpiled in holding bay. Loaded into shredder 120 tonnes per batch.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) 1. MBT input – sampled from top of conveyor feeding composting unit during loading of reactor 1. 2. MBT output – sampled from conveyor emptying reactor 2. Not in operation on day of sampling. Material was from previous day's discharge left on conveyor 3. Dense contras – sampled by grab samples from pile in skip used to collect dense contras from mechanical separation 4.Compost – sampled by grab samples from pile in container lorry used to collect compost from mechanical separation	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): 1. MBT input – 5 sub-samples taken equally spaced during a period of 1.5 hours when reactor 1 was	

being loaded. Total loading time 3 hours. Represents input of one batch. 2. MBT output – 2 sub-samples collected from conveyor at base of reactor. Represents sample of MBT output discharged on 5/12/05 3. Dense contras – 2 sub-samples collected from stockpile of batch discharged previous day on 5/12/05 4. Compost – 2 sub-samples collected from stockpile of batch discharged previous day on 5/12/05.
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: The input MSW was when plant was running normally for loading composting. Samples of dense contras and compost were from separated product streams mechanically sorted the previous day. The MBT output was from the conveyor belt and is only a limited spot sample of material left on the belt. At time of sampling the mechanical separation unit was not in operation and no discharge from composting unit was taking place.
Location and point of sampling: Described above
Access problems that limit areas or volumes of material that can be sampled:
Record persons present: As above
Equipment used: Plastic snow shovel (compost sampling) or dust pan all others.
Describe sampling procedure (i.e. how were the samples collected): MBT input – dustpan used to collect grab samples from conveyor. Placed in tubs (5). Dense contras, MBT output – Dustpan used to scoop up several grab samples from around stockpiles and off conveyor (MBT output). Compost – snow shovel used to scoop from around pile in container. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: Scoops were about 1-2 kg in weight each time
Estimated increment size/sample size:
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging:
Preservation:
Storage:
Transport:
DEVIATIONS FROM SAMPLING PLAN
Detail:
Signature of sampler:

A4.14 MBT SAMPLING 15/12/05

SAMPLING RECORD	
Sample code(s): (Reflect site location, material type and date of collection)	
Date and Time of sampling: 15/12/05 am	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company): WRc and Reading Sampler: A.Godley (WRc), H (RU)
Reason samples required (sampling objective): Obtain samples of MBT input and output for Defra Waste characterisation project	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) 1.MBT input – typical MSW pre-shredded. Particle size variable and composition diverse. 2.Compost – compost like material, brown fibres with contaminating contras. Fine sized particles. Destined for maturing and use in landfill completion as sub-soil component.	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day). General description – two parallel Civic 3-stage composting units with mechanical separation. Operated semi-continuously. MSW is shredded and fed by conveyer to top of reactor. Composted for 6 days (two days in each stage). Material discharged to mechanical separation giving various product streams. Fe metals, non-Fe metals, dense contras, light contras, compost, glass. Input MSW from general household sources plus some industrial MSW. Material stockpiled in holding bay. Loaded into shredder 120 tonnes per batch.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) 1. MBT input – sampled from top of conveyor feeding composting unit during loading of reactor 1. 2..Compost – sampled by grab samples from sub-sample collected in skip on 12/12/06 from batch input sampled on 5/12/06. Material had been stored for three days in skip prior to collection. Same sample used by Reading for their studies.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): 1. MBT input – 4 sub-samples taken equally spaced during a period of 1.5 hours when reactor 1 was being loaded. Total loading time 3 hours. Represents input of one batch. Compost – 4 sub-samples collected from stockpile of batch discharged on 12/12/05.	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions: The input MSW was when plant was running normally for loading composting. The separation system had recently failed so only a small fraction of material had been discharged and was	

sampled on the sampling day.
Location and point of sampling: Described above
Access problems that limit areas or volumes of material that can be sampled:
Record persons present: As above
Equipment used: Plastic snow shovel (compost sampling) or dust pan all others.
Describe sampling procedure (i.e. how were the samples collected): MBT input – dustpan used to collect grab samples from conveyor. Placed in tubs (5). Compost – snow shovel used to scoop from around pile in container. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.
Number of increments/samples collected: Scoops were about 1-2 kg in weight each time
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)
SUB-SAMPLING
If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging:
Preservation:
Storage:
Transport:
DEVIATIONS FROM SAMPLING PLAN
Detail:
Signature of sampler:

A4.15 INPUT MSW TO MBT PLANT 2

SAMPLING RECORD	
Sample code(s): MSW_MBT2_comp_in	
Date and Time of sampling: 15/03/06	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company):WRc and OU Sampler: A. Godley & A. Hobson (OU)
Reason samples required (sampling objective): Sample of MSW prepared for windrow MBT plant	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Shredded mixed MSW fraction containing plastics, glass, metals and organics (BMW)	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) The sampled material is from a shredding process. Black bag MSW is shredded and then passed onto a size sorting sieve. Material of size <60 mm is collected and used for composting by windrow. Material >60 mm is separated as reject and may be landfilled.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) A stockpile of material was prepared and sampled.	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week):	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions:	
Location and point of sampling: The stockpile was sampled by grab sampling all around the stockpile. Attention was made to sample within the stockpile to obtain representative sample	
Access problems that limit areas or volumes of material that can be sampled: None	
Record persons present: A Godley & A. Hobson	
Equipment used: shovel	
Describe sampling procedure (i.e. how were the samples collected): Shovel sub-samples collected from around and within the stockpile **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.	
Number of increments/samples collected: 20 sub-samples collected to give a total sample size of about 30 kg	
Estimated increment size/sample size: 1.5 kg	
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)	
SUB-SAMPLING	

If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Packed into tubs and rubble bags
Preservation: None
Storage: To be stored frozen
Transport: Own car
DEVIATIONS FROM SAMPLING PLAN
Detail:
Signature of sampler:

A4.16 MATURE CLO FROM MBT PLANT 2

SAMPLING RECORD	
Sample code(s): MSW_MBT2_comp_out	
Date and Time of sampling: 15/03/06	
GENERAL INFORMATION	
Material producer: Contact name:	Project Ref. No.:
Site Address:	Carried out by (Company):WRc and OU Sampler: A. Godley & A. Hobson (OU)
Reason samples required (sampling objective): Sample of CLO from windrow MBT plant	
MATERIAL DETAILS	
Material Type:	
Description:(colour, moisture content, odour, consistency/homogeneity/particle size – uniform or diverse) Blackish brown compost-like material containing a few visible contras (plastics, stones)	
Describe the process generating the material to be sampled: (include source of input materials and volumes generated per hour or per day) The material is from an MBT plant treating MSW. The MSW is shredded and then sieved. The <60 mm fraction is composted in windrows for 34 days and then sieved to 6 mm. The <6 mm fraction is the CLO material.	
Describe nature of arising to be sampled (e.g. static – stockpile, silo or moving – conveyor belt, falling stream) The sample material was from a bin used as a demonstration of material from the composting process. The age and how representative of typical output material is unknown	
SAMPLING METHODOLOGY	
Define sub-population or consignment sampled (e.g. stockpile represents one weeks production and then quantify/record input loads that make up that week): Not known	
Was the process operating under 'standard' running conditions for the sub-population to be sampled, record any deviations or 'out of norm' conditions:	
Location and point of sampling: Sampled from small demonstration bin	
Access problems that limit areas or volumes of material that can be sampled: None	
Record persons present: A Godley	
Equipment used: Hand grabs	
Describe sampling procedure (i.e. how were the samples collected): Grab handfuls of CLO were sampled and combined to give a mixed sample. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however in the case of static piles, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral.	
Number of increments/samples collected: 40 sub-samples collected to give a total sample size of about 10 kg	
Estimated increment size/sample size: 0.25 kg	
Observations during sampling: (e.g. gassing out, reactions, heat, variation in colour, particle size etc.)	
SUB-SAMPLING	

If sample size reduction (e.g. coning and quartering) or sub-sampling was carried out on-site describe procedure undertaken:
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT DETAILS
Packaging: Packed rubble bags
Preservation: None
Storage: To be stored frozen
Transport: Own car
DEVIATIONS FROM SAMPLING PLAN
Detail:
Signature of sampler:

A5 SAMPLING PLANS FOR INORGANIC WASTES

In contrast to the organic waste programme the **inorganic waste programme** was focused on collecting more comprehensive data for a smaller number of waste streams. This objective was achieved through selection of a discrete number of processes or plants, each of which handled a complex cocktail of input wastes and operated a suite of basic treatment recipes.

A second objective of this testing programme was to obtain samples that represented the extremes and middle ground of waste inputs and outputs and encompassed the range of processes being undertaken at the selected plants. Process complexity and variability dictates in this instance that sampling would need to take place over a much longer period of time than the single point in time snap-shot approach used in the organic waste programme. Following analysis of plant specific routine compliance monitoring data, a discrete number of site-specific sampling plans were produced that targeted each individual operating regime. Paired input/output samples were collected from a suitable fixed operating period determined after analysis of background testing data and discussions with plant personnel.

Sampling plans for the following waste streams are provided here:

- Treated municipal solid waste incineration (MSWI) air pollution control (APC) residues (A5.1).
- Physico-chemical treatment filter cakes (A5.2).
- MSW gasification residues (A5.3 and A5.4).

A5.1 TREATED MSWI APC RESIDUES

SAMPLING PLAN	
Sample code(s): MSW1_APCtreat_SH_Nov; MSW1_APCtreat_SH_Dec; MSW1_APCtreat_SH_Jan; MSW1_APCtreat_SL_Nov; MSW1_APCtreat_SL_Dec; MSW1_APCtreat_SL_Jan	
GENERAL INFORMATION	
Project Code: DEFRA Waste Characterisation - 14253-0	
Sampling Plan completed by: Jane Turrell	On behalf of: DEFRA
Site Name and operator: Physical-Chemical Waste Treatment Plant. Contact: Plant representative Tel: Confidential	Material producer: Same Plant Contact: Confidential Tel: Confidential
Other involved parties: Samples required to support R&D waste characterisation testing programme, therefore no need to involve the regulator and no other parties involved.	
Sampling to be carried out by: Plant Operator	Specify name of sampler: Confidential
SPECIFY THE OBJECTIVE OF THE TESTING PROGRAMME	
Overall Sampling Objective: To undertake a preliminary characterisation of a non-hazardous residue from a physico/chemical treatment process mixing acid metal wastes with MSW Air Pollution Control residues (APC). Test data will be used to produce an initial benchmark of the composition and leachability that might be expected from these types of residues. **Technical Goal:** To collect six spot samples of non-hazardous residue from a UK plant to gain a measure of the composition and leachability of these residues and obtain an estimate of between week variability in these quality characteristics. A measure of the middle range of quality characteristics (which represents the majority of residue produced) is required rather than information on the extremes (which represent the minority of residues produced). The samples collected will not be specifically linked, but represent randomly chosen loads (with a stratified schedule) leaving the plant.	
DEVELOPING THE PRACTICAL INSTRUCTION	
MATERIAL	
• **Type of material**: non-hazardous residue	Location: (address) Confidential
Form and nature of arising: Short-term storage stockpile of treated residue in a storage bay at the end of the process conveyor. **Note:** Wherever possible samples should be taken so that every particle in the sub-population being sampled has an equal chance of being selected. This is best achieved by sampling from a moving stream e.g. a conveyor. However, if this is not possible and samples are collected from a static pile where possible, a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or as in this case, sampling is carried out during transfer of the stockpile using the bucket of a JCB. Samples are then taken across the full period of transferral from a volume of waste that matches the chosen scale.	
Background process information: The chosen waste facility carries out a physico/chemical treatment process mixing liquid acidic metal wastes with APC residues to produce a non-hazardous residue. The plant currently handles up to 100 ktonnes of APC residues per annum. The plant has been operating to the current process within the last decade and consists of a number of acid/sludge settling tanks, mixing tanks and six APC storage silos. Settled solids from acidic liquid/sludge wastes are pumped at a metered rate into the mixing plant where they are combined with APC residue using a screw feeder in an approximately 50:50 mix of APC residue and acidic sludge. The acidic waste is a mix of regular/consistent locally derived wastes and spot work. APC residue is derived from several MSWI energy from waste plants and arrives at the treatment plant in 27 tonne capacity tankers. The input loads are dominated by APC residues from two of the EfW plants, which make up approximately 99% of the	

total. Of these, one plant supplies of the order of 85% of inputs and the other supplies 15%. The plant can process 120 m^3 or 27 tonnes of APC residues in approximately 2 hours. Current inputs to the plant stand at approximately 200 tonnes per day (or on average 8 tanker loads). The residue product from the treatment area is moved by a conveyor and dropped into a storage bay where it is moved using JCBs into lorries for transportation to landfill. The majority of residue is moved in 8 wheel rigid trucks with a payload of 17 tonnes. This volume equates to approximately 90 minutes of processing. A fairly consistent level of blending of the input loads occurs during storage, treatment and excavation from the pit.

SAMPLING METHODOLOGY

Scale: Each sample to be collected from a volume of residue that fills a 17 tonne truck (going to landfill).

Specify no. of samples to be collected: 6 separate spot samples each made up of 20 increments.

Background to adopted sampling approach: Interviews with site technical staff indicated there was no reason to expect any substantial quality differences in the composition of the APC residue being produced day-to-day/ week-to-week/ or month-to-month at the plant. Treatment trials have shown that the process is relatively insensitive to changes in acidic input wastes, but it is sensitive to APC quality. Potentially problematic APC streams are avoided and blending of APC residues from accepted plants is undertaken to iron out input load variability. The process is operated to avoid extremes in residue composition and we would therefore not expect 'bad' or 'different' weeks. This mode of operation is substantiated by daily and weekly compliance monitoring data generated at the plant. The plant operates a regular routine compliance programme on treated APC residues. *Note: Daily grab samples (approx. 1 kg) are collected, for a nominal list of parameters, these samples are used to construct weekly composites, which are tested more extensively (total metals and anions, Extractable petroleum hydrocarbons, TOC and PAHs). One of the daily samples is taken at random once a month for external checking.* The plant provided compliance data for a month in 2005, which provided a reasonable picture of annual inputs.

The compliance monitoring data shows monthly inputs to the process are steady. Two plants supply at least one load of APC residue to the plant on all routine operating days, the remaining inputs are more periodic, but make up a much smaller fraction of the APC residue being processed. To ensure that the samples collected for this testing programme are a reasonable representation of the quality of the majority of residues being produced at the plant the sampling programme will focus on the two plants supplying the majority of APC residues. Three samples of each treated stream will be taken and can be used to establish whether there is any statistical difference in residue quality between different input streams.

Load numbers (i.e. volume of APC residue received for treatment) are constant by day of the week and by week in any given month. We can therefore reasonably assume that we should see the full range of expected variability in residue composition in any given month that we choose to sample. The compositional analysis indicates that whilst there is considerable variability in concentrations of a number of key parameters there are no apparent monthly trends in composition. Adoption of a random sampling approach is therefore suggested as an appropriate approach. The selection of a random start date and random selection of the specific loads to be sampled means we can make assumptions about the wider population i.e. production over an annual period (rather than just the load sampled) and make an estimate of the magnitude of the week to week component of variability, as well as that of random variability. The identified daily variability in residue composition could mean we are potentially vulnerable to a large within week component of variability if samples are taken over too short a period. It is therefore advocated that sample collection is spread across at least four weeks to provide an opportunity to identify any week-to-week component of variability if it is present.

Sampling population: It is intended that a total of 6 spot samples will be collected in such a way that the resulting test data should be representative of normal operating conditions at the facility over a year.

Specify detailed sampling location It is usually preferable to take samples from a moving stream i.e. in this case the conveyor moving the treated residue to the temporary storage bay. However, in this instance we intend to take the sample from the location where it is most thoroughly mixed i.e. make use of the additional mixing that occurs during excavation of the material from the storage bay into a truck for landfilling.

Specify date and time(s) of sampling: Sampling should be carried out over a four week operating period. The sampling period will be stratified, so that the four week period is divided into equal periods of four working days. This avoids any bunching of samples within a smaller time frame and subsequent vulnerability to abnormal week to week variability. The exact day and load selected for sampling within each sampling period will be at the discretion of the plant operator. A start date should be chosen at random by the plant. Within each 4 day period of operation collect a sample of residue. Repeat this process for consecutive 4-day periods until 6 samples of APC residue have been collected. Sample collection should be alternated between the two input plants until 3 samples of each stream have been collected. Please record the mix of APC residue being sampled by the plant at the time of sampling.
Identify access problems that may affect sampling programme: None anticipated
Specify persons to be present: Plant Manager
Identify equipment: Stainless Steel Spade.
Specify no. of increments per spot sample: 20 (This should produce a composite spot sample that is representative of the selected lorry load).
Specify increment size/sample size: Spadeful collected from three positions across the surface of a JCB bucket.
Description of sampling event: Sampling of residue from a specific APC source load should be carried out over a time period that produces a volume of residue at the chosen scale i.e. 17 tonne, this is estimated to be 90 minutes. If it takes approximately 20 grab or excavator shovels to fill a 17 tonne truck from the stockpile, from each of 20 JCB shovels taken over the chosen 90-minute period, take three spadefuls of residue across the surface of the residue in the excavated bucket. Alternatively if the process is not running and the source load of residue is in the storage bay, take 20 JCB buckets from the pile as it is excavated into a lorry and sample from each bucket as before. Time constraints at the plant may make this the preferred option. Place each incremental sample (made up of 3 spadefuls) on a plastic sheet until 20 increments have been collected. It is important that the volume of residue from which sampling occurs is only the volume of a lorry load i.e. 17 tonnes.
Detail requirements for on-site determinations: Visual examination only.
Identify sample-coding methodology: Each bulk sample should have an indelible label on the outside of the container and a paper label sealed inside a polythene bag placed inside the main container pre-sealing. The following coding should be adopted: Residue code: APC residue, Site or producer: Sample collection number: 1 to 6, Time (of sample collection): Date: Initial of Sampler.
Identify safety precautions: As per local (site specific) sampling procedure
SUB-SAMPLING
Detail procedure: Two sample containers have been provided by WRc for each sample. If the volume of the 20 incremental samples (each of three spadefuls) is greater than that of the two containers, coning and quartering should be undertaken to reduce the volume of sample. Place the 20 incremental samples on a clean tarpaulin or plastic sheet. Mix the material by taking a spade of the material and putting it on the top of the preceding one to form a conical heap. Now transfer the material from this first cone and form a new cone in the same manner. Deposit each spadeful on the peak of the new cone in such a way that the sample runs down all sides of the cone and is evenly distributed. Repeat for a third time to form a third cone. Flatten the third cone and divide the resulting heap into four approximately equal quarters. Produce a 20 kg final sample by taking spadefuls from alternate quarters (this may be all of the material in the two quarters and fill the two sample containers provided.
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT REQUIREMENTS
Packaging: Use clean, robust 30 litres lidded plastic containers (supplied by WRc).
Preservation: The addition of chemical additives is not required.
Storage: Store outside in a cool place
Transport: WRc will collect the samples and transport them to their Swindon laboratory when sample

collection is complete	
ANALYTICAL LABORATORY: WRc plc, Frankland Rd, Blagrove, Swindon, Wilts., SN5 8YF	
Contact: Jane Turrell Tel. 01793 865176/ John Andrews 01793 865181	Delivery Date: Complete

A5.2 PHYSICO-CHEMICAL TREATMENT FILTER CAKES

SAMPLING PLAN	
Sample Codes: phys_chem_nhaz1_fcake; phys_chem_haz2_fcake; phys_chem_nhaz3_fcake; phys_chem_haz4_fcake; phys_chem_nhaz5_fcake; phys_chem_haz6_fcake; phys_chem_nhaz7_fcake; phys_chem_haz8_fcake; phys_chem_nhaz9_fcake; phys_chem_haz10_fcake; phys_chem_nhaz11_fcake; phys_chem_haz12_fcake	
GENERAL INFORMATION	
Project Code: DEFRA Waste Characterisation - 14253-0	
Sampling Plan completed by: Jane Turrell	On behalf of: DEFRA
Site Name and operator: Physico-chemical Waste Management Facility 2 Contact: Plant representative Tel: xxxxxxxx	Material producer: Same Plant Contact: Plant representative Tel: xxxxxxxx
Other involved parties: Samples required to support R&D waste characterisation testing programme, therefore no need to involve the regulator and no other parties involved.	
Sampling to be carried out by: Plant Operator	Specify name of sampler: xxxxxx
SPECIFY THE OBJECTIVE OF THE TESTING PROGRAMME	
Overall Sampling Objective: To undertake a preliminary characterisation of hazardous and non-hazardous filter cakes from a physico/chemical treatment process handling liquid industrial effluents. Test data will be used to produce an initial benchmark of the composition and leachability that might be expected from these types of residues. **Technical Goal:** To collect a number of spot samples of hazardous and non-hazardous treatment filter cakes from a high throughput UK plant to gain a measure of the composition and leachability of these types of residue and obtain an estimate of the potential between week variability in basic quality characteristics. A measure of the middle range of quality characteristics (which represents the majority of filter cake (FC) produced) is required rather than information on the extremes. The samples collected are not specifically linked, but represent randomly chosen loads, within a stratified schedule to provide a snap-shot of the heterogeneity that might be expected in the resulting filter cakes.	
DEVELOPING THE PRACTICAL INSTRUCTION	
MATERIAL	
• **Type of material**: Hazardous and Non-hazardous filter cake	Location: (address) XXXXXX
Form and nature of arising: Continuous batched deposits of treated filter cake from the filter presses.	
Background process information: The facility accepts an extensive range of aqueous, bulk, non-flammable, 'pumpable' liquid wastes. These are treated using basic physico/chemical processes and filtration to generate hazardous and non-hazardous filter cakes which are disposed to landfill. Liquid effluent generated as part of the treatment process can be stored and blended, where necessary, prior to discharge to a sewage treatment works (STW). Intake wastes include acids from metal treatment, chemical manufacturing wastewaters, alkalis, food and beverage wastes, landfill leachates, oil/water mixtures and interceptor wastes. The plant has a high throughput and volumetric capacity and the flexibility to treat complex waste mixtures. It currently treats about 100,000 tonnes of waste per annum. Wastes commonly arrive in tankers (circa 28t per load) which are tested prior to unloading. Wastes are stored in the following categories: acid wastes (pH<4) – storage 200m^3; wastes requiring chemical/physical treatment (pH>4) – storage 400m^3 and oil/water mixtures – storage 170m^3. Additional storage is available for waste for direct discharge to the STW, treated waste requiring filtration "stock" and treated waste for discharge to the STW. Wastes requiring chemical and/or physical processing e.g. neutralisation and removal of heavy metals,	

are batched from storage into one of the four reaction vessels (3 of 20m^3 and 1 of 60m^3). Compatible wastes are commonly mixed at this stage, and acid wastes used where possible to neutralise alkali wastes etc. Additional treatment reagents are then added such as calcium hydroxide and ferrous sulphate. The volumes of reagents required and mixing regimes are batch specific. Testing is undertaken prior to filtration to check the acceptability of each processed batch. The resulting stock is then stored prior to filtration in one of three 200m^3 stock tanks. Storage in this way allows reactions such a precipitation of metals to continue. Treatment reagents are sometimes added to the stock tanks as part of final polishing. Three filter presses are used to separate particulates from the stock material. The composition of the filter cake from the presses are periodically tested as part of a routine compliance testing programme and can be stored in dedicated bays prior to off-site disposal. Liquids are checked for composition prior to discharge to the sewage treatment works, which operates strict effluent quality standards.

A gravity separator is available for separation of oil/water mixtures, prior to mixing and treatment with other wastes to remove heavy metals etc.

SAMPLING METHODOLOGY

Scale: Each sample to be collected from the volume of filter cake required to fill an 18 tonne truck.

Specify no. of samples to be collected: 6 separate spot samples of hazardous and non-hazardous filter cake should be collected for each increment.

Background to adopted sampling approach: The waste management facility handles high volumes of liquid wastes requiring treatment. Inputs to the plant are extremely varied in terms of the source, volume and frequency of loads submitted for treatment. Clients submit repeat loads on a daily/weekly and monthly basis but a high proportion of inputs are one-off jobs. The numbers of inputs commonly exceed 100 per month. The physical/chemical processes operated at treatment facilities in the UK are based on the same basic principles, as are the generic wastes generated by specific industry groups. This and the pattern of inputs to this facility, means that we can reasonably expect to see the full range of filter cakes that might be produced at other plants in the UK. The wastes requiring treatment fall into 4 main categories – acid wastes, alkalis, neutral wastes and oily water mixtures. Examination of routine test data generated at the plant pre-treatment indicates that inputs to the plant are of the order of 1000 tonnes of hazardous and 500 tonnes of non-hazardous liquid effluents per month. The variability week on week is ± 30% and can increase to 100% if required i.e. leading to a doubling in filter cake production. This large and complex range of inputs, which are treated using a continuous batch process (mixing of the individual input types is undertaken under controlled conditions) means we can expect substantial quality differences in the composition of the filter cake being produced hour-to-hour, day-to-day, week-to-week and month-to-month at the plant. The process is operated to avoid extremes in FC composition and in the main we would not expect 'bad' or 'different' weeks. This mode of operation is substantiated by daily and weekly compliance monitoring data generated at the plant. This data shows that although monthly inputs to the process are far from steady, the compositional analysis indicates that although there is considerable variability in concentrations of a number of key parameters, there are no apparent monthly trends in composition. However, occasionally large inputs from an individual supplier can mean that this waste dominates the characteristics of the resulting FC in a particular week and the plant are asked to avoid taking two samples of the same input stream.

The adoption of a random sampling approach is suggested as appropriate. The selection of a random start date and random selection of the specific loads to be sampled means we can make assumptions about the wider population i.e. production over an annual period (rather than just the load sampled) and make an estimate of the magnitude of the week to week component of variability, as well as that of random variability. The identified daily variability in FC composition could mean we are potentially vulnerable to a large within week component of variability if samples are taken over too short a period. It is therefore advocated that sample collection is spread across at least four weeks to provide an opportunity to identify any week-to-week component of variability, if it is present.

Sampling population: Collect 6 spot samples of non hazardous filter cake and a further six of haz filter cake from random treatment batches generated in an operating month. The resulting test data should be representative of filter cake production at the facility over an annual period.

Specify detailed sampling location: Wherever possible samples should be taken so that every particle in the sub-population being sampled has an equal chance of being selected. This is best achieved by sampling from a moving stream. In this case the input liquid to the press has been well mixed in the bulk processing tank and collection of sample from the filter press provides a similar approach. Incremental samples are taken across the full period it takes to produce a volume/mass of waste at the chosen scale. The filter presses are loaded and take approximately 2 hours per press cycle. The press can be opened and sampled at the end of each cycle. Each filtration stock tank will produce approximately 40 tonnes of filter cake. Each set of 10 incremental samples should only be taken from a volume of approximately 20 tonnes (i.e. the volume of a load going to landfill).
Specify date and time(s) of sampling: Sampling should be carried out over a four week operating period. The sampling period will be stratified, so that the four week period is divided into equal periods of four working days. This avoids any bunching of samples within a smaller time frame and subsequent vulnerability to abnormal week to week variability. The exact day and load selected for sampling within each sampling period will be at the discretion of the plant operator. A start date should be chosen at random by the plant. Within each 4 day period of operation, collect a sample of hazardous and non-hazardous FC. Repeat this process for consecutive 4-day periods until 6 samples of each FC have been collected. Sample collection should be alternated between the three basic residue types until 2 samples of hazardous FC and 2 samples of non-hazardous filter cake have been collected for each stream.
Identify access problems that may affect sampling programme: None anticipated
Specify persons to be present: xxxxxx
Identify sampling equipment: Stainless Steel Spade.
Specify no. of increments per spot sample: 10 (This should produce a composite spot sample that is representative of the selected lorry load).
Specify size of each increment: Collect a spadeful from six positions across the drop area from the filter press.
Description of sampling event: Sampling of FCs from a chosen treatment batch should be carried out over the full time period it takes to produce a volume of FC at the chosen scale i.e. 18 tonnes. Place each incremental sample (made up of 6 spadefuls) on a plastic sheet until 10 increments have been collected. It is important that the volume of FC from which sampling occurs is only 18 tonnes.
Detail requirements for on-site determinations: Visual examination only.
Identify sample-coding methodology: Each bulk sample should have an indelible label on the outside of the container and a paper label sealed inside a polythene bag placed inside the main container pre-sealing. The following coding should be adopted: Residue code: Haz or Non Haz FC, Site or producer: Plant operator, Sample collection number: 1 to 6, Date (of sample collection): xx/xx/xxxx, Batch Type (Acid, Hydroxide or Oil/water): XXXX, Initial of Sampler: xxxxxx
Identify safety precautions: To be agreed with Plant operator
SUB-SAMPLING
Detail procedure: The 10 incremental samples (each of six spadefuls) should be placed on a clean tarpaulin or plastic sheet. These require mixing before a sub-sample can be taken for dispatch to WRc. Mix the material by taking a spade of the material and putting it on the top of the preceding one to form a conical heap. Now transfer the material from this first cone and form a new cone in the same manner. Deposit each spadeful on the peak of the new cone in such a way that the sample runs down all sides of the cone and is evenly distributed. Repeat for a third time to form a third cone. Flatten the third cone and divide the resulting heap into four approximately equal quarters. Produce an approx. 20 kg final sample by taking spadefuls from alternate quarters (this may be all of the material in the two quarters). Combine each spadeful into the sample containers supplied.
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT REQUIREMENTS
Packaging: Use clean, robust 30 litres lidded plastic containers (supplied by WRc).

Preservation: The addition of chemical additives is not required.	
Storage: Keep in a cold store prior to dispatch to WRc	
Transport: Send the samples using 24 or 48 hour delivery to the WRc Swindon laboratory	
ANALYTICAL LABORATORY: WRc plc, Frankland Rd, Blagrove, Swindon, Wilts., SN5 8YF	
WRc, OU, Cranfield, STL. WRc to undertake all sub-sampling and despatch of test samples to participating laboratories.	
Contact: Jane Turrell Tel. 01793 865176/ John Andrews 01793 865181	Delivery Date: xx/xx/xxxx

A5.3 MSW GASIFICATION RESIDUES

SAMPLING PLAN	
Sample code: MSW Gasification APC1, MSW Gasification APC2, MSW Gasification IBA1, MSW Gasification IBA2	
GENERAL INFORMATION	
Project Code: DEFRA Waste Characterisation - 14253-0	
Sampling Plan completed by: Jane Turrell	On behalf of: DEFRA
Site Name and operator: MSW Gasification Plant 1 Contact: Plant representative Tel: xxxxxxxx MSW Gasification Plant 2 Contact: Plant representative Tel: xxxxxxxx	
Other involved parties: No need to involve the regulator for research characterisation and no other parties involved.	
Sampling to be carried out by: Plant Operator	Specify name of sampler: xxxxxx
SPECIFY THE OBJECTIVE OF THE TESTING PROGRAMME	
Overall Sampling Objective: To undertake a preliminary characterisation of residues from two full scale MSW Gasification Plants. Test data will be used to produce an initial benchmark of the composition and leachability that might be expected from bottom ash and APC gasification residues **Technical Goal:** To collect spot samples of Bottom Ash (BA) and Air Pollution Control Residue (APC) from two plants on a single day of operation to gain a measure of the composition of these residues and obtain an estimate of within day variability. It is intended that the chosen day should be representative of normal operating conditions at each facility over a year. A measure of average quality characteristics is required rather than information on the extremes.	
DEVELOPING THE PRACTICAL INSTRUCTION	
MATERIAL	
• **Type of material**: Bottom Ash and APC residues	Location: (address) XXXXXX
Form and nature of arising: Short-term storage in skips (BA) and ? (APC) for each residue stream at the end of a process conveyor belt (BA) and ? APC. This limits the potential for settling of fines or sample degradation prior to the sampling process.	
Background information: The participating plant was selected as being typical of world-wide full scale gasification facilities. The plant processes 34 ktonnes of MSW and local commercial waste generating 65 GW energy per annum. Interviews with technical staff indicate that we have no reason to expect any substantial quality differences in the wastes being produced day to day/ week to week/ or month to month. Feedstock is shredded and fed into the primary gasification chamber where it is heated to 900ºC in the presence of restricted oxygen. Unlike traditional mass burn incineration the oxygen levels in the chamber are controlled to facilitate liberation of hydrocarbons into the gas phase and production of a syngas which is fed into a secondary oxidation chamber (residence time 2 seconds at 850ºC) for energy recovery. The control over the burning process reduces the production of harmful contaminants and reduces the need for sophisticated gas clean-up. Bottom Ash from the oil cooled grate is quenched and fed via conveyor belts to skips for disposal. Following removal of larger particulates in the flue gases using a bag filter, the gas is cleaned using dry lime scrubbers and activated carbon.	
Identify access problems that may affect sampling programme:	
SAMPLING METHODOLOGY	
Scale: Each sample to be collected from the volume of waste required to fill a skip/truck of BA and skip/truck	

APC
Sampling population: Sampling to be carried out for wastes generated over a single operating day.
Specify detailed sampling location Samples to be collected during movement to or discharge from the off-site disposal vessel at a time when input loads and process operating conditions can be quantified.
Specify date and time(s) of sampling: In the absence of any data to the contrary it is assumed that variability in the bottom ash and filter residues is random rather than having any systematic or time trend. In this situation, and when it is only possible to test a small number of samples, it is just as valid to sample on a single day as over a longer period. As we have no reason to suspect that any one day is different to any other, a sampling day will be arranged on a date that is mutually convenient to the site operator. Each set of two samples, for each residue, at each plant represents a spot sample in time, but if our assumptions on waste variability are correct, should provide a sample that is acceptably representative of the average properties of each residue over an annual production period. By selecting a random start date and random selection of the specific loads to be sampled i.e. a random sampling approach, we can make assumptions about the wider population (rather than just the load sampled) and make an estimate of the magnitude of the day-to-day component of variability, as well as that of random variability.
Specify persons to be present: xxxxxx
Identify sampling equipment: Stainless Steel Spade.
Specify no. of samples to be collected: One sample of BA and APC.
Specify no. of increments per sample: 20
Specify increment size/sample size: Spadefuls collected across the full width of the conveyor or discharge stream. **Note:** Wherever possible samples should be taken so that every particle in the sub-population has an equal chance of being selected. This is best achieved by sampling from a moving stream, however if this is not possible and samples are collected from a static pile, where possible a mechanical digger could be used to either flatten the pile so that samples can be taken in a random/systematic sampling grid to the full depth of the resulting pancake, or effectively transfer the stockpile using the bucket of the digger and select random buckets to be sampled across the full period of transferral (from a volume of waste that matches the chosen scale).
Description of sampling event: Each sample should consist of 20 increments collected over the time period it would actually take to fill the vessel being used to transport the wastes for off-site disposal. (i.e. the chosen scale). Each increment should be collected in a container (to check the weight and volume of each increment is similar) and then combined with all previous increments on a large plastic sheet laid flat on a suitable area of hardstanding.
Detail requirements for on-site determinations: Visual examination only.
Identify sample coding methodology: Each bulk sample should have an indelible label on the outside of the bag and a paper label sealed inside a polythene bag placed inside the main collection bag or container pre-sealing. The following coding should be adopted: residue code: MSW GAS BA or APC / site or producer: plant operator- XXX or YYY / sample collection number: 1 or 2 / Time (of sample collection) / date: Initial of Sampler
Identify safety precautions: To be agreed with plant operator
SUB-SAMPLING
Detail procedure: 20 increments should be collected for each sample. These require mixing before a sub-sample is selected for dispatch to WRc. Remove very large oversized material that could bias the final sample. On a clean tarpaulin, mix the material by forming a conical heap, taking a spade of the material and putting it on the top of the preceding one. Now transfer the material from this first cone and form a new cone. Deposit each spadeful on the peak of the new cone in such a way that the sample runs down all sides of the cone and is evenly distributed so that different particle sizes become well mixed. Repeat. Flatten the third cone and divide the resulting heap into four approximately equal quarters. Produce a 20 kg final sample by taking spadefuls from alternate quarters. Placing each spadeful in a single bag or sample container.
PACKAGING, PRESERVATION, STORAGE AND TRANSPORT REQUIREMENTS

Packaging: Use clean, robust 30 litre polythene containers or bags.
Preservation: The addition of chemical additives is not required.
Storage: Keep in a cold store prior to dispatch to the laboratory
Transport: Deliver the samples as quickly as possible to the WRc Swindon laboratory
ANALYTICAL LABORATORY: WRc plc, Frankland Rd, Blagrove, Swindon, SN5 8YF, United Kingdom.
WRc, OU, Cranfield, STL. WRc to undertake all sub-sampling and despatch of test samples to participating laboratories. Contact: Jane Turrell Tel. 01793 865176/ John Andrews 01793 865181 Delivery Date: xx/xx/xxxx