Waste Management Technologies in Regions, Georgia

Municipal Solid Waste Composition Study Methodology

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1. BASIS FOR THE WASTE COMPOSITION STUDY. The physical composition of the municipal solid waste stream will vary from region to region based on a number of factors including, among other things, the waste generation practices of a municipality's population and businesses, the extent of recovery programs that divert solid waste components before collection, and the effect of the informal sector in recovering materials of value from collection containers prior to collection. Generally, waste composition assessments are important in determining the extent of recoverable materials within the waste stream so as determine the technical and economic viability of recovery and recycling programs. Assessments can also help to determine the extent of biodegradable material that must be treated prior to disposal.

Given the typical variability of a municipal solid waste stream, the extent of sampling and sorting required in any locale to generate reliable Waste Composition Study data is a function of the required confidence level of the assessment results. For example, the investigation of a major investment in recycling infrastructure may justify a need for a high confidence level in characterization data. Moderate confidence level may be justified to properly assess the recycling and recovery opportunities that may exist in the certain region based on existing market opportunities for recoverable materials.

The following describes a basic process by which a municipal solid waste composition study could be conducted.

2. METHODOLOGY

2.1 Waste Composition Study - For characterization purposes, representative sampling is an established practice for accurately determining waste quantities and waste characteristics for planning purposes. The basis for the Waste Composition Study criteria presented below are two international standards including the following:

- ASTM - American Society for Testing and Materials - Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste -D5231 – 92 - 2008);http://www.astm.org/Standards/D5231.htm
- UNEP/IETC - Developing Integrated Solid Waste Management Plan, Volume 1,Waste Composition Study and Quantification with Projections for Future (2009).http://apps.unep.org/publications/pmtdocuments/ISWMPlan_Vol1.pdf

A general overview of the quantification and characterization process is presented in a third reference document:

- Source Specific Quantification and Characterization of Municipal Solid Waste – A Review – V. Gawaikar and Dr. V.P. Deshpande -

http://www.seas.columbia.edu/earth/wtert/sofos/Gawaikar_Source%20Specific%20Quantification%20and%20Characterization%20of%20MSW.pdf

The proposed approach is intended to accomplish a reasonable level of Waste Composition Study knowledge in a structured approach, produce accurate and reliable results, and be repeatable in multiple locations within the country. The selected method is based on the collection and manual sorting of a number of samples of waste over a period of five (7) days in each season i.e. from Monday to Friday in target location.

A recommended sample weight of approximately 100 kg is proposed for the study since it has been established, through various studies that measurements made on this sample size do not vary significantly from measurements made on far larger samples taken from the same waste sources.

Since a mass of 100 kg of waste transported to the landfill will be allocated for study, it is essential to pre-determine waste collection time throughout the period of study. Trucks used for sampling are to be selected in representative (typical) areas of waste collection where taking samples reflecting the waste collected in the whole municipality (using the principle of proportional selection of waste spread on the location of waste disposal).

Nine (9) major waste categories could be selected for sampling. These nine waste categories can be further broken down into 42 sub-categories – all of which are detailed within the Sample Analysis Form provided Attachment 1 to this report.

The nine (9) major Waste Composition Study categories include the following:

- Paper and Paperboard
- Glass
- Metal
- Plastic
- Textiles
- Organics
- Construction and Demolition (C & D) Wastes
- Special Care Wastes
- Other Wastes

For characterization purposes, each 100 kg waste sample should be sorted manually into dedicated containers for each of the respective waste components by a team trained prior to commencement of the sampling and sorting process.

3. EQUIPMENT

3.1 Waste Composition Study - The equipment used in the execution of the Waste Composition Study survey included the following:

- Access to a wheeled-loader to transport, when necessary, samples of waste to the area designated for the analysis.
- One (1) Bench Scale
- Five (5) Heavy-Duty Tarps,

- Five (5) Shovels,
- Five (5) Rakes,
- Five (5) Hand Brooms,
- Forty-five (45) waste containers – labeled for each sub-category of waste shown on the Waste Composition Study Summary Form;

Use a sampling form at the end of the protocol to show the full list of waste to be collected in each container. Disregarding the size of a container, in case of its filling to overflowing, the container must be weighed and then emptied. After every cycle of sorting, the sorted waste in each container (disregarding the frequency of its weighing and emptying) are collected in one place and make a total of waste of a given type (at a waste disposal location). As for the type of container, a rigid waste container is more convenient for weighing and emptying. A maximum size container is the one that is easy to handle when filled in and the one that is to be weighed.

- two (2) wheel-barrows
- One (1) large canopy to provide shade and shelter during heavy rain
- Twenty (20) traffic cones.
- One (1) first aid large kit
- One (1) eye-bath
- Protective gear:
    - Overalls
    - Thin leather and rubber gloves
    - Rubber boots
    - Disposable mask
- Portable shower with soap and disinfectants
- Availability of potable water, food, regular breaks and shade between sample analyses for personnel involved in sample testing.

4. PROCEDURE

4.1 Waste Composition Study - The following procedures should be utilized in completing the waste composition study process:

1. An area should be designated for the waste analysis and demarcated using high visibility traffic-cones. This is intended to assure the safety of the team by preventing vehicles from randomly entering the sorting area.
2. The sorting area should be as flat as possible and in close proximity to the final disposal location for ease of movement of waste between the two zones once the sorting process has been completed.
3. Large tarps should be spread on level ground within the designated area for the sorting process. Their use is intended to minimize the degree of sample contamination due to underlying soil.

4. Forty five (45) waste storage containers should each be labeled with the waste components selected for sampling and arranged around the perimeter of each of the tarps as shown on the Waste Composition Study Summary Form.
5. The tare weight of each of the containers must be initially recorded and periodically rechecked.
6. A bench-scale should be placed in the vicinity of the storage containers on a clean, flat wooden table.
7. The accuracy of the scale should be periodically checked using a known (reference)weight.
8. At the start of the characterization process, waste samples should be randomly selected from incoming waste delivery vehicles.
9. Complete details of the source and type of each examined waste sample should be entered on the Municipal Solid Waste Composition Study Summary Form. In addition other preliminary information should be logged for each sample including:

    A. Date;
    B. Time;
    C. Vehicle details;
    D. Origin of waste;
    E. Weather conditions.

10. For the waste samples obtained from incoming vehicles, the wheeled-loader should be used to mix the waste and transport a sample to the designated sampling area for sorting.
11. This waste should then be placed onto the tarpaulin and a representative 100 kg sample size separated using the bench-scale.
12. The sorting personnel should then begin sorting the selected waste sample without delay.
13. All containers within the waste, such as capped jars, paper bags, and plastic bags should be emptied of their contents and the different materials segregated – such as metal lids from glass jars.
14. Following identification and segregation, each waste item is placed in the appropriately labeled storage container.
15. In the case of composite items found in the waste, the individual materials should be separated, where practical, and the individual materials placed in the appropriate storage containers.
16. Sorting of the waste sample should continue until the maximum particle size of the remaining waste particles is approximately 10mm at which point the remaining particles should be apportioned into the storage containers corresponding to the waste components represented in the remaining mixture.
17. The gross weights of the storage containers should then be recorded on the Municipal Solid Waste Composition Study Summary Form including, where necessary, waste items sorted but not initially stored in the containers due to volume restrictions.

18. Following the weighing of the sorted wastes, the sorted waste material should be removed from the containers and transported to the disposal location.

4.2 Bulk Density - The bulk density of the incoming waste may be calculated through the following process:

- A container of a known volume (V1) is weighed and its weight recorded (W1).
- A sample of each consignment of waste is poured into the container until it overflows.
- The contents of the container were then settled by dropping it three times onto the measuring table from an approximate height of 10cm.
- The container was then topped up with additional waste from the selected sample.
- The container was then weighed again and the weigh recorded (W2).
- The bulk density was then calculated using the following equation: W2–W1/ V1.

5. HEALTH AND SAFETY

5.1 Waste Composition Study - Because of the hazards associated with the sorting of typical municipal solid waste materials, appropriate measures should be taken to ensure the health and safety protection of the sorting team.

The sorting team should be clearly instructed to be mindful of the danger that may be associated with various waste components. Clearly, any process that involves handling large numbers of glass, metal, and plastic containers, will generate a certain amount of airborne material that could pose a threat. Similarly, the sorting team should be made aware of the threat posed by various sharp objects such as nails, razor blades, hypodermic needles, and pieces of glass since all of these components could be present in the municipal solid waste to be handled during sorting.

Waste Composition Study supervisory staff should ensure that all sorting-personnel adhere to all health and safety measures and precautions, particularly including the use of PPE. Exposure of the team to heat stress, dehydration and fatigue should also be monitored and risks minimized by ensuring the adequate provision of drinking water, food and shade in conjunction with regular rest breaks. In addition, high levels of hygiene should be emphasized throughout the sorting process through the provision of water, soap and disinfectant for use during rest breaks and prior to eating and at the end of each working day.

6. WASTE COMPOSITION STUDY SUMMARY FORM

An example Waste Composition Study summary form is shown on the following page. A separate form should be completed for the analysis of each sample including the calculation of the percent content for each of the investigated components. Depending on the number of samples analyzed at each location, an increasing confidence level of the characteristic results can be derived from an extensive number of samples. After completion of the sampling and assessment process, the results noted on each of the forms can then be combined and averaged to derive a Waste Composition Study for the target location.

Annex 1. Sample Analysis Form

MUNICIPAL SOLID WASTE COMPOSITION STUDY SUMMARY FORM					
Municipality			**Date**		
Truck ID Number			**Waste Originating From**		
Time Started			**Time Finished**		
Weather Conditions			**Other Observations**		
Form completed by:			**Signature**		
Solid Municipal Waste Total Mass:			**---------- kg**		
	MATERIAL TYPE	**Gross (kg)**	**Tare (kg)**	**Net (kg)**	**% of Total**
Paper and Paperboard					
1	Newspaper				
2	Cardboard/boxboard				
3	Magazine/Catalogues				
4	Office paper				
5	Other/Miscellaneous Paper				
Glass					
6	Clear Containers				
7	Green Containers				
8	Amber Containers				
9	Remainder/composite glass				
Metal					
10	Tin/steel containers				
11	Aluminum containers				
12	Ferrous Metal				
13	Non-ferrous containers				

14	Major Appliances				
Plastics					
15	PET containers, including clear, green and amber containers				
16	Clear PET containers				
17	Green PET Containers				
18	Amber PET containers				
19	Black PET containers				
20	Film plastics				
21	HDPE containers				
22	Other plastics				
Textiles					
23	Textiles				
Organics					
24	Food Waste				
25	Garden Waste				
26	Agricultural Waste				
27	Abattoir Waste				
28	Poultry Fluff				
29	Remainder/composite waste				
Construction and Demolition Materials					
30	Concrete				
31	Lumber				
32	Remainder/composite C&D				
Special Care Waste					
33	Paint				
34	Hazardous materials including agrochemicals and their packaging materials as well as those including oil products				

35	Biomedical				
36	Batteries				
37	Oil filters				
38	Remainder/Composite waste				
Other Waste					
39	Waste Electrical Products				
40	Tires				
41	Furniture				
43	Ceramics				
44	Other				
45	Rubber, leather				
46	<10mm				