



**DEVELOPMENT OF A METHODOLOGICAL TOOL  
TO  
ENHANCE THE PRECISION & COMPARABILITY  
OF  
SOLID WASTE ANALYSIS DATA**

Proposal Acronym: S.W.A.-Tool  
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**Brasov Waste Analysis  
Final Report**

27 February 2004

## TABLE OF CONTENTS

<b>1.</b>	<b>Objective of investigation, background</b> .....	<b>4</b>
<b>2.</b>	<b>Planning of the analysis</b> .....	<b>6</b>
2.1	Waste under observation/ Definition of the parent population .....	6
2.2	Identification of factors that may effect waste generation and composition .....	7
2.3	Preinvestigation of survey area.....	7
2.4	Stipulation of relevant strata.....	8
2.5	Definition of sample unit and level of sampling.....	9
2.6	Determination of the necessary sample size .....	9
<b>3.</b>	<b>Execution of the analysis</b> .....	<b>10</b>
3.1	Sampling .....	10
3.2	Sorting.....	10
<b>4.</b>	<b>Evaluation</b> .....	<b>12</b>
4.1	Presentation of sample results.....	12
4.1.1	Spring Campaign .....	12
4.1.2	Summer campaign .....	17
4.2	Extrapolation .....	22
<b>5.</b>	<b>Costs related to the analysis</b> .....	<b>23</b>

## TABLE OF TABLES

Table 1	Districts in Brasov .....	4
Table 2	Types of buildings in Brasov .....	5
Table 3	Types of households in Brasov .....	5
Table 4	Waste containers in Brasov .....	8
Table 5	Sampling units established for Brasov .....	9
Table 6	Analysis results for stratum A, Spring .....	12
Table 7	Analysis results for stratum B, Spring .....	13
Table 8	Analysis results for stratum C, Spring .....	14
Table 9	Analysis results for overall, Spring .....	15
Table 10	Analysis results for stratum A, Summer .....	17
Table 11	Analysis results for stratum B, Summer .....	18
Table 12	Analysis results for stratum C, Summer .....	19
Table 13	Analysis results for overall, Summer .....	20
Table 14	Overall results for Brasov .....	22
Table 15	Cost drivers for waste analyses in Brasov .....	23

## TABLE OF FIGURES

Figure 1	Map of Brasov City .....	5
Figure 2	Sorting Procedure .....	11
Figure 3	Overall results, Spring .....	16
Figure 4	Overall results for Summer campaign .....	21
Figure 5	Overall average values for Brasov City .....	23

## 1. OBJECTIVE OF INVESTIGATION, BACKGROUND

Main aims of the project is to test the methodology set up in the frame of the project for the conditions of the city of Brasov. The objective of the trial for the waste composition in Brasov is to set up a selective collection system in the city and a sorting plant at the new municipal landfill.

**Brasov City** is the capital of Brasov County in Romania, located in the center of the country, in a mountain area, at 180 km North from Bucharest. The city is about 110 km<sup>2</sup> in area (276 km<sup>2</sup> with the surrounding areas). It is the 5<sup>th</sup> important town in Romania.

The occupied territory, also named Brasov Depression, is delimited by the Carpathian Mountains on three sides and opened to the high plain of Transilvania on the Northern side. The city average altitude is 570 m.

The annual average temperature is +6...+7<sup>o</sup>C, with the lowest values in January and highest in July. In wintertime, the daily temperature may decrease to -30<sup>o</sup>C. The average amount of rainfall is 700 mm.

Brasov is divided into 11 districts and has a population of about 284,000 inhabitants (2002).

**Table 1 Districts in Brasov**

No	District	Inhabitants
1	Poiana Brasov	7951
2	Schei	9673
3	Centru	22245
4	Bartolomeu	38251
5	Tractorul	36195
6	Gara	10748
7	Florilor	23828
8	Triaj	19998
9	Astra	82615
10	Racadau	22104
11	Noua	10283
	<b>TOTAL</b>	<b>283891</b>

The total number of employees (2002) is about 126,000 (44%). Most of the resident labour force is employed in industry (manufacture), construction, energy and water, but also in commerce, tourism, public administration and education/health care.



**Figure 1 Map of Brasov City**

The total number of buildings in the city is 13,263 with a number of 107,620 households in total.

**Table 2 Types of buildings in Brasov**

<b>Buildings</b>	with single households	with 2 or more households	with storeys
13,263	7,200	3,741	2,322
	54.3%	28.2%	17.5%
<b>Households</b>	in single houses	in coupled houses	in blocks
107,620	7,200	13,194	87,226
	6.7%	12.3%	81%

**Table 3 Types of households in Brasov**

<b>Households</b>	on groundfloor	on 1 <sup>st</sup> floor	on 2 <sup>nd</sup> floor	on other floors
107,620	29,556	19,880	15,769	42,415
	27.5%	18.5%	14.6%	39.4%

The general pattern of dwelling is, in average:

- 73% of the population is living in over 4 storeys blocks
- 22% of the population is living in up to 4 storeys blocks
- 5% of the population is living in individual houses.

## **2. PLANNING OF THE ANALYSIS**

Planning was carried out by highly qualified personnel / researchers, in cooperation with the operator. Planning of the analysis consisted of:

- determination of the basis for sampling
- discussions over the sorting guide and waste categories
- discussions over the statistical accuracy
- determination of the stratification criteria and strata
- determination of the sampling plan
- organisation of the work (personnel, equipment).

Brasov municipality practices in waste management represent a special experience within the Romanian sanitation services because of the early distribution of the tasks to more than one company and introducing the competitive climate (1993 – 1994). This action was aimed to assure a better use of low financial resources allocated by the City Hall for waste management and urban cleaning.

The responsible authority for municipal waste management in city of Brasov is the Municipality (City Hall's Public Work Department, Sanitation Office). It takes care of the organisation, control and monitoring of waste management. It may also sign contracts with operators. The local legal decision on sanitation regulates the activities of the City Hall and public operators in the field. There are 2 major sanitation companies in Brasov. COMPREST SA is the largest and operates in most of the districts for municipal waste collection, transport and street cleaning. It also operates the municipal landfill site. It covers 85% of the sanitation services in Brasov.

Municipal waste is not collected separately in Brasov. The following types are considered as municipal waste: refuse from households, refuse from institutions, hospital waste except hazardous/infectious waste, market and commercial waste, street cleaning waste, yard and garden waste from public places, demolition waste, non-hazardous industrial waste.

Industrial waste is handled by the generators, using their own means or paying to specialized companies.

Municipal landfill is owned by the Municipality and operated by a service provider. For Brasov landfill, COMPREST SA is the operator of the municipal landfill.

### **2.1 WASTE UNDER OBSERVATION/ DEFINITION OF THE PARENT POPULATION**

Parent population considered for the analysis in Brasov is the residual waste, not collected separately, from population.

## **2.2 IDENTIFICATION OF FACTORS THAT MAY EFFECT WASTE GENERATION AND COMPOSITION**

In Brasov city, the possible factors that could influence the municipal waste amounts generated and its composition are:

- dwelling types: individual houses, blocks
- commerce, mainly in the center area
- population density
- season
- heating system
- temporal:
  - tourists
  - students
  - commutants.

## **2.3 PREINVESTIGATION OF SURVEY AREA**

Municipal waste consists of:

- refuse from households
- similar waste from schools, businesses, hotels, restaurants and shops
- street cleaning waste
- green waste from parks and public gardens.

Comprest SA is the largest and oldest sanitation company in Brasov, dealing with refuse collection and haulage from population, offices and institutions and also with street cleaning in the city. The household and commercial waste is not collected separately in Brasov. Comprest also takes care and operates the municipal landfill site.

Comprest performs 85% of the sanitation activities in Brasov and serves 60% of the population and over 3,000 businesses.

Household waste is not collected together with the commercial waste in Brasov.

The collection of residential waste is done daily, in week-days. The frequency of collection is once per week for houses and 3 times per week for blocks.

The newest data on waste amount (dated 2002) show that Comprest collects the following types of municipal waste:

- 87,650 tons households waste (75%)
- 20,822 tons similar waste from offices and commerce (18%)
- 5,975 tons street waste
- 2,190 tons market waste
- 290 tons green waste.
- TOTAL = 116,927 tons

### Information about Container Collection System

The main activity of Comprest SA in Brasov city is related to households waste collection and disposal. The following types of containers for the refuse collection were available in 2002:

**Table 4 Waste containers in Brasov**

Type of container	Size (litres)	Number
Bin	120	11,811
Bin	240	3,414
Container	1,100	2,561
Container	4,000	181

The collection containers for household waste are bins of 120 l and 240 l and containers of 1,100 l.

The total volume covered by the collection containers for residential waste is 5,053,780 l. 120 l bins cover 25% of the volume, 240 l bins cover 15% of the volume and 1,100 l containers cover 60% of the volume.

The 1,100 l containers are usually placed for waste collection from blocks (multi-storeyed dwellings) and bins are used for waste collection from houses.

Data about the daily weight of container were helpful to determine the temporal variation of waste arisings and to determine the days on which the sampling survey should take place.

## 2.4 STIPULATION OF RELEVANT STRATA

Given the conditions in Brasov city and the possible influences over the residential waste arisings, in order to build up the relevant strata we have used the following stratification criteria:

- residential structure (single dwellings and multi-storeyed dwellings)
- collection containers/bins size (120 l bin, 240 l bin, 1,100 l container)
- seasonal effects.

The team decided over 3 strata by the types of collection containers:

- stratum A – 1,100 l container (for blocks)
- stratum B – 240 l bin (for big houses, villas)
- stratum C – 120 l bin (for small houses).

The analyses were carried out for 2 seasonal campaigns: spring and summer.

## 2.5 DEFINITION OF SAMPLE UNIT AND LEVEL OF SAMPLING

Given the necessities of the local operator (Comprest Brasov), the technical procedure and the high arisings of the households waste, only residential waste was analysed.

Waste samples were taken from the sources, randomly selected. The most appropriate level of sampling for Brasov is the external waste container, placed outside the households. People were not informed about the survey in order not to affect the waste generation behaviour.

The sampling unit was considered the collection container volume. The most commonly used container volume in the survey area is the 1,100 l container (1 m<sup>3</sup>). Also, combinations of the respective number of smaller bins were used, e.g. 4 x 240 l; 9 x 120 l.

## 2.6 DETERMINATION OF THE NECESSARY SAMPLE SIZE

The necessary sample size for waste analysis depends on consistency of the waste and on the aspired accuracy of the results.

The natural variation coefficient for residential waste is considered to be between 30 – 35%. The aspired accuracy of the results (maximum allowance for random sampling error) is  $\pm 10\%$ . So, for a confidence interval of 95%, the necessary sample size was calculated to be approx. 45.

sample size  $n = 45$  sampling units (1 sampling unit = 1 m<sup>3</sup>) = 45 m<sup>3</sup> per campaign  $\rightarrow$  90 m<sup>3</sup> in 2 campaigns.

Selection of samples per campaign:

As 60% of the volume of waste is covered by 1,100 l collection containers, 27 sampling units were established for stratum A. 15% of the waste volume is covered by 240 l collection bins, so 7 sampling units were established for stratum B. As 25% of the waste volume is covered by 120 l collection bins, 11 sampling units were established for stratum C.

**Table 5 Sampling units established for Brasov**

Container type	No of sampling units	No of containers per sampling unit
1,100 l	27	1 * 1,100
240 l	7	4 * 240
120 l	11	9 * 120
<b>TOTAL</b>	<b>45</b>	

### **3. EXECUTION OF THE ANALYSIS**

#### **3.1 SAMPLING**

Samples were taken randomly from different addresses during the collection programme of Comprest in the week-days. The addresses were established together with the operator, from relevant districts in Brasov (large blocks area, area with rich villas in peripheral zone, area with small houses in the center of the city). It was not a rule for choosing a certain type of container during the campaign.

The spring campaign was carried out during March and April 2003. It lasted longer due to Easter Holidays. The weather conditions changed drastically during the period, from very cold to very hot.

The summer campaign was carried out in August – September 2003. The weather conditions were moderate most of the period (25<sup>0</sup>C) with some colder days (18<sup>0</sup>C), some hot days (30<sup>0</sup>C) and some wet days.

The equipment used for the sampling consisted of an open sided truck carrying the container/bins, heavy duty bags, shovels and brushes, labels and tags, markers and protective equipment for workers.

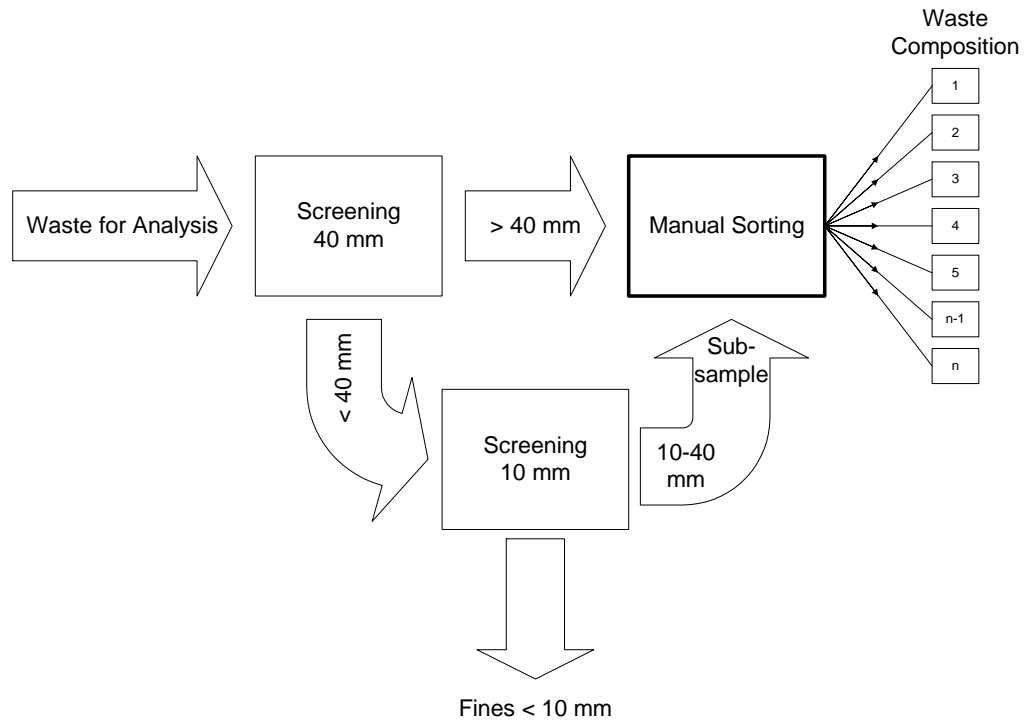
Personnel involved was middle and low qualified.

#### **3.2 SORTING**

Each sample unit was collected, transported to the sorting area and weighed. The sample unit was sorted into the categories according the SWA-Tool sorting guide. Each sampling unit was sorted separately. The sorting procedure followed the procedure bellow:

1. Separated the waste into a fraction > than 40 mm and < 40 mm by screening with 40 mm mesh screen-table.
2. Sorted the > 40 mm fraction into the waste categories mentioned in the Sorting Guide
3. Divided the < 40 mm fraction into a fraction < 10 mm and a fraction 10-40 mm by screening it with a 10 mm mesh screen.
4. The < 10 mm fraction was reported as the category: fines < 10 mm.
5. From the fraction 10-40 mm a representative sub-sample was taken by coning and quartering and sorted into the waste categories specified in the sorting catalogue.
6. Weight the categories

For each sample unit the composition was determined separately. Based on this procedure, separate results for each sample unit were obtained.



**Figure 2 Sorting Procedure**

Sorting was done using the Sorting Guide mentioned in the draft methodology, on 34 secondary waste categories and 12 primary waste categories.

Equipment used for the sorting phase was consisted of: screening table (with 40 mm and 10 mm meshes), brushes and shovels, plastic sheets, boxes and bins of different sizes, heavy duty bags of different sizes, weighing platform, scale, data forms, calculator, labels, pens and markers, camera.

Low qualified personnel was used for sorting and middle qualified personnel was used to supervise the sorting procedure.

#### 4. **EVALUATION**

##### 4.1 **PRESENTATION OF SAMPLE RESULTS**

##### 4.1.1 **Spring Campaign**

**Stratum A (1 x 1,100 x 27)**

**Table 6 Analysis results for stratum A, Spring**

<b>Primary waste category</b>	<b>Min kg</b>	<b>Max kg</b>	<b>Sample mean kg</b>	<b>Standard deviation</b>	<b>Confidence interval %</b>	<b>Composition %</b>	<b>Weights kg</b>
<b>Organic</b>	38.091	55.18	48.37	4.03	3.28	49.22	1306.077
<b>Wood</b>	0	1.28	0.38	0.32	33.27	0.38	10.1998
<b>Paper, cardboard</b>	4.185	13.072	6.78	1.78	10.33	6.90	183.154
<b>Plastics</b>	7.598	13.846	11.34	1.39	4.83	11.53	306.093
<b>Glass</b>	6.724	9.917	8.36	0.74	3.48	8.51	225.772
<b>Textiles</b>	0.288	6.25	1.91	1.42	29.39	1.94	51.45
<b>Metals</b>	1.759	7.849	2.97	1.21	16.08	3.02	80.082
<b>Hazardous</b>	0	1.358	0.24	0.35	56.82	0.25	6.602
<b>Complex</b>	0.381	2.977	1.18	0.62	20.83	1.20	31.849
<b>Inert</b>	0.28	12.6	7.54	3.08	16.14	7.67	203.591
<b>Other categories</b>	2.155	6.28	3.99	1.06	10.52	4.06	107.823
<b>Fines</b>	4	6.4	5.22	0.70	5.26	5.31	140.96
	<b>88.39</b>	<b>110.22</b>	<b>98.28</b>	<b>3.69</b>	<b>1.15</b>	<b>100.00</b>	<b>2653.6528</b>

**Stratum B (4 x 240 x 7)**

**Table 7 Analysis results for stratum B, Spring**

<b>Primary waste category</b>	<b>Min kg</b>	<b>Max kg</b>	<b>Sample mean kg</b>	<b>Standard deviation</b>	<b>Confidence interval %</b>	<b>Composition %</b>	<b>Weights kg</b>
<b>Organic</b>	30.366	39.19	34.77	2.99	7.66	47.15	243.399
<b>Wood</b>	0.122	0.6874	0.37	0.20	47.19	0.51	2.6104
<b>Paper, cardboard</b>	3.944	9.351	8.20	1.91	20.76	11.11	57.366
<b>Plastics</b>	9.392	11.062	10.29	0.54	4.72	13.95	72.035
<b>Glass</b>	4.973	8.6	6.13	1.23	17.84	8.32	42.931
<b>Textiles</b>	0.4	2.533	1.44	0.74	46.27	1.95	10.051
<b>Metals</b>	1.06	2.794	1.83	0.52	25.59	2.48	12.809
<b>Hazardous</b>	0	0.3	0.09	0.13	124.94	0.13	0.656
<b>Complex</b>	0.418	1.11	0.71	0.21	26.98	0.96	4.936
<b>Inert</b>	1.79	6.09	4.16	1.97	42.25	5.65	29.145
<b>Other categories</b>	0	2.759	1.75	1.06	54.31	2.37	12.222
<b>Fines</b>	0.8	6	4.01	1.60	35.69	5.43	28.04
	<b>68.84</b>	<b>78.15</b>	<b>73.74</b>	<b>3.36</b>	<b>1.60</b>	<b>100.00</b>	<b>516.20</b>

**Stratum C (9 x 120 x 11)**

**Table 8 Analysis results for stratum C, Spring**

<b>Primary waste category</b>	<b>Min kg</b>	<b>Max kg</b>	<b>Sample mean kg</b>	<b>Standard deviation</b>	<b>Confidence interval %</b>	<b>Composition %</b>	<b>Weights kg</b>
<b>Organic</b>	51.801	90.567	77.06	13.27	11.42	53.28	847.66
<b>Wood</b>	0	1.873	0.96	0.61	42.12	0.66	10.505
<b>Paper, cardboard</b>	6.319	20.305	10.15	4.31	28.18	7.02	111.618
<b>Plastics</b>	10.806	15.505	13.32	1.81	9.03	9.21	146.471
<b>Glass</b>	6.284	11.13	9.05	1.50	11.03	6.26	99.515
<b>Textiles</b>	0.998	4.593	2.12	1.13	35.31	1.47	23.315
<b>Metals</b>	2.72	7.827	4.55	1.81	26.41	3.15	50.07
<b>Hazardous</b>	0	0.66	0.26	0.28	71.12	0.18	2.846
<b>Complex</b>	0.989	2.098	1.39	0.33	15.68	0.96	15.322
<b>Inert</b>	9.55	16.1	12.45	2.12	11.31	8.61	136.97
<b>Other categories</b>	2.607	16.619	5.99	3.80	42.11	4.14	65.857
<b>Fines</b>	4.2	15	7.34	2.76	12.32	5.07	80.7
	<b>128.66</b>	<b>156.28</b>	<b>144.62</b>	<b>8.13</b>	<b>1.84</b>	<b>100.00</b>	<b>1590.85</b>

### Overall results for Spring campaign

**Table 9 Analysis results for overall, Spring**

Primary waste category	Min kg	Max kg	Sample mean kg	Standard deviation	Confidence interval %	Composition %	Weights kg
Organic	30.366	90.567	53.27	16.17	8.87	50.35	2397.136
Wood	0	1.873	0.52	0.46	25.97	0.49	23.3152
Paper, cardboard	3.944	20.305	7.83	2.94	10.96	7.40	352.138
Plastics	7.598	15.505	11.66	1.72	4.32	11.02	524.599
Glass	4.973	11.13	8.18	1.38	4.94	7.73	368.218
Textiles	0.288	6.25	1.88	1.27	19.62	1.78	84.816
Metals	1.06	7.849	3.18	1.56	14.36	3.00	142.961
Hazardous	0	1.358	0.22	0.31	40.40	0.21	10.104
Complex	0.381	2.977	1.16	0.55	13.98	1.09	52.107
Inert	0.28	16.1	8.22	3.82	13.57	7.77	369.706
Other categories	0	16.619	4.13	2.43	17.16	3.90	185.902
Fines	0.8	15	5.55	1.90	10.00	5.25	249.7
	<b>68.843</b>	<b>156.278</b>	<b>105.79</b>	<b>24.49</b>	<b>6.76</b>	<b>100.00</b>	<b>4760.70</b>

### Discussion on Spring campaign results

- **Comparison between strata**

- biodegradable waste prevailed in all strata, but was more in strata C (individual houses with gardens)
- paper and cardboard amount was higher in strata B (big houses) – more newspapers and magazines
- plastic waste was more in strata B (big houses) – mostly packaging
- inert was found more in strata C
- fines were mostly found in strata C and strata A – for houses: mostly ashes from the heating system; for blocks: very small items

- **Overall results**

- in average, over 50% of the total waste was represented by biodegradable waste (mostly kitchen waste – 83%, also garden waste, few other biodegradable waste)
- plastic waste was 11% (over 90% represented by packaging)
- paper and cardboard was somehow low – 7.4% (mostly packaging, but also newspapers and magazines)
- glass component in household waste was higher than paper and cardboard (7.7%), bottles and jars representing almost 70%
- metals found were rather low (3%), most of them being packaging (cans)
- inert component was high (7.8%), mostly due to the spring works in the gardens and inside dwellings
- fines in average represented 5.3% of the total
- all other categories summed 7.5% in average
- average generating index for spring in Brasov was 0.8 kg/inh.day.

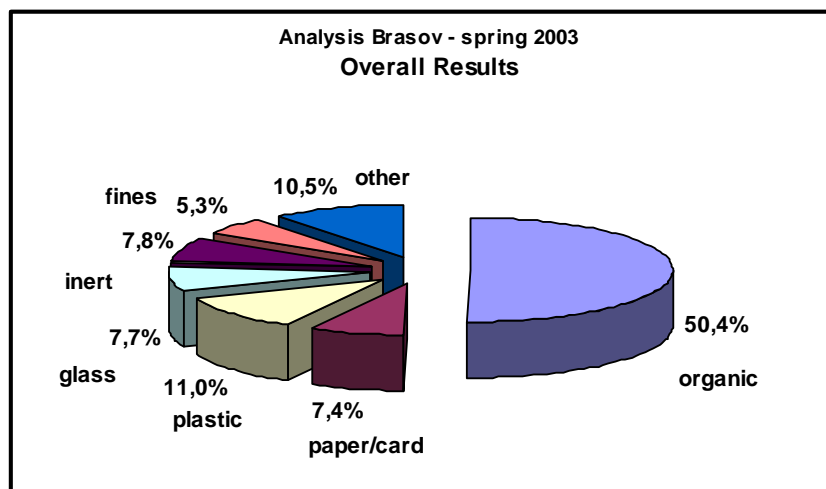


Figure 3 Overall results, Spring

4.1.2 **Summer campaign**

**Stratum A (1 x 1,100 x 27)**

**Table 10 Analysis results for stratum A, Summer**

<b>Primary waste category</b>	<b>Min kg</b>	<b>Max kg</b>	<b>Sample mean kg</b>	<b>Standard deviation</b>	<b>Confidence interval %</b>	<b>Composition %</b>	<b>Weights kg</b>
<b>Organic</b>	42.995	72.05	63.49	5.68	3.53	53.33	1714.189
<b>Wood</b>	0.28	2.75	1.27	0.63	19.65	1.07	34.377
<b>Paper, cardboard</b>	8.396	11.65	10.06	0.68	2.68	8.45	271.694
<b>Plastics</b>	10.84	13.09	12.28	0.49	1.58	10.31	331.516
<b>Glass</b>	6.92	11.4	8.87	0.95	4.24	7.45	239.394
<b>Textiles</b>	1.14	4.7	2.83	0.87	12.21	2.37	76.316
<b>Metals</b>	3.06	5.52	4.03	0.57	5.58	3.38	108.687
<b>Hazardous</b>	0.12	1.035	0.48	0.24	19.64	0.41	13.067
<b>Complex</b>	1.55	3.37	2.37	0.52	8.61	1.99	63.924
<b>Inert</b>	3.05	7.94	4.90	1.07	8.61	4.12	132.41
<b>Other categories</b>	0.82	4.34	3.11	1.00	12.65	2.61	83.893
<b>Fines</b>	5	6	5.36	0.33	2.45	4.50	144.6
	<b>105.24</b>	<b>124.96</b>	<b>119.04</b>	<b>4.70</b>	<b>1.21</b>	<b>100.00</b>	<b>3214.067</b>

**Stratum B (4 x 240 x 7)**

**Table 11 Analysis results for stratum B, Summer**

<b>Primary waste category</b>	<b>Min kg</b>	<b>Max kg</b>	<b>Sample mean kg</b>	<b>Standard deviation</b>	<b>Confidence interval %</b>	<b>Composition %</b>	<b>Weights kg</b>
<b>Organic</b>	40.95	45.9	43.74	1.95	3.98	44.82	306.21
<b>Wood</b>	0.14	1.02	0.53	0.31	52.07	0.54	3.71
<b>Paper, cardboard</b>	10.64	11.95	11.22	0.46	3.64	11.50	78.55
<b>Plastics</b>	12.46	13.38	12.99	0.35	2.39	13.31	90.94
<b>Glass</b>	6.45	8.36	7.08	0.78	9.89	7.25	49.54
<b>Textiles</b>	3.2	11.8	5.21	2.94	50.28	5.34	36.5
<b>Metals</b>	2.9	4.95	3.91	0.78	17.81	4.01	27.38
<b>Hazardous</b>	0.18	1.36	0.63	0.44	61.90	0.65	4.42
<b>Complex</b>	1.2	3.2	1.94	0.69	31.85	1.98	13.56
<b>Inert</b>	1.2	4.3	2.70	1.04	34.49	2.77	18.9
<b>Other categories</b>	0.21	3.05	2.23	0.99	39.62	2.29	15.62
<b>Fines</b>	5	6	5.40	0.34	5.64	5.53	37.8
	<b>92.45</b>	<b>105.98</b>	<b>97.59</b>	<b>4.62</b>	<b>1.67</b>	<b>100.00</b>	<b>683.13</b>

**Stratum C (9 x 120 x 11)**

**Table 12 Analysis results for stratum C, Summer**

<b>Primary waste category</b>	<b>Min kg</b>	<b>Max kg</b>	<b>Sample mean kg</b>	<b>Standard deviation</b>	<b>Confidence interval %</b>	<b>Composition %</b>	<b>Weights kg</b>
<b>Organic</b>	80.6	97.8	88.42	5.51	4.13	60.18	972.62
<b>Wood</b>	0	1.89	0.64	0.49	51.49	0.43	7
<b>Paper, cardboard</b>	5.78	7.81	6.65	0.54	5.36	4.52	73.12
<b>Plastics</b>	12.74	13.8	13.25	0.30	1.48	9.02	145.74
<b>Glass</b>	5	5.9	5.47	0.29	3.57	3.72	60.15
<b>Textiles</b>	1.1	3.12	2.31	0.73	20.89	1.58	25.46
<b>Metals</b>	2.4	7.52	3.77	1.34	23.61	2.56	41.42
<b>Hazardous</b>	0.24	3	0.66	0.78	78.42	0.45	7.3
<b>Complex</b>	1.3	2.75	1.95	0.48	16.43	1.33	21.42
<b>Inert</b>	8.1	15.9	10.98	1.98	11.96	7.47	120.8
<b>Other categories</b>	1.2	5.86	3.38	1.50	29.39	2.30	37.17
<b>Fines</b>	8.1	10	9.46	0.63	2.18	6.44	104.1
	<b>137.61</b>	<b>161.68</b>	<b>146.94</b>	<b>7.57</b>	<b>1.69</b>	<b>100.00</b>	<b>1616.30</b>

### Overall results for Summer campaign

**Table 13 Analysis results for overall, Summer**

Primary waste category	Min kg	Max kg	Sample mean kg	Standard deviation	Confidence interval %	Composition %	Weights kg
Organic	40.95	97.8	66.51	15.31	6.73	54.29	2993.019
Wood	0	2.75	1.00	0.65	18.90	0.82	45.087
Paper, cardboard	5.78	11.95	9.41	1.75	5.43	7.68	423.364
Plastics	10.84	13.8	12.63	0.61	1.41	10.31	568.196
Glass	5	11.4	7.76	1.67	6.28	6.33	349.084
Textiles	1.1	11.8	3.07	1.63	15.51	2.51	138.276
Metals	2.4	7.52	3.94	0.83	6.18	3.22	177.487
Hazardous	0.12	3	0.55	0.46	24.15	0.45	24.787
Complex	1.2	3.37	2.20	0.57	7.52	1.79	98.904
Inert	1.2	15.9	6.05	3.22	15.57	4.94	272.11
Other categories	0.21	5.86	3.04	1.17	11.24	2.48	136.683
Fines	5	10	6.37	1.83	8.39	5.20	286.5
	<b>92.45</b>	<b>161.68</b>	<b>122.52</b>	<b>16.86</b>	<b>4.02</b>	<b>100.00</b>	<b>5513.50</b>

### Discussion on Summer campaign results

- **Comparison between strata**

- biodegradable waste prevailed in all strata, but was more in strata C (individual houses with gardens)
- paper and cardboard amount was higher in strata B (big houses) – more newspapers and magazines
- plastic waste was more in strata B (big houses) – mostly packaging
- textiles were more in strata B
- glass was found more in strata A (blocks)
- metals were higher in strata B
- inert was found more in strata C
- fines were mostly found in strata C
- in strata A, glass is more than in other strata
- in strata B, paper and cardboard, plastics, metals, textiles were found more than in the other 2 strata
- in strata C, biodegradable waste, inert and fines were found more than in other 2 strata
- as regard to packaging, in strata B there were more (33% of the total) than in other strata
- paper and cardboard, glass and composite packaging were found more in strata B
- plastic and metal packaging were found more in strata A.

- **Overall results**

- in average, over 54% of the total waste was represented by biodegradable waste (mostly kitchen waste, also garden waste, few other biodegradable waste)
- plastic waste was 10.3% (over 90% represented by packaging)
- paper and cardboard was 7.7% (mostly packaging, but also newspapers and magazines)
- glass component in household waste was higher than paper and cardboard (6.3%), bottles and jars representing almost 70%
- metals found were rather low (3.2%), most of them being packaging (cans)
- inert component was low (4.9%)
- fines in average represented 5.2% of the total
- all other categories summed 8% in average
- average generating index for spring in Brasov was 0.97 kg/inh.day.

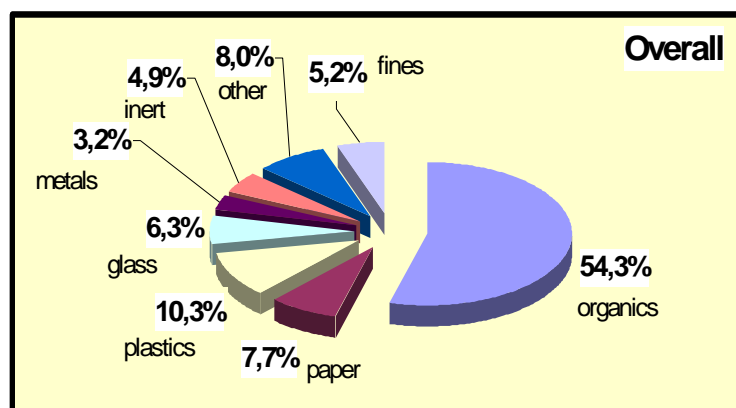


Figure 4 Overall results for Summer campaign

- **Comparison between campaigns**

- waste quantities were higher in summer than in spring
- in summer, biodegradable waste was higher than in spring
- even the percent of packaging was similar (23%) in the 2 campaigns, the quantities of some packaging were higher in summer: plastic bottles, brown glass, aluminium cans and composite packaging
- in spring, the plastic, glass and inert components were found more than in summer
- percentages of wood, paper and cardboard, metals, hazardous materials, complex materials and fines were almost similar in spring and summer
- wood, hazardous and composites components were almost insignificant compared to the other components
- biodegradable waste was in both campaign the most representative (over 50% of the total).

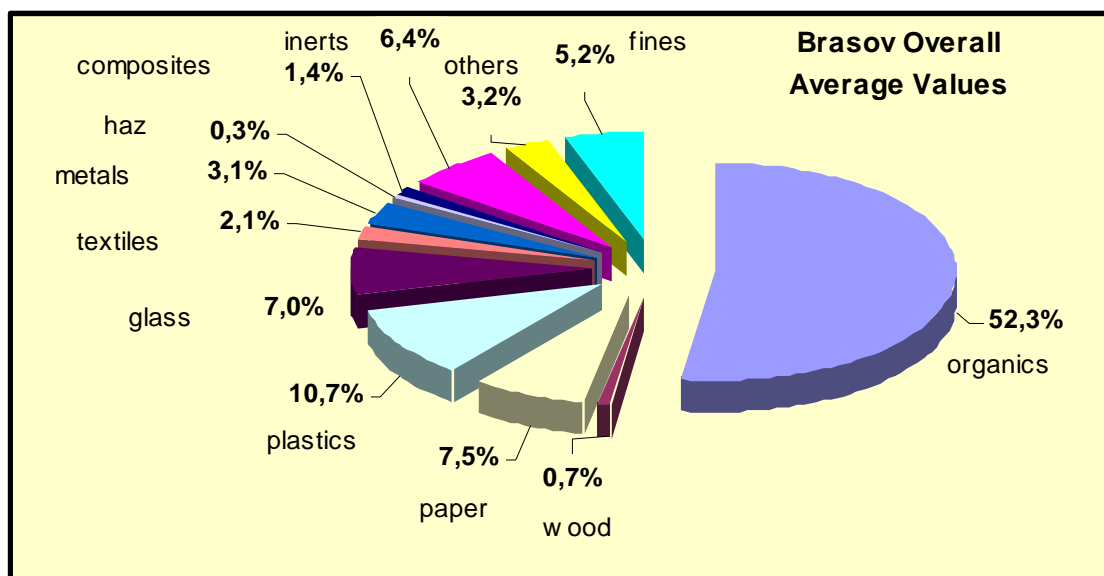
## 4.2 EXTRAPOLATION

Extrapolating the results obtained in the 2 campaigns in Brasov to the overall results for a year, the following conclusions may be drawn:

- total amount of residential waste in Brasov for a year would be at least 91,740 tons
- for an inhabitant the average values of generation would mean 0.885 kg/day or 322 kg/year
- biodegradable waste is the prevailing component of residential waste: 52.3%
- plastic waste represents 10.7% of the total amount
- paper and cardboard represents 7.5%
- glass represents 7%
- metals represent 3.1%
- all other waste, including inerts, represent 19.4%

**Table 14 Overall results for Brasov**

<b>Residential waste</b>	<b>%</b>	<b>tons/year</b>	<b>kg/inh.year</b>
biodegradables	52.3	47,705	168
paper and cardboard	7.5	6,881	24.2
plastics	10.7	9,816	34.5
glass	7	6,422	22.6
metals	3.1	2,844	10
wood	0.7	642	2.2
textiles	2.1	1927	6.8
hazardous	0.3	275	0.96
composites	1.4	1,284	4.5
inerts	6.4	5,871	20.7
others	3.2	2,936	10.3
fines	5.2	4,770	16.8
<b>TOTAL</b>	<b>100</b>	<b>91,740</b>	<b>322</b>



**Figure 5 Overall average values for Brasov City**

**5. COSTS RELATED TO THE ANALYSIS**

The total number of sampling units for the 2 campaigns in Brasov city was 90. The soring was done manually from the collection bins.

The following table presents the cost estimation for the waste analyses in Brasov.

**Table 15 Cost drivers for waste analyses in Brasov**

	<b>Planning</b>	<b>Sampling</b>	<b>Sorting</b>	<b>Interpretation</b>
<b>Personnel</b>	48 man-hours highly qualified	85 man-hours low and middle qualified	680 man-hours low and middle qualified	144 man-hours highly qualified
<b>Equipment</b>	computer	open sided truck, heavy duty bags, shovels, brushes, labels and tags, markers, protective equipment for workers	screening table, brushes, shovels, plastic sheets, boxes and bins of different sizes, heavy duty bags of different sizes, weighing platform, scale, data forms, calculator, labels, pens and markers, camera	computer