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***Proceedings of the International Conference
on Materials Science and Engineering***

BRAMAT 2009

26-28 February 2009, Brasov, Romania



“Gheorghe Asachi” Technical University of Iasi

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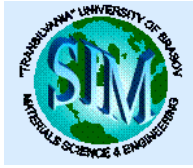
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TRENDS IN SELECTIVE COLLECTION OF THE HOUSEHOLD WASTE

Liana Baltés^{1*}, Camelia Draghici¹, Camelia Manea², Dan Ceausescu², Mircea Tiorean¹

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Abstract

The paper presents actual trends concerning the selective collection of the household waste. The collecting methods used in the EU countries and the results obtained by the Romanian municipalities in the last two years are also exposed. The results show the dynamics of household collection and the expectations for the next years. It is known that a town of 100 000 inhabitants collecting 100% of its household recyclable packaging waste could recycle 780 tonnes of steel, 200 tonnes of aluminium, 470 tonnes of plastics, 2300 tonnes of paper and 2200 tonnes of glass per year (Bio Intelligence Service S.A.S., 2005). This is why it is important that local authorities implement an efficient waste collection system, which enables them to maximize the recyclable packaging collected with minimum environmental impacts and costs

Key words: recycling, selective collection, waste

1. Introduction

The Framework Directive of 1975 (75/442/EEC) stipulates the basic principles relating to waste collection, elimination, reuse and treatment, and which can be schematically summarised as two principles:

- The Polluter-Pays principle.
- The principle of prioritising treatment procedures.

The directive invites Member States to focus on:

1. Prevention;
2. Re-use;
3. Recycling;
4. Energy recovery;
5. Elimination.

The "landfill" directive (1999/31/EC) defines three types of landfills corresponding to three types of waste:

- Class I landfills, for hazardous waste;
- Class II landfills, for non-hazardous waste;
- Class III landfills, for inert waste.

It sets the objective for the Member States to reduce the proportion of waste placed in landfills and provides that only waste that has undergone prior

treatment shall be admitted, and that the waste be monitored for thirty years after its disposal at the site. The European directive on garbage incineration (2000/76/EC) sets out new environmental thresholds, in particular those governing dioxin emissions; the threshold for dioxin emissions should not exceed 0.1ng/m³.

There is a strong movement in many countries to reduce the volume of wastes to be dumped. The increase of composting sites is an indication that organic fraction of garbage could be converted into a useful and commercial product with a higher value. For inert materials, technologies are needed to use wastes as raw materials to produce new products. Development of new materials from recycled materials will also encourage sorting of solid waste. "Zero Waste" movement also targets industries and waste exchange. 40% of landfilled waste in industrialised countries comes from building materials and this suggests that such wastes can be avoided by developing long-lasting materials and dwellings to reduce wastes from need to rebuild. Partisans of long-lasting materials and buildings say that any new waste recycling projects is not going to increase the knowledgebase appreciably. Instead

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funds for research and development should be diverted to redesigning dwellings that can last longer and that will facilitate higher levels of wastes-handling efficiencies. Conventional thinking will provide small gains only. Other alternatives and efforts indicate that:

- onsite treatment and utilisation will reduce need for transport;
- waste minimization is a socially desirable goal;
- subsidy on products generated from recycled materials will encourage socio-economic changes;
- centres with technologies that use collected waste materials are needed;
- waste that has severe risks and excessive problems in disposal should be identified and that which cannot be neutralized may need to be restricted at the point of creation or entry;
- a database on waste that is available will provide information to possible users of waste.

Four key aspects of waste management are very important: disposal, recycling, processing, and minimization (Fig. 1). These four issues have been put into a dual axis. One is the horizontal stakeholder scale, ranging from municipalities and local governments to the community. The other is the vertical technology scale ranging from high tech/high energy disposal systems to low tech/low energy systems (<http://www.gdrc.org/uem/waste/continuum/continuum.html>).

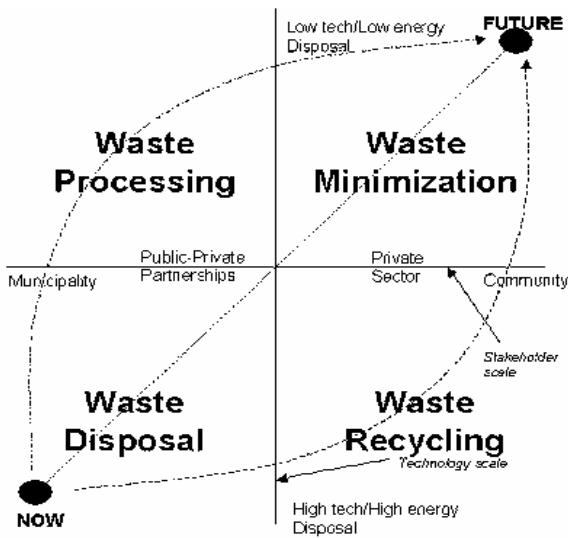


Fig.1. Evolution of waste treatment

2. Selective collection of waste in EU countries

Industrialization and economic growth has produced larger amounts of waste, including hazardous and toxic wastes. There is a growing concern of the negative impacts that wastes have had on the local environment (air, water, land, human health etc.). Local governments are now looking at waste as a business opportunity:

- to extract valuable resources contained within it that can still be used and;
- to safely process and dispose wastes with a minimum impact on the environment. Time needed for biodegradation of waste if left untreated is presented in Table 1 (<http://www.gdrc.org/uem/waste/waste.html>)

Because our experimental results are applied to the selective collection of paper, glass and plastics, the following categories of paper are of interest to a separate collection program (Guidelines for Municipal Solid Waste Management in the Mediterranean Region, 2003):

- Newspaper. The recycling of newspapers is a basic element of all paper recycling programs, but requires additional involvement by the resident;
- Cardboard. The main cardboard waste producers are supermarkets, product warehouses, industries, etc;
- High quality paper. Mainly rejected by offices;
- Mixed paper. It is the paper fraction with the lowest market value.

Table 1. Time needed for waste biodegradation if left untreated

Type of waste	Time needed for biodegradation if left untreated
Litter paper	2-4 weeks
Cotton rags	1-5 months
Orange peels	6 months
Woolen socks	12 months
Filter-tip cigarette butts	10-12 years
Plastic bags	10-20 years
Leather shoes	25-40 years
Aluminium cans	200-500 years

Glass collection for recycling concerns: glass bottles, glass containers and jars, as well as other glass materials, such as windowpanes, crystals, etc. The main sources of glass are industries dealing with the bottling of beverages, refreshments and water, hotels, restaurants, households and stores.

Glass is subdivided into three categories: white, green and brown, and the market value of the separated glass is higher than the value of the mixed; however, this material is usually collected mixed.

The major concern when collecting plastics is the high ratio of their volume to their mass (in many cases it reaches 3:1). Plastic recycling mainly deals with PVC, PET and HDPE. Numerous problems rise concerning the recycling potential of plastic materials, the most important of which are the following:

- There are many types and levels of quality for plastic materials, each with different physical properties and chemical composition.
- Several types of plastics are difficult to identify.
- There are a lot of admixtures in recycled plastics, due to residues of the packaging systems.

In Table 2 there are some appreciations concerning separate collection versus mixed

collection (Guidelines for Municipal Solid Waste Management in the Mediterranean Region, 2003).

Table 2. Separate collection vs. mixed collection

<i>Separate collection</i>	<i>Mixed collection</i>
Extends landfill life. Removes potential recyclables from the waste stream. Lowers net disposal costs.	It is not time or space consuming for the residents.
Done by the household. No extra cost for the community.	The facility does not need additional space to handle recyclables.
Highly applicable to residential waste.	Basic technology is needed.
Industrial waste may be recycled through industrial waste exchanges.	The effectiveness of the collection system does not depend on how people prepare recyclables.
An effective and reliable tool for recycling.	There is no need for established secondary markets.
Can be implemented on small-scale, then expanded.	
Recyclables are usually uncontaminated by garbage and other debris.	

It is known that one way to decrease the waste collection is to produce less. For example in Romania, from the 1st of January 2009, it is forbidden to give free plastic bags. The same rule was applied in Ireland since 2002. Therefore the decrease of plastic bags was 90%. In per capita terms, 500 kilograms of mixed urban waste were collected per person and per year in Spain (<http://www.arc-cat.net/en/municipals/recollidaselectiva>).

By Autonomous Community, Balears islands registered the highest per capita value of mixed waste (630 kg per person per year). At the other end of the spectrum were Cataluña and Galicia, with 441 kg. In Catalunya (6 millions inhabitants, 32.000 km²) the selective collection of glass and paper and cardboard is presented Figs. 2 and 3.

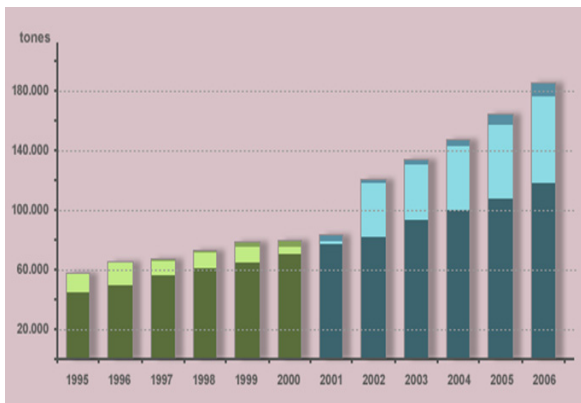


Fig. 2. Selective collection of glass waste in Catalunya dark – industrial; light – household

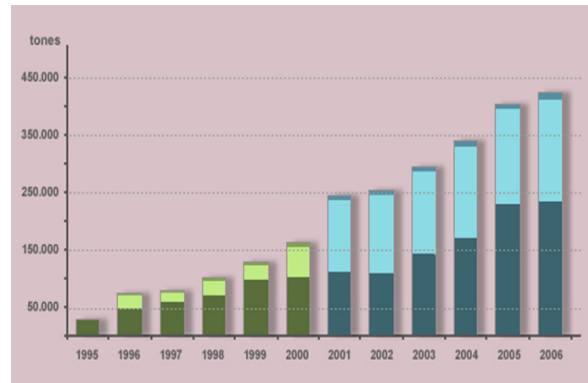


Fig. 3. Selective collection of paper and cardboard waste in Catalunya (dark – industrial; light – household)

3. Results of selective collection of waste in Romania

Since 1999, Romania adopted the Waste Management Evidence and The Waste European Catalogue. At the end of 2005, the 1281 Rule (1281/16.12.2005) of the Environment and Water Management Ministry concerning the waste containers colours was adopted (Fig.4):

- black/grey for unrecoverable/unrecyclable waste;
- brown for compost/biodegradable waste;
- white/green for white/coloured glass waste;
- blue for paper/cardboard waste;
- yellow for metal/plastic waste;
- red for hazardous waste.

A Romanian citizen generates around 5 kilos of household waste per week, half of it is biodegradable, a half of a kilo is glass and another half of a kilo is paper and cardboard (Turcitu Badalan, 2008). The rest is shared between other types of waste, 250 grams textiles and 200 grams polymers and PET.



Fig. 4. Containers for selective collection in Brasov

The National Plan of Waste Management anticipates that, by 2013, this type of waste will increase with 0.8% a year. It is not clear yet where all this waste will be land filled, considering that majority of waste disposals will be closed due to the European Regulation. Further, at the selective

collection chapter the situation is worse: from all the waste quantity, half can be recycled, but only 2% of this quantity is recycled in only one pilot plant.

Whole Romanian waste production is increasing; the population produces daily around 100 000 tons of all type of waste. 71% is industrial waste and the rest is household waste. The waste production quantity situates us at the middle of the ranking of waste production in EU countries.

In Romania the selective collection of household waste against waste recovery of main materials: paper and cardboard, glass, metals, plastics it's not a usual practice; it is applied at local level in pilot projects initiated by Waste Recycling Companies and City Halls in co-operation with companies which produce packaging and packaging products. These programs are in progress with inhabitants' associations, schools, institutions, and companies and according to the obtained results and available funds, the projects are extended (Ghita, 2008).

The selective collection is anticipated to be approached in three stages as showed in Fig.5 (Ghita, 2008):

- 2004 – 2006: experimental phase (pilot project), population aware;
- 2007 – 2017: enlargement of selective collection at national level;
- 2017 – 2022: implementation of selective collection in difficult to access areas (countryside area, mountain area).



Fig. 5. Stages of selective collection in Romania

Between 2004 and 2006, a special attention was paid to the information and making the population aware of the problem, simultaneous with the pilot projects extension concerning the selective collection.

Concerning the investments costs in selective collection in Romania, you can see a medium-range forecast in Fig. 6. The main effort will be focused in building of research facilities (63%) (Ghita, 2006).

Concerning this waste selective collection problem at national level (the second phase), by December 31st 2007, the system was implemented in 182 villages and in district 2 of Bucharest, covering 2,412,472 inhabitants. The selective collection in 2007 was as in Table 3 (<http://www.anpm.ro>).

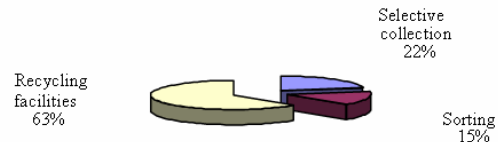


Fig. 6. Forecast of investments costs in selective collection in Romania (2003-2013)

Previsions concerning the waste recovery in Romania, depending on the materials' type are presented in Table 4 (Dogar, 2009).

In Bucharest (1,944,000 inhabitants) the selective collection covers 2/3 of population. 180 collection points were created, half of them in the 6th district, by Urban Company. This means 7,200 inhabitants at one collection point, insufficient to be efficient. In Bucharest, for example, the waste quantity collected annually is between 800,000 and 1,000,000 tons (Dogar, 2009).

But now the waste recycling companies are confronted with economical crisis effects. So, the prices for paper and cardboard, polymers and glass are decreasing. For example, for cardboard, the price decreased at 10 euro per tons from 75 euro per tons before. For polymers, from 250 euro per tons the price decreased to half. Only the price for paper is the same for now (Dogar, 2009).

The waste collection in Brasov city (279,700 inhabitants) is split between 2 companies, approximately 50% each. The results obtained by Urban Company concerning the selective collection of waste in last two years are presented in Table 5.

Fig. 7 presents the collection of paper and cardboard waste in Brasov. A significant difference between 2007 and 2008 and the important contribution of the industry waste in the total amount can be observed. The collection is lower in the summer months than in autumn and winter, caused probably by the holidays.

Fig. 8 presents the collection of polymers waste in Brasov. A significant difference between 2007 and 2008 and the important contribution of the industry waste in the total amount can be observed. The collection is lower in the spring months than in winter, caused probably by the increasing of liquids consumption.

Fig. 9 presents the collection of polymers waste in Brasov. A relative constancy for both years and strong differences between odd and even months, caused probably by the bimonthly collection can be observed.

Investments costs of Urban Company in Brasov between 2006 and 2008 were 1,478,000 Euro, of which 89,000 Euro invested in population information. As result of these investments, a significant increasing of population participation to the selective collection program can be observed (Table 6).

Table 3. Results of selective collection of waste covering 2412472 inhabitants in 2007

<i>Selective collection quantity (tonnes)</i>	<i>PET</i>	<i>Plastics</i>	<i>Paper/Cardboard</i>	<i>Glass</i>	<i>Metal</i>	<i>Wood</i>
2043998	374456	220623	1328289	94273	14026	12331

Table 4. Provisions concerning the waste recovery in Romania

<i>Year</i>	<i>Paper and cardboard (%)</i>	<i>Polymers (%)</i>	<i>Glass (%)</i>	<i>Metals (%)</i>	<i>Wood (%)</i>	<i>Main objective intend through recycling (%)</i>
2007	15	10	22	15	5	28
2008	60	11	32	50	7	33
2009	60	12	38	50	9	38
2010	60	14	44	50	12	42
2011	60	16	48	50	15	46
2012	60	18	54	50	15	50
2013	60	22,5	60	50	15	55

Table 5. Selective collection of waste done by Urban Company in Brasov

<i>Year</i>	<i>Month</i>	<i>Household waste (tonnes)</i>		<i>Industrial & household waste (tonnes)</i>		
		<i>Paper + cardboard</i>	<i>Polymers</i>	<i>Paper + cardboard</i>	<i>Polymers</i>	<i>Glass</i>
2007	January	1.65	0.56	93.58	7.81	13.4
	February	1.8	1.1	106.941	5.836	2.85
	March	2.28	1.169	129.28	15.715	24.02
	April	1.5	0.606	137.5	8.451	4.25
	May	2.84	1.1	139.84	11.414	29.4
	June	36.14	6.14	131.34	17.1	13.775
	July	55.67	11.19	141	18.4	9.37
	August	45.94	11.012	146	20.567	35.5
	September	53.706	17.828	143.88	21.9	10.78
	October	44.573	7.105	145.67	16.162	29.025
	November	63.825	3.417	167.52	11.03	10.76
December	61.4	9.075	189.3	15.064	8.36	
TOTAL 2007		371.324	70.302	1671.851	169.449	191.49
2008	January	45.682	26.014	149.32	28.55	25.15
	February	92.5	21.6	182	24.22	16.82
	March	81.787	14.139	181.28	17.09	16.35
	April	67.868	15.701	176.46	22.22	17.24
	May	59.17	19.885	179.52	23.88	26.35
	June	55.309	20.326	154.832	24.485	12.46
	July	74.33	21.635	176.68	25.775	30.14
	August	86.435	23.93	184.28	26.22	25.36
	September	82.94	22.86	198.02	24.84	12.16
	October	88.355	23.76	204.4	26.29	20.14
	November	80.76	15.852	202.46	22.06	18.72
	December	85.3	14.5	205.74	17.29	10.4
TOTAL 2008		900.436	240.202	2194.992	282.92	231.29

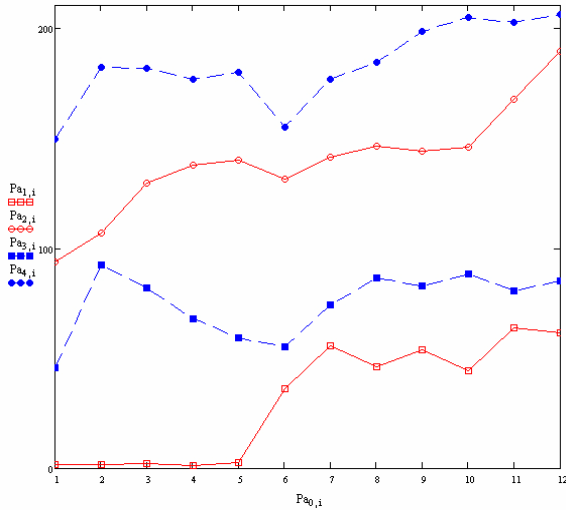


Fig. 7. Selective collection of paper and cardboard waste in Brasov city by Urban Co.

- ▣▣▣ household waste 2007,
- ▣▣ industrial and household waste 2007
- ▣▣▣ household waste 2008,
- ▣▣ industrial and household waste 2008

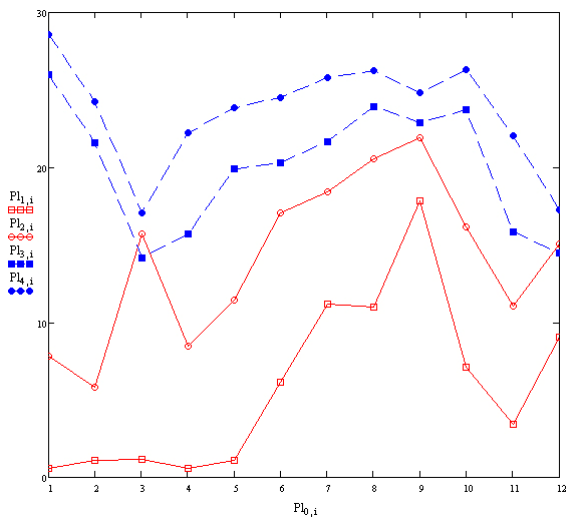


Fig. 8. Selective collection of polymer waste in Brasov city by Urban Co.

- ▣▣▣ household waste 2007,
- ▣▣ industrial and household waste 2007
- ▣▣▣ household waste 2008,
- ▣▣ industrial and household waste 2008

Table 6. Results of investments in population information by Urban Company in Brasov

	2006	2007	2008
Nr. of locations /storage places	17	106	123
Population participation	11360	80000	100000

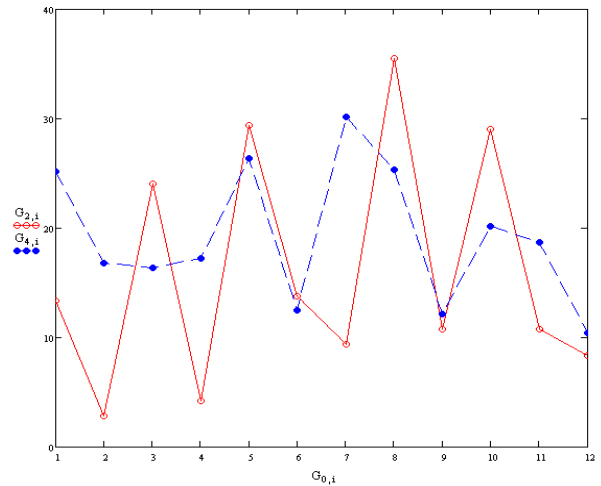


Fig. 9. Selective collection of glass waste in Brasov city by Urban Co.

- ▣▣ industrial and household waste 2007
- ▣▣ industrial and household waste 2008

4. Conclusions

An important step for municipal councils is to stop considering environmental problems as a matter to be resolved by a single company or group or companies involved in waste collection. The selective collection is a problem of municipality, citizens and waste collection companies.

The factors that reduce the selectivity of the waste are:

- individual effort required by the method;
- distance between residence of the citizens and containers;
- low availability of space at citizen’s home;
- low availability of time;
- comfort and dimensions of the containers;
- recurrence of old habits of the users.

Some factors are influenced by the age of the waste producers, the occupation, the degree of education, age, education, place of residence, the level of income; the rest of them are affected by the environment, the community, politics and civic rules.

The environmental education must be integrated into municipal action plans, thereby offering simple and updated information in an attractive and easily understandable way, and distributing this information so that it reaches the largest part of the population.

This education can be done by:

1. local administrations, through visits and meetings with representatives of the various municipal institutions;
2. large image promoters, through visits to the large waste production centres and the business associations that represent them;
3. citizens, through printed materials distributed to the entire population (brochures, signs, etc.) and through informative talks and itinerant exhibits;

4. visitors, through the placement of signs and the distribution of brochures in areas with a large flow of tourists;

5. schools, through the preparation of specific materials on waste prevention and management and distribution of the materials at educational centres.

The waste collection companies can contribute to the increasing of selective collection by changing the design of the recipients and the availability of them according the users. They can also organize periodically contests on selective collection and give prizes to the top neighbourhoods.

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