ANALYSIS OF COLLECTING AND RECYCLING OF SOME WASTE CATEGORIES IN ROMANIA

Adrian IOANA[1], Florina Eliza ISTRATE[2], Mihai BUZATU[3], Mircea Ionuţ PETRESCU[4], Augustin SEMENESCU[5], Mirela SOHACIU[6*]

The paper presents a thorough analysis of collection and recovery of metal scrap (ferrous and nonferrous) in Romania. This analysis is based on the waste categories in accordance with the OECD, and also on the waste codes under incidence of ANPM classification. In addition, the paper presents the stock variation of metal scrap (ferrous and nonferrous) and the metal scrap (ferrous and nonferrous) and non-metallic quantities capitalized, and, respectively, removed. The waste quantities treated in EU countries, according to EUROSTAT, are also presented. We have also presented a structure of municipal waste, generated during 2010 - 2015, including the packaging placed on the market.

Keywords: waste, collection, recovery, recycling

1. Introduction

The authors of this article subscribe to the motto "Many of us do not consider themselves environmental activists ... but every person is an infectious agent of change" [2].

The environmental challenges of the late twentieth century generated a new understanding of the correlations and reciprocal impacts between and on the environment and the human society, materialized by joint efforts of the world states to cope with new issues raised, such as [1, 3, 4]:

Globalization

- Economic crisis

[1] Assoc. Prof., Dept. of Engineering and Management of Metalic Materials Obtaining, University POLITEHNICA of Bucharest, Romania, e-mail: adyioana@gmail.com

[2] PhD student, Dept.of Engineering and Management of Metallic Materials Obtaining, University POLITEHNICA of Bucharest, Romania, e-mail: eistrate90@yahoo.ro

[3] Prof., Dept. of Engineering and Management of Metallic Materials Obtaining, University POLITEHNICA of Bucharest, Romania,, e-mail: buzatu.mihai@yahoo.com

[4] Prof., Dept. of Engineering and Management of Metallic Materials Obtaining, University POLITEHNICA of Bucharest, Romania, e-mail: ipetrescu@yahoo.com

[5] Prof., Dept. of Engineering and Management of Metallic Materials Obtaining, University POLITEHNICA of Bucharest, Romania, e-mail: asemenescu2002@yahoo.com

[6] Reader, University POLITEHNICA of Bucharest, Romania, *corresponding author, mirelasohaciu@yahoo.com

- Energy crisis
- Climate change
- Loss of biological and ecological diversity of systems
- Abiotic environmental deterioration.

The issue of the negative impact on the environment and human health, is the result of obsolete waste disposal technologies, especially in the context of sustained growth trend in the quantities of generated waste [5,6,7].

It thus becomes imperative to incorporate in the strategic priorities in Romania equally important aspects such as:

- decline of natural resources
- appropriateness of using waste as raw material to support economic activities.

Consumer society has brought, in addition to its benefits, many difficult issues, including the technical, economic and legal requirements of the existence of waste and eliminating or reducing it [8,9,10].

The first problem (technical) refers to the possibilities offered by current science and technology towards reducing, recycling, treatment and disposal of waste [11, 12, 13].

The second category (economic and legal) refers to the economic implications involved in these operations, and those in the latter category (decrease) in evolution, and the statutory regulations [14, 15].

2. Issues regarding recovery and recycling of waste categories in Romania

2.1. Materials and methods

The new appropriate concept of the management of the waste, in terms of sustainable development, obliges to consider it a significant material resource [16,17]. Thus, the qualitative leap from simple elimination of waste to reuse it became absolutely necessary.

Preserving natural resources through recycling and reusing of waste requires to consider it as a real resource [18, 19, 20, 21]. In Romania, the main objectives in the field of waste recycling and transforming in an added value product are in accordance with the National Waste Management Strategy (SNGD), as follows:

- Focused efforts on the waste management under incidence of the waste hierarchy criterion;
- Developing measures to encourage waste reduction and reuse, promoting the sustainable use of resources.
- Increase of recycling rate and improvement of the quality of recycled materials.
- Promoting recovery of packaged waste.

- Reduction of the carbon quantity generated by waste recycling and recovery treatment
- Encourage production of the energy from the waste that cannot be recycled.
- Organizing a national database and making the monitoring process more efficient.
- Implementing the concept of "life cycle analysis" of waste management policy.

We consider useful to present some complementary definitions of the waste concept. In accordance with the documents of the European Union (EU) «waste means any substance or object that the holder eliminates or is required to be removed /thrown».

The organization for Economic Cooperation and Development (OECD) believes that «wastes are materials other than radioactive, meant to be removed». United Nations Environment Programme (United Nations Environment Programme - UNEP) provides that «wastes are substances or objects, which are or are intended or required to be discarded due to provisions of national law». In addition to those three previous definitions, the Table 1 presents the waste categories, in accordance with the OECD (OECD document includes 700 items, further evidence of the complexity of the concept of waste).

Table 1

The waste categories according to OECD

Q1	Production and consumption residues not otherwise specified below in another way.
Q2	Non-specific products.
Q3	Products whose warranty is expired.
Q4	Materials thrown away, lost or having defects, or other materials, equipment accidentally contaminated.
Q5	Materials contaminated or soiled resulting from planned action. I.e. residues from cleaning process, containers etc.
Q6	Unusable parts. I.e. rejected batteries, exhausted catalysts, etc.
Q7	Substances which no longer have the desired performance. I.e. contaminated acids, impure solvents, expired salts etc.
Q8	Residue from industrial processes. I.e. clay, remains distillation etc.
Q9	Residues from cleaning processes. I.e. from sewage sludge, used filters etc.
Q10	Residues from industrial machines. I.e. metal drilling scraps etc.
Q11	Residues from mineral extraction and processing. I.e. the tailings.
Q12	Mixed materials. I.e. oils contaminated with PCBs, etc.
Q13	Any materials, substances or products whose use has been banned by the law of the country of export.
Q14	Products for which there is no use. I.e. agricultural waste, household waste, the office of business waste etc.
Q15	Materials, substances or products resulting from actions of contaminated soil purification and maintenance.
Q16	Any materials, substances or products which the manufacturer or exporter declares waste that is contained into the above item categories.

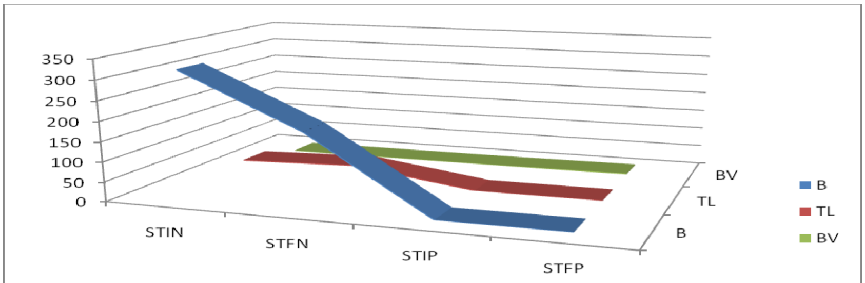
As a conclusion, we can say that definitions such as "***waste: things thrown by owner***" cannot cover all types of waste. And definitions like ***"things falling into the 700-item***" cannot be considered as scientific definition because they contain waste classes such as "waste not otherwise specified" (Q1 Table 1).

2.2. Results and discussions

Fig. 1 shows the variation in stocks of categories of collected waste (non-hazardous and hazardous waste) for three cities in Romania, Bucharest, Brasov and Tulcea in 2015.

Table 2 includes the changes, in inventories, of metal scrap (ferrous and nonferrous) and non-metallic waste in 2015.

Table 3 shows the quantities of metal scrap (ferrous and nonferrous), non-capitalized, respectively removed.



	STIN	STFN	STIP	STFP
B	319.8	187.8	0	0
TL	34.231	42.39	0	0
BV	0.08	0	0.08	2.12

Fig.1. Changes in stocks of waste categories

STIN - Initial stock of non-hazardous waste [t / year]; ***STIP*** - Initial stock of hazardous waste [t / year]; ***STFN*** - Final stock of non-hazardous waste [t / year]; ***PPB*** - Final stock of hazardous waste [t / year]; ***B*** – Bucharest; ***TL*** - Tulcea; ***BV*** - Braşov.

Table 2

Changes in inventories of categories of metal scrap (ferrous and nonferrous) and non-metallic waste

Nr. Crt.	Waste code	Stock at the beginning of the year [t]	Generated quantity [t]	Stock at the end of the year [t]
1.	02.01.03	1244.04	435919.38	2454.48
2.	19.01.02	26.65	304.30	5.25
3.	15.01.01	10129.9363	5747.2794	432.2435
4.	15.01.02	84.2894	1348.3131	79.4221

5.	16.06.01	49.944	741.11	52.051
6.	20.01.40	0.104	154.901	0.030
7.	16.01.17	30.309	236.884	29.899
8.	17.04.05	1051.804	35907.413	701.923
9.	12.01.01	265.316	7469.92	90.06
10.	17.04.01	4.336	18.86	3.995
11.	17.04.02	2.583	36.897	1.18

02 01 03 – Vegetable waste
19 01 12 – Combustion ash and slag other than those mentioned in 19 01 11 (19 01 11 * flue ash and slag containing dangerous substances)
15 01 01 – Paper and Cardboard packaging
15 01 02 – Plastic packaging
16 06 01 – Lead Batteries
20 01 40 – Metals
16 01 17 – Ferrous
17 04 05 – Iron and steel
12 01 01 – Filings and scrap iron
17 04 01 – Copper, bronze, brass
17 04 02 – Aluminum

Among the analyzed waste, cardboard packaging and paper had maximal initial stock (10129.9363 t, representing 78.59%, in weight, of all stocks firstly examined). In the same context, the minimal initial stock is the waste called "metals" (code 20 01 40) or 1,104 t, i.e. 0.8 x 10^{-3} % of initial supplies.

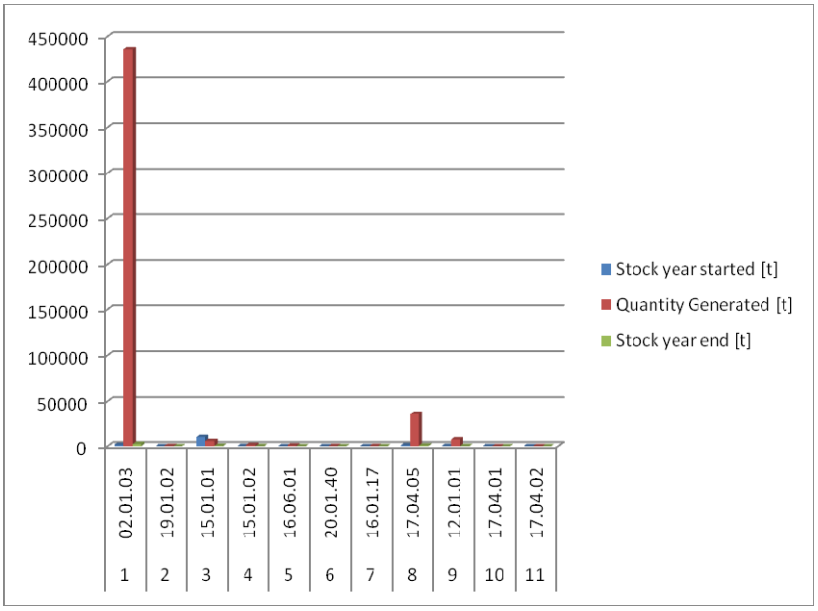


Fig. 2. Changes in inventories of metal scrap categories (ferrous and nonferrous) and non-metallic waste

Table 3

The metal scrap quantities (ferrous and nonferrous) and non-metallic waste, capitalized and removed respectively

Crt. No.	Waste Code	Capitalized quantity [t]	Removed quantity [t]	Remarks
1.	02.01.03	134670.84	-	Valorif. 3o.8%
2.	19.01.02	281.31	44.29	Valorif. 13.28%
3.	15.01.01	6210.1713	-	Valorif. 39.11%
4.	15.01.02	1399.5386	-	Valorif. 97.50%
5.	16.06.01	16387.647	-	-
6.	20.01.40	154.975	-	Valorif. 99.98%
7.	16.01.17	236.664	-	Valorif. 88.57%
8.	17.04.05	31680.263	-	Valorif. 85.70%
9.	12.01.01	7305.568	-	Valorif. 94.45%
10.	17.04.01	18.379	-	Valorif. 79.23%
11.	17.04.02	38.3	-	Valorif. 97.01%

We note the maximal recovery level (99.98%) for metals (code 01.20.40). Minimum capitalization of 13.38% is related to 'burning ash and slag" waste, code 19.01.02.

Fig. 3 shows the variation, in quantities of metal scrap (ferrous and nonferrous) and non-metallic waste, capitalized and removed respectively.

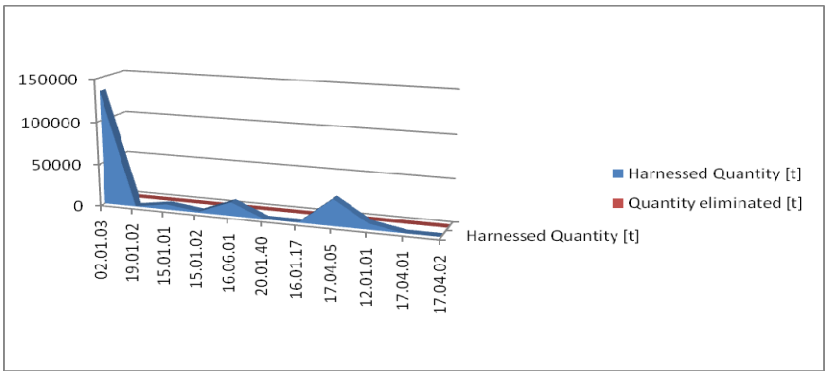


Fig. 3. Quantity changes in certain categories of metal scrap (ferrous and nonferrous) and non-metallic waste capitalized and removed respectively

Currently, the EU municipal waste are treated through storage (38%), incineration (22% - 25%), recycling and composting (15%). In Romania, where the efforts and significant investments have been made to align with the community acquis, the situation is evolving rapidly, but the main way of waste disposing is still represented by storage treatment.

The 2010 Eurostat data (EUROSTAT Communiqué No. 48/2012 - 27 March 2012 for 2010) reveal significant differences between Member States (MS) of the EU as follows: from the countries where storage is largely performed, such

as Bulgaria (100%), Romania (99%), Lithuania (94%) and Latvia (91%) to the countries where recycling of municipal waste is situated on an important place: Denmark (54%), the Netherlands (39%), Belgium (37%).

Fig. 4 presents the number of waste treatment in EU countries.

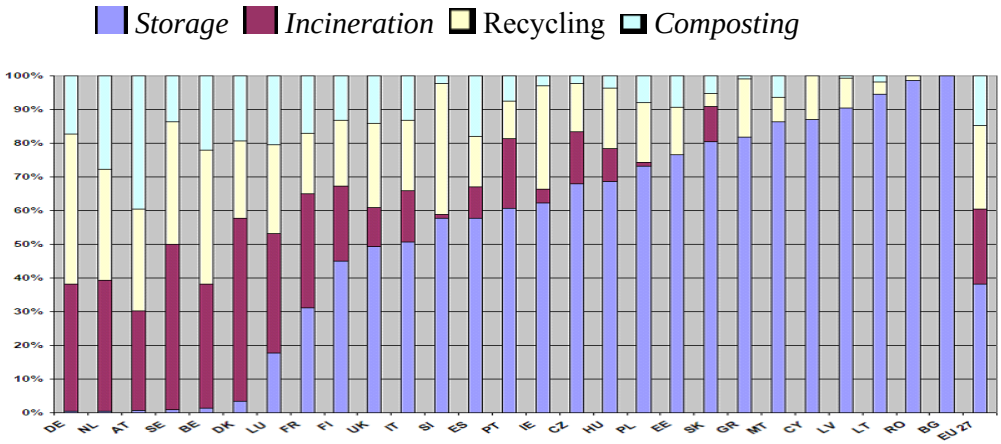


Fig. 4. Share of waste treatment in EU countries

Romania is one of the countries where the bulk of municipal collected waste is removed/treated by storage, recycling and recovery operations being used in a very limited way.

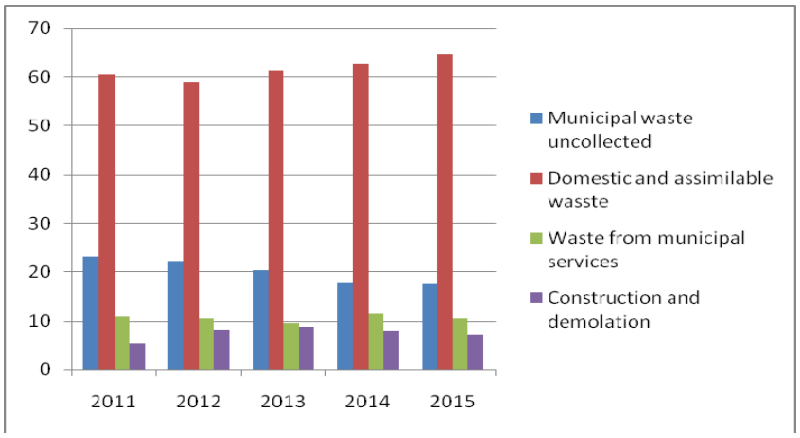


Fig. 5. Structure of municipal waste generated during 2011-2015 [%]

In the structure of municipal waste in Romania, the largest share is represented by household waste (about 64%), while street waste and construction and demolition waste have about the same share (10% and 9% respectively). Over

90% of municipal waste collected is disposed by storage. Fig. 5 shows the structure of municipal waste generated during 2011-2015.

Fig. 6 lists the quantities of municipal waste generated and collected during 2011-2015.

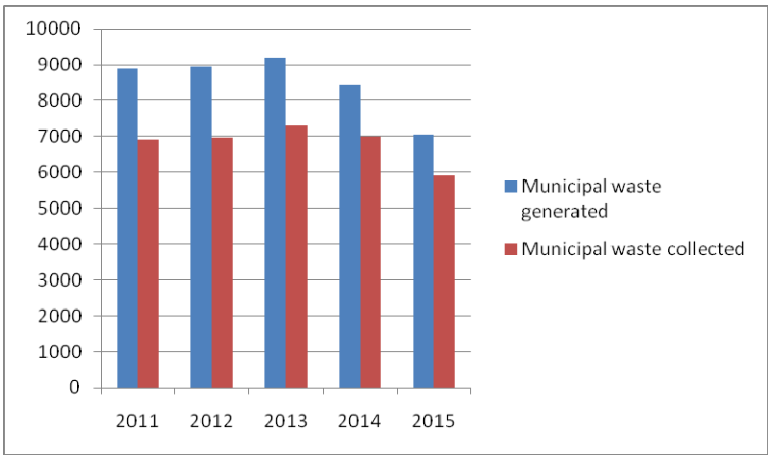


Fig. 6. The amount of municipal waste generated and collected during 2011-2015 [t]
(Source: ANPM, mediator Report, 2015)

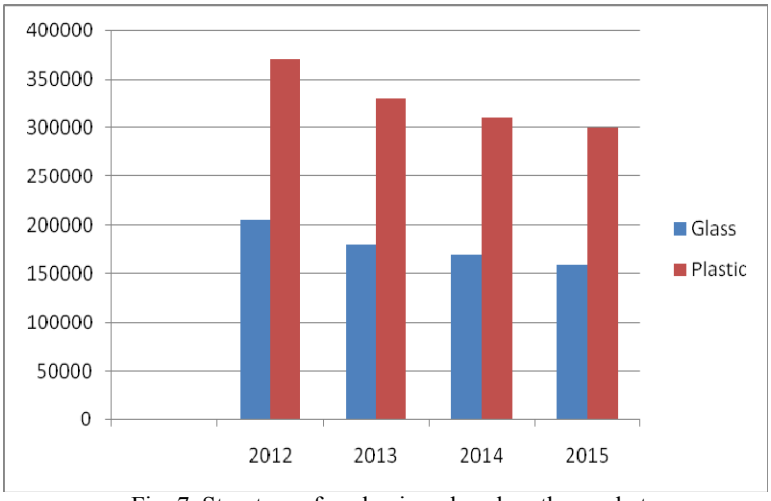


Fig. 7. Structure of packaging placed on the market
(Source: ANPM)

Concerning the structure of packaging placed on the market (Fig. 7), on types of material, during 2012 – 2015, a decrease, in quantity, of the glass packaging in favor of plastic can be remarked, which shows the direction of consumer behavior.

3. Conclusions

The first and most important current aspect in the collection and recycling of waste in Romania, especially in metal scrap area, is «no respect» of the principles of sustainable development. Under incidence of this point of view, the collection and recycling of such waste had a quantitatively "boom" during 1991-1993.

The businesses in the area thought that this activity would further increase. They were wrong. Real life has proven the contrary, the quantity of the waste (particularly metal) production, decreased dramatically. The economic crisis and exponential falling of national economy have thoroughly "contributed" to this phenomenon.

In the structure of municipal waste generated during 2010 - 2015, the largest share is represented by domestic waste. Thus, this share varies between a minimum of 58.94% in 2010 and a maximum of 64.64% in 2015.

It is important to note that in the same structure, the minimal share is represented by construction and demolition waste, such waste being mainly metallic ones. These share range from 5.35% in 2011 and 8.79% in 2012.

The waste recycling, considering the waste as a significant material resource, has multiple beneficial aspects, such as:

- Stimulate innovation through design, planning and implementation of new and efficient recycling facilities to recycle waste.
- Create economic growth.
- Create new jobs.
- Ensure better conditions for the conservation and availability of scarce (critical) natural resources.
- Lead to the application of the concept of sustainable development (generates prosperity while preserving a healthy environment and social equity for present and future generations).

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