

Recycling Household Waste

Prof. Dipl. Eng. **Elena SURDU**¹, Prof. Dipl. Eng. **Dana-Claudia FARCAȘ-FLAMAROPOL**¹

¹"Ion I.C. Bratianu" Technological High School in Bucharest, elena.surdu@yahoo.com;
claudia.flamaropol@gmail.com

Abstract: Waste management refers to the temporary storage, reuse, collection, transport, treatment, recycling and disposal of waste, the main purpose being the saving of the raw material by reusing recyclable waste, thus contributing to reducing the pressure on natural resources.

The most effective approaches to reduce the environmental impact are to prevent the uncontrolled disposal of waste and also to collect and recycle them.

Also, by recycling we can obtain new raw materials and also even thermal energy.

The social education of young people is a decisive factor to increase efficiency of long-term waste, collecting and recycling.

Keywords: Waste, recycling, collecting, environment

1. Introduction

A strong impact on natural resources has, first of all, the demographic expansion, which entails the necessity of an economic growth based on technological progress in the productive processes, responsible for ensuring the necessity of material consumer goods. There is a direct, proportional link between the pace of economic growth and that of the volume of waste, which contributes to the exacerbation of the conflict between the technosphere and the sphere.

With the demographic explosion and the revolution in agriculture and industry, waste has exceeded the capacity of the environment to absorb and neutralize them at a rate close to the rate at which they are generated. Demographic growth has led to an increase in the pace of expansion of habitable areas. Urbanization, as a phenomenon with profound implications in contemporary society, requires a significant and concentrated consumption of material and energy resources. Their transformation into goods and services, in addition to meeting material requirements, produces a large and diverse pollutant quantity, which requires, as a necessity increase the capacity to assimilate the environmental factors. The urban and the productive system extend on the basis of the protective and assimilative-dissipative systems.[1]

Unfortunately, a high rate of industrialization, beyond the positive perception in the direction of increasing the degree of civilization, contributes to the aggravation of the environmental and health problems by concentrating in a certain perimeter the different types of waste - urban and industrial.

The concept of waste, generally difficult to define, includes a wide category of products, variable in time and space, which, at least in relation to the intention and the degree of current use, has no special economic value, raising general problems of separation, storage and possibly revaluation.

Recycling is important both for the preservation of this healthy environment and for the reintroduction into the economic circuit of materials that are becoming increasingly difficult to find.

Waste recycling has become a major issue for the overall sanitation of the Earth, the magnitude of the phenomenon largely conditioning the economic development.

Waste recycling is defined as a process of reusing used or old materials and products for the creation of others, without resorting to new raw materials, considerably reducing the energy consumption needed to extract the raw materials, or to destroy any kind of waste.

The waste to be collected and recycled is [2]:

1. *Non-hazardous waste from packaging* (paper-cardboard, plastic, glass, metal) obtained from storage, handling, tertiary repacking and shipment of primary prepackaged products, as well as from current office activity.

- Paper waste (paper and cardboard packaging waste): cardboard boxes from various materials and products (from furniture, supplies, food, etc.), wrapping paper, scrap paper: documents, newspapers, magazines.

- Plastic waste: packaging waste from various products, consumables, foil type, PET, other plastic containers.
- Metal waste: packaging waste for beverages and food.
- Glass waste: packaging waste from food containers.

2. *Hazardous waste and its packaging* (mineral oils, car supplies, detergents, batteries and accumulators; fluorescent light bulbs and tubes; printer cartridges and toners, etc.).

3. *Wastes from electrical and electronic equipment*, resulting from the failure of office equipment during current activity or such products, damaged during storage or handling, as well as from electrical and electronic products returned by customers.

4. *Household waste* and assimilated to them, arising from current office, cleaning and maintenance activities.

Domestic waste contains large quantities of reusable materials that can be collected and used.

Waste is any object that is no longer used and thrown away.

2. Reduction of household waste

Recycling is the process of processing waste for reuse; almost all materials that enter the waste composition: paper, glass, plastic packaging, metal boxes can be recycled;

For the purpose of recycling, the waste is collected on a minimum of 4 fractions (paper-cardboard, plastic, glass, metal);

Selective collection is one of the recycling stages, together with the separation and processing of some of the waste components, in order to transform them into useful products; selective waste collection is a process that is available to everyone and involves storing waste in special places for recycling.

Natural resources are limited and do not regenerate very quickly, while the amount of waste increases reaching large areas of land. It is very important to understand that almost half of the waste we dispose of can be reused. The environment is increasingly polluted, and we, by recycling waste, are trying to save the environment and the earth. [3, 4]

Advantages of selective collection:

- Conservation of natural resources;
- Reducing the level of harmful emissions from the air - reducing pollution;
- Decreasing the quantity of waste;
- Eliminating the transformation of some areas into outbreaks of infection;
- Energy saving;
- Keeping a cleaner environment for us and future generations;
- Increasing the quality of life and health of children;
- Reducing costs, including the degree of sustainability.

3. Waste management

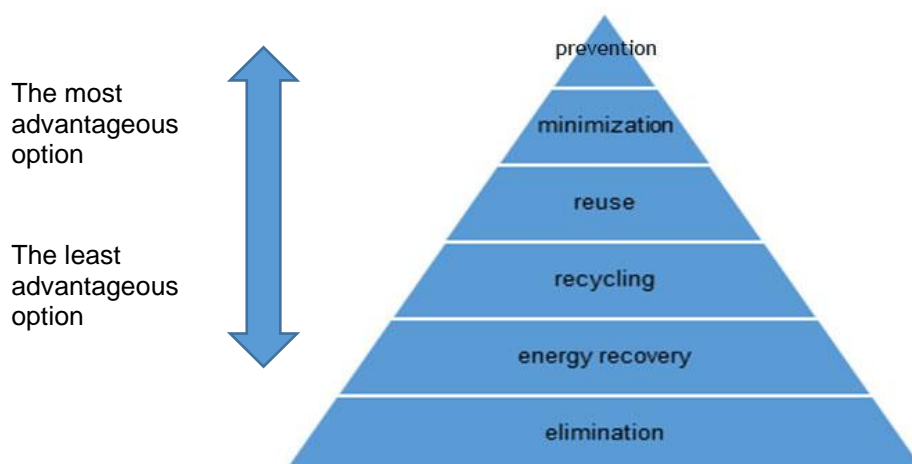


Fig. 1. The hierarchy of waste management [5]

Waste hierarchy refers to: reduction (prevention and minimization), reuse and recycling (energy recovery), which classifies waste management strategies according to their opportunity in terms of waste minimization. This waste hierarchy aims to obtain maximum practical benefits from products and to generate a minimum amount of waste.

The most effective environmental solution is to reduce (by preventing and minimizing) the generation of waste, and the products and materials can sometimes be reused for the same or different purpose.

4. Methods of municipal waste management

According to the hierarchy, the most efficient environmental solution is to reduce (by preventing and minimizing) the generation of waste, and the products and materials can sometimes be reused for the same or different purpose. Recovery of resources from waste (recycling and composting), recovery and capitalization through energy generation from waste (anaerobic digestive, incineration) are the first options used, and the last option is the disposal of waste. [6]

In addition to the methods mentioned above, the following treatment methods are also used:

1. *Recycling* - involves the processing of used materials into new products, in order to prevent the transformation into waste of potentially useful material (figure 2). Recyclable materials include many types of glass, paper, metal, plastic, textile and electronics. Separate waste at the source is transferred to waste sorting facilities. In these specialized installations, recyclable materials are received, separated and prepared for marketing to end-user producers.

2. *Biological treatment* - uses live microorganisms for the decomposition of organic waste either in water, CO₂ and simple inorganic materials or in simple organic materials (aldehydes and acids). The main biological treatment methods used in the EU are aerobic (composting) and anaerobic treatment. The resulting products are compost used in agriculture or landscaping, and in the case of anaerobic digestion, biogas that can be used for energy production (figure 3).

3. *Incineration* - it is used as a treatment for a very wide range of waste. Waste incineration is to treat waste in such a way as to reduce its volume and hazard, to capture or destroy potentially hazardous substances that are or may be released during incineration. Incineration processes can provide means to enable the recovery of energy, mineral and / or chemical content from waste. Thus, during incineration, combustion gases are created that contain most of the available energy in the form of heat (figure 4)

4. *Waste landfill* - landfill, which involves waste management, with a reduced or non-existent prior treatment (figure 5). Biodegradable waste landfill has as a result the formation of the storage gas. The main impact of municipal waste management is considered the existing methane in the waste gas, in the form of greenhouse gas. The storage at the landfill must be reserved for stable waste, which can no longer be used. The storage gas can be collected or disposed of by combustion or it can be used as fuel. All municipal waste components are accepted for storage, including the residual fractions remaining after the separation of the recycling materials and the residues from the processes prior to the treatment (incineration and biological treatment).



Fig. 2. Waste recycling [10]



Fig. 3. Biological waste treatment station [11]

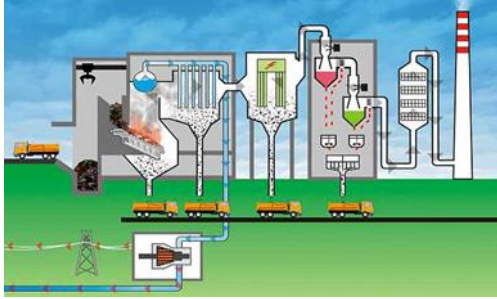


Fig. 4. Waste incineration [12]



Fig. 5. Waste disposal [13]

5. Methods of municipal waste management

The environmental legislation establishes that the application of a hierarchy of waste, a hierarchy through which the actions of waste generation and management are efficient, thus reducing the negative effects on the environment and population health, by:

- Prevention of waste generation;
- Preparation for reuse;
- Waste recycling;
- Other operations of recovery (energy recovery);
- Disposal of waste.

The management of household waste is based on legislation:

- OUG 1955 regarding the protection of the environment, with the subsequent modifications and completions
- OUG no 196 2005 on the Environmental Fund with subsequent amendments and completions
- Law no. 211 2011 on the regime of waste republished with amendments and completions transposes the Waste Framework Directive 2008 98 / as well as the Directive no 851 2018 amending the 2008 Directive 98 / CE on waste
- Law No 249 2015 on the regime of packaging and packaging waste with subsequent amendments and completions transposes Directive 94 62 1994 CE on packaging and packaging waste as well as Directive 852 2018 which amends Directive 94 62 1994 CE
- Commission Decision 2014 955 / EU of 18 December 2014 amending Decision 2000 532 / CE establishing a list of waste under Directive 2008 98 / CE
- Government Decision no. 856 2002 on the records of waste management
- Government Decision no 1061 2008 on the transport of hazardous and non-hazardous waste on the territory of Romania
- Order no 1362 2018 regarding the approval of the Procedure for authorization, annual approval and withdrawal of the right of operation of the organizations that implement the obligations regarding the extended liability of the producer
- Law on sanitation services for localities no 101 2006. [7]

6. Statistical data

Romania produces 5.8 million tonnes of waste per year, with an average of 272 kilograms per year per capita and with a collection rate of only 82.3% (as Waste Atlas study shows). Of the total waste, 56% is organic matter, 9.9% paper and cardboard, another 9.9% represents plastic waste, 4% glass, 2.3% metal and 17.8% other types of waste. Romania recycles only 3%, followed by Bulgaria with a recycling rate of 0%. The collection rate of Romania is 82.3%, followed by Bulgaria with 81% and Estonia 79%.

Of the total 5.8 million tons of waste per year, only Bucharest is responsible for producing 709,720 tons per year, with an average of 375kg per capita.

Table 1: Amount of waste in different countries [9]

Countries	Amount of waste produced		Recycling rate %	Collection rate %
	tons / year	Kg / inhabitant		
Germany	50.5 mil	617	47	100
Slovenia	852.075	414	55	100
Sweden	4.3 mil	458	33	100
Denmark	4.1 mil	747	28	100

The figures on the amount of waste per capita mentioned nationally in the Waste Atlas are similar to those reported by Eurostat for 2016, of 261 kg.

The EU Member State that produces the largest amount of waste is Germany, with a figure of 50.5 million tonnes per year and 617 kg per capita. However, Germany also has the second highest recycling rate of 47%, plus a collection rate of 100%.

Slovenia is the EU Member State with the highest percentage of recycled waste, 55%, plus a collection rate of 100%. However, Slovenia produces only 852,075 tonnes of waste per year, with 414 kg per capita. Sweden produces 4.3 million tonnes per year, i.e. 458 kg per capita, but also has a recycling rate of 33%, plus a collection rate of 100%.

According to the number of inhabitants, Denmark has the highest rate of waste per capita, of 747 kg per year, which amounts to 4.1 million tonnes per year. It also has a collection rate of 100% and a recycling rate of 28%.

Also, worth mentioning are the United Kingdom, which has a recycling rate of 28% at a total amount of 30.7 million tonnes per year, the Netherlands and Austria - both with a recycling rate of 24% - or Italy with 26%.

Table 2: Evolution of waste generation [8]

Residence environment	Generation indicator (kg / inhabitant / day)				
	2015	2016	2017	2018	2019
Urban	0.66	0.66	0.65	0.65	0.64
Rural	0.31	0.31	0.30	0.30	0.29

Table 3: Amounts of municipal waste at national level [8]

Types of municipal waste	Quantity (tonnes / year)				
	2015	2016	2017	2018	2019
Domestic waste mixed and separated	3615166	3598678	3586583	3506695	3498851
Assimilable waste collected in the mix and separately	903791	899670	896646	876674	874713
Waste from gardens and parks	97400	97400	97400	97400	97400
Waste from markets	71800	71800	71800	71800	71800
Waste from the street	336800	336800	336800	336800	336800
Total of municipal waste	5024957	5004348	4989229	4889369	4879563
Indicators for municipal waste generation (kg/loc x an)	253	253	253	248	248

Table 4: Composition of household waste and assimilation [8]

Types of waste	Ratio (%)				
	2015	2016	2017	2018	2019
Paper and cardboard	11.9	11.9	11.9	12.0	12.2
Metals	2.7	2.7	2.7	1.8	2.0
Plastic	11.7	11.7	11.7	11.5	11.3

Glass	5.1	5.1	5.1	5.0	5.0
Wood	2.2	2.2	2.2	2.5	2.5
Bio-waste	57.9	57.9	57.9	57.5	57.0
Textiles	0.9	0.9	0.9	1.0	1.0
High Volume	0.9	0.9	0.9	2.0	2.2
Other Waste	6.7	6.7	6.7	6.7	6.8

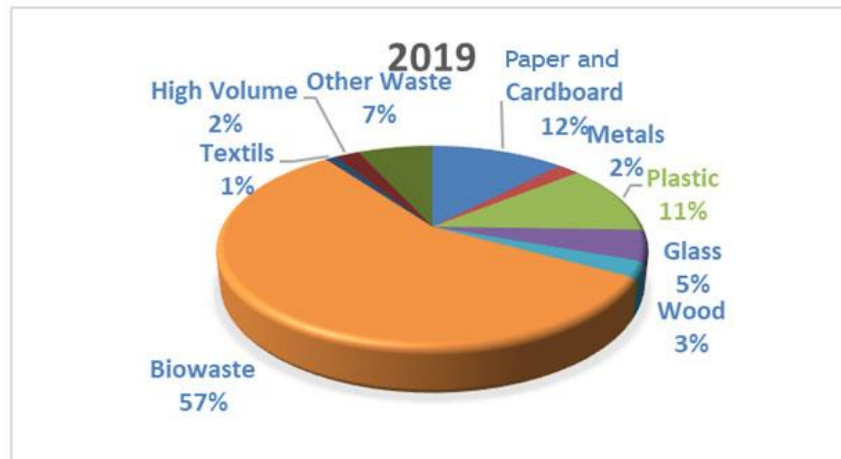


Fig. 6. Waste collection weight at national level [8]

7. Conclusions

In the socio-economic systems, the largest share of waste was and continues to be considered unusable, the main concern related to their management being the identification of disposal solutions. Waste management is based on the four major principles (prevention, recycling, recovery and disposal), which must lead to the continuous improvement of the quality of life for present and future generations, by creating sustainable communities, capable of managing and using resources in a way efficient and to harness the potential of ecological and social invocation of the economy, in order to ensure environmental protection and social cohesion.

The selective collection of waste at the locality level, regardless of its type and the methods of waste disposal by incineration so as to obtain thermal energy that can be used for heating the houses or for heating the domestic water leads to a successful recycling of the domestic waste.

As a member state of the European Union, Romania has to meet, by 2020, according to European directives, the following objectives: minimum 50% rate of reuse and recycling from the total mass of the quantities of waste (paper, metal, plastic and glass), minimum 70% level of preparation for reuse, recycling and other material recovery operations of minimum 70% by mass of non-hazardous waste from construction and demolition activities, 60% recovery of packaging waste from total packaging introduced on the national market. Also, our country will have to reach, annually, a collected quantity of electronic waste of 4 kg / inhabitant and to collect separately the bio-waste in order to compost and ferment them.

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