

THE WASTE RECYCLING IN ROMANIA

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Abstract

The paper approached an actual subject, "Waste recycling in Romania", an important topic in terms of increased quality of life, so superficially treated for methodological and procedural aspects. Essentially, the mismanagement of waste is an important cause concerning the pollution of environment and threats to human health, and at the same time it reflects the inefficient way of the usage of natural resources. One of the greatest risks for people is represented by ineffective and irresponsible collection and recycling of solid waste which pollutes the environment. The waste management technologies like land filling and incineration do not represent a complete solution for solving the existing problems. The organizations should continuously improve the manufacturing and using of waste. Additionally, in order to protect the environment it is necessary to eliminate waste or to transform waste into useful products. At the same time, it may be required to review the identification of waste. The framework regarding waste elimination contains three consecutive phases: waste documentation, waste analysis, and waste removal. In this paper, waste elimination is the main approached aspect to ensure that the manufacturing sector progresses towards efficient production processes and a hazard-free workplace environment.

Key words: environmental issues, pollution, waste, waste management, waste recycling, waste recycling within the European Directive

INTRODUCTION

It is now a common place to say that today's lifestyle generates constant current problems including environmental incidents mostly due to the large amount of packages that are to be recycled. It should be noted from the beginning that wastes, containing a significant proportion of materials and raw materials that can be reintroduced and recycled into the economic circuit and thus used in various manufacturing processes. Additionally, it should be noted that a significant share of the whole quantity of waste is represented by non-biodegradable materials (plastic, glass, metal, etc.) that were considered by European legislation as agents of soil pollution and contaminants that are to be eliminated. *"Everyday waste consists of 45% food waste, 24% plastic, 7% paper and 6% iron. Approximately 95-97% of waste collected is taken to landfill for disposals. Wastes which Remain are sent to small incineration plants, or diverted to recyclers/re-processors or is dumped illegally. Actually, only 5% of waste is*

recycled, however the government aims to reach a ceiling of 22% in terms of waste recycled by 2020". (Malaysia Environment-Current issues-Geography, 2010) [13].

Recent studies show that *"our earth suffers from many environmental problems which need to be addressed and tackled at an individual level, requiring individuals to develop those attitudes which will guide them to environmentally supportive behaviour". (Ahmed & Mohammed Al-Mekhlafi, 2009) [1].* Given these considerations briefly established, we intend to describe the approach to waste management aiming at developing strategies/actions and to improving environmental systems in the urban areas.

The good practice we teach is that the best strategy for guaranteeing high standards of waste is to separate at collection in new developments and restoration areas e.g. *"at door-to-door waste collection".*

The applicable regulations in the construction it can be identified and recognized that the criteria for dimensioning the space to be

reserved for waste collection, both at the apartment and at the block and urban sites.

In all countries is necessary for a solid waste management protocol for the proper valuation of waste such as the discovery of specialized researchers indicating that "reliable waste management data provides an all-inclusive resource for a comprehensive, critical and informative evaluation of waste management options in all waste management programmes" (Chang and Davila, 2008). "Unfortunately, these required fundamental statistics are lacking in many developing countries" (Buenrostro et al., 2001) [3] and where available, "they are inconsistent due to the fact that they come from many sources in which cannot be validated and are sometimes based on assumptions and not specific and scientific measurements". (Couth and Trois, 2011, IPCC, 2006 and Ranjith, 2012) [7, 12, 17].

The current classification of waste is realized via the legislative framework to specific industries and indicates the desirability scale in waste management from a feature perspective. "EU Waste Framework Directive defines the different types of waste processing and provides a view to desirability of the different strategies along with definitions of their meaning for industry". (Conroy et al., 2006, Council directive, 2008/98 and Pickering, 2006) [5, 6, 16].

It additionally shows that "current waste management practices in relation to composites are dominated by landfilling" (WRAP, 2013) [19], "which still is a relatively inexpensive option for industry in comparison to alternatives. However, it is the least preferred option according to legislation" (Council Directive 2008/98/EC) [5].

Moreover, exists the specialist views that "it has also been recognised that landfilling will become unviable for industries mainly due to legislation-driven cost of disposal increase" (Pickering, 2006) [16]. From another perspective, "from 1998 the standard landfilling rate has increased from £7 per tonne to £64 per tonne in 2012 on average increasing £4 annually. From 2013 that annual increase has risen to £8, making the 2014 landfilling rate to be £80/tonne and in

2015 it is declared to be 82,60/tonne" (HM Revenue and Customs, 2015) [11].

Although, the management of waste recycling continues to improve in the EU, the European economy still loses a significant amount of potential "secondary raw materials" (metals, wood, glass, paper, plastics). Total waste production in the EU, in 2010 amounted to 2.5 billion tons. From this total only a limited share (36%) was recycled, with the rest landfilled or burned, of which could be some 600 million tons recycled or reused.

Regarding waste it was established that "each person in Europe is currently producing, on average, half of tonne of such waste. Only 40 % of it is reused or recycled and in some countries more than 80% still goes to landfill". (Environmental Data Centre on Waste, Eurostat) [8].

An effective waste management programme would result in an improved quality of life, reducing the negative impact on human health and the environment, reducing emissions of greenhouse gases (directly by reducing emissions from landfills and indirectly through materials that would otherwise be extracted and processed for recycling), as well as a significant reduction in the damage to the natural environment.

Recently, introduced in the literature that an interesting definition defines "recycling as the practice of sorting out, collecting, remanufacturing or converting of waste products into new materials. The process involves a series of steps to produce new products. Waste recycling plays vital roles such as reducing the utilization of raw materials, energy convention and air pollution". (Moore, 2008) [14].

Moreover, it is a key constituent of modern waste reduction. Researchers affirm that "waste recycling helps in extending the life and usefulness of products that have served their initial purpose by producing numerous items that are useable" (Baud, Johan, & Furedy, 2004) [2].

Nowadays, the main concern of policy makers regarding the issue of waste (biodegradable waste) is represents by the production of methane from such waste decomposing in landfills, which accounted for some 3% of

total greenhouse gas emissions in the EU-15 in 1995. The Landfill Directive (1999/31/EC) obliges Member States to reduce the amount of biodegradable municipal waste that they landfill to 35% of 1995 levels by 2016 (for some countries by 2020) which will significantly reduce this case.

MATERIALS AND METHODS

The purpose of this research is waste elimination as the manufacturing sector to progress towards efficient production processes and a hazard-free workplace environment.

It is based on literature in the field and the ideas belong the authors who synthesized the main aspects in a critical manner.

RESULTS AND DISCUSSIONS

(1) The management of environmental issues

From an economic point of view, recycling is more attractive than the production of primary resources, also due to the allocation of costs and the negligence of external costs of materials production and waste management. But, when low-cost mass production techniques reduced the costs of materials and products since the industrial revolution, you see a decreasing attention for recycling, as it became economically less attractive.

This article presents the role of recycling in full change as part of waste management, beginning with experts in the field followed by concepts in relation to recycling as a significant key and an integral part of modern waste management.

Waste goes through specific processes from collection to recycling or disposal. Thus, *"together they make up the overall waste treated in the European Union (at 4.6 tonnes per capita in 2012)"* (European Union, 2015). Waste streams can be divided into two broad types: streams made of materials (such as metals or plastics) or streams made of certain products (for example electronic waste or end-of-life vehicles) which require specific treatment and ultimately feed into materials-related streams. Reports suggest that the new legislative proposal on waste to be tabled by

the European Commission by the end of 2015, as part of the new "circular economy" package, is likely to focus on individual materials. Each waste stream has its specific characteristics and applicable legislation, including in terms of treatment method, hazardousness, practical recovery and recycling possibilities. Broadly, a set of general principles apply across waste streams. Waste streams can be divided into two main categories: material-related streams (including metals; glass; paper and cardboard; plastics; wood; rubber; textiles; bio-waste) and product-related streams (including packaging; electronic waste; batteries and accumulators; end-of-life vehicles; mining, construction and demolition waste). A number of aspects need to be considered in assessing different waste streams: sources of waste to be treated and uses of treated waste; applicable recycling and recovery methods; specific opportunities and challenges, in particular related to recycling; and applicable European Union legislation and its implementation. Therewith, the negative effects on the environment are made through the using and processing of raw materials.

However, some technologies can contribute to reducing negative effects on the environment additionally they also have a positive economical effect. For example, one of these processes is to recycle waste. The process for conversion of materials into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, energy usage, air pollution and water pollution by reducing the need for "conventional" waste disposal is **recycling**.

However, recycling of waste quantities can be considered a process with multiple beneficial effects that reduces their accumulation in landfills, resulting in a space which can be used for purposes beneficial to the environment. The countries from Europe are dependent on imports of raw materials that is precisely why, recycling provides alternatives for EU industries which can be used for various types of waste, such as glass, paper, plastic and metals, as well as precious metals from used electronic appliances. Since there exists a European legislative framework in the

field of recycling of waste, it may indicate that they are intended to ensure that waste is used as raw material for making other new products. Recycling promotes energy saving in which transforms the recycling of a material of aluminium which saves approximate 95% of energy needed to produce a new product from raw materials.

A. European Directives on Waste Management

a. Waste Framework Directive 2008/98/EC sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling, recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and by-products. The Directive lays down some basic waste management principles: it requires that waste be managed without endangering human health and harming the environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest. The main features of waste management that must be taken into account, figure 1: (i) *waste prevention*, by application of "clean technologies" in waste generating activities; (ii) *reduction of waste quantities*, by implementing best practices in every day waste generating activity; (iii) *valorification*, by reuse, material recycling and energy recovery; (iv) *disposal*, by incineration and landfill.

This Directive introduces the "*polluter pays principle*" and the "*extended producer responsibility*". It incorporates provisions on hazardous waste and waste oils (old Directives on hazardous waste and waste oils being repealed with the effect from 12 December 2010), and includes two new recycling and recovery targets to be achieved by 2020: 50%.

Preparing for re-use and recycling of certain waste materials from households and other origins similar to households, and 70% preparing for re-use, recycling and other recovery of construction and demolition waste.

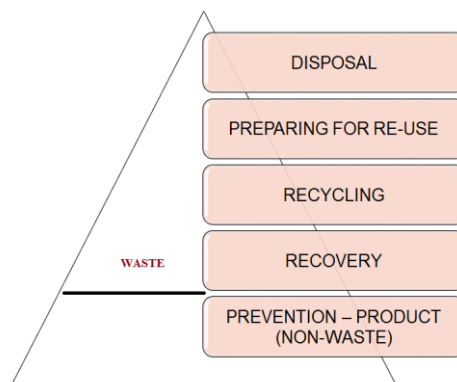


Fig. 1. Waste recycling [18]

b. Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on incineration of waste the European Union imposes strict operating conditions and technical requirements on waste incineration plants and waste co-incineration plants to prevent or reduce air, water and soil pollution caused by the incineration or co-incineration of waste. And emission limits are introduced for certain pollutants released to air or to water.

c. The Landfill Directive

Council Directive 1999/31/EC on the landfill of waste (the Landfill Directive) was agreed in Europe at Council on 26 April 1999 and came into force in the EU on 16 July 1999. The Directive aims to harmonise controls on the landfill of waste throughout the European Union, and its main focus is to achieve common standards for the design, operation, and aftercare of landfill sites. It also aims to reduce the amount of methane, a powerful greenhouse gas, emitted from landfill sites.

B. Specific responsibilities on the waste

The issue of responsibility on waste implies an inherent hierarchy from individual and family responsibilities at the institutional, legal and community. Generally speaking all have to take our responsibilities regarding waste recycling. Additionally, it is important to understand that as the quantity of waste increases, there is also an accumulation of effects, some of which are evil due to lead to pollution and decrease in comfort, others such beneficial as it creates a natural source raw materials and recyclable materials. It is also

essential to have clarity regarding the action of factors acting as producers of waste. Therefore, legislation on waste management clearly imposes certain responsibilities incumbent upon the waste producer but what of processing such material. If reference is made at the Guidance about "Waste Management: The Duty of Care - A Code of Practice" can be defined for the producer such as: (i) *"the person who made the substance become waste e.g. by breaking or contaminating it"*; (ii) *"the person who decided that a substance was unwanted and therefore waste"*.

(2)Waste recycling

2.1. Types of waste

The waste could be liquid or solid waste, however both of them could be hazardous for the environment. Also, these waste types can also be grouped into organic, re-usable and recyclable waste. Further, waste could be divided into the following types: (i) **liquid waste** can come in non-solid form and some solid waste can also be converted to a liquid waste form for disposal. It includes point source and non-point source discharges such as storm water and wastewater. For example, include wash water from homes, liquids used for cleaning in industries and waste detergents; (ii) **solid type** is represents through any garbage, refuse or rubbish that we make in different places. For example, old car tires, old newspapers, broken furniture and even food waste. They may include any waste that is non-liquid; (iii) **hazardous waste** potentially threaten public health or the environment, besides this waste could be **inflammable**, **reactive** (can explode), **corrosive** (can eat through metal) or **toxic** (poisonous to human and animals). The law on waste from different countries must involve the competent environmental authorities to supervise disposal of hazardous waste and can be included as examples fire extinguishers, old propane tanks, pesticides, mercury-containing equipment, lamps and batteries; (iv) **organic waste** derived from plants or animals sources. Thus, identified waste as a food waste, fruit and vegetable peels, flower trimmings and other. Additionally, these wastes are biodegradable

materials and therefore people turn their organic waste into compost and use them in their gardens.

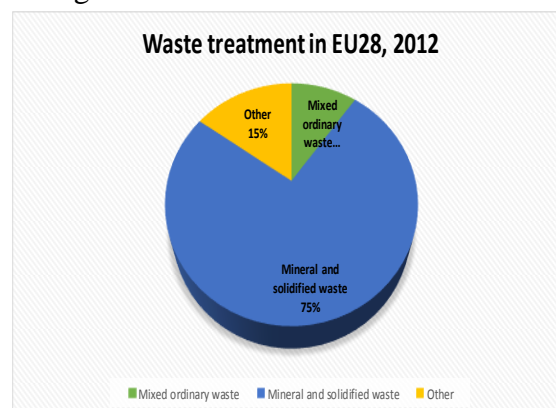


Fig. 2. Waste treatment in EU28, 2012 [9]

2.2.Importance and benefits of waste recycling

According to experts it can be stated that *"the first benefit of waste recycling is that it creates job opportunities for many people involved in the waste management process such as waste collectors"* (Baud, Johan, & Furedy, 2004) [2].

The importance of recycling is a theme that no longer needs to be demonstrated. In terms of purely economic process itself is generating profits and lead to saving natural resources. Thus, we should reuse metal items because they degrade over a long period. Recycling of materials from metal can be carried out by re-selling to specialized companies. As mentioned previously, recycling of waste papers can save our forests. Recycling is a benefit to the environment and the population thus it: (i) *Helps protect the environment via* recyclable waste materials in which would have been burned or ended up in the landfill. Pollution of the air, land, water and soil is reduced. (ii) *Conserves natural resources*, for example recycling more waste means that we do not depend too much on raw (natural) resources, which are already massively depleted. (iii) *It Saves energy*: it takes more energy to produce items with raw materials than from recycling used materials. This means we are more energy efficient and the prices of products can be significantly reduced. *"This has various benefits and advantages such as more taxes and revenues*

to the city or state governments, production of affordable and durable goods, clean and healthy environment, clean water, and fresh air to breathe. To sum it up, waste recycling leads to a healthier economy for all concerned” (Moore, 2008) [14].

Recycling requires much less energy and therefore helps to preserve natural resources.

(3) Recycling of waste in Romania

"According to data gathered by the European Commission, 92% of this total in 2006 was deposited as before, i.e. by collecting waste in landfills. Then, the percentage began to decline from 81% in 2007 and 76% in 2008" (EC, 2012) [9]. But "the percentage recorded in 2009 was only 75%" (NEPA-ANPA, 2010) [15] indicating an early rise proposed objective for 2010.

Several factors modify Romanian waste management. Increasing the amount of waste plastics simultaneously decreasing the storage of waste is the main problem. The plastic products are, in our country, growing at a rate of 15% per year.

The Ministry of Environment developed the National Waste Management Strategy, with the main purpose to create the necessary framework for the development and implementation of an environmentally and economically sound integrated waste management system.

Waste collection and recycling is a success business in Romania. Investments in equipment which are not currently encouraged only by the availability of EU funds but is, equally, a necessity given the lack of capacity to meet EU recycling by 2017. The companies invested significant amounts in waste recycling in Romania, especially in equipment, transport machines and installations.

Romania still has fixed the issues concerning waste recycling, although it is better situated than other states, Table 1.

Companies focus on the development of solutions in accordance with European legal framework in order to avoid landfills that are poorly managed and producing adverse effects on the environment.

The big companies specializing in waste recycling comply with the legislation in force

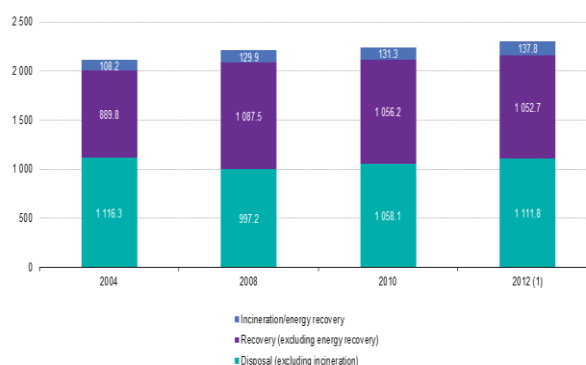
and looking for ways to be efficient and environmentally friendly, so that they can be closed illegal landfills.

Table 1. Waste Landfilled and Incinerated

Country	Landfilled waste (kg/capita/year)	Country	Incinerated waste (kg/capita/year)
Germany	3	Bulgaria	0
Netherlands	14	Romania	0
Belgium	21	Poland	1
Sweden	21	Czech Republic	36
Austria	86	Hungary	38
France	185	Great Britain	53
Poland	239	Italy	67
Czech Republic	243	Belgium	162
Romania	284	Austria	180
Italy	286	Germany	192
Great Britain	324	France	194
Hungary	341	Netherlands	200
Bulgaria	388	Sweden	240

Source: Eurostat, 2009 [10]. (Online), Available at: <http://epp.eurostat.ec.europa.eu>

The companies hereby set up for that it takes of a better waste management and alignment to standards imposed on the amount of materials that must be recycled per capita. In Romania, the waste has been stored in mines, industrial plants and military and therefore resulted in a significant amount of radioactive waste, chemical weapons, rocket fuel and other hazardous toxic.



(1) Eurostat estimates.

Fig. 3. Comparing the amount of waste incinerated/recovered / disposal

Source Eurostat, 2015, http://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_statistics

Unfortunately, besides the big cities were deposited municipal waste which not complying environmental legislation and

hygiene provisions. However, our country has implemented the along during a series of reforms in determining compliance with European directives imposed by the European Union.

One can see from Fig.3, the difference between the analyzed years in Eurostat estimates 2004, 2008, 2010, 2012 and in the last year, the amount of waste was recovered and reused in industry and agriculture.

(4) Innovative ideas regarding the waste recycling

The *anaerobic digestion* provides an innovative and useful solution through which gases from organic waste is converted into energy. Degradation of waste material using microorganisms in a particular environment. Its use is in the treatment of organic solid waste and wastewater. The remaining material in the vessel may act as a fertilizer for plants, and biogas from energy turns.

Another innovative method for recycling a *waste to energy* is, that energy from waste is a complex method. However, this has the advantage that it can eliminate waste faster than other processes.

Organic materials can turn into a gas (carbon monoxide and hydrogen) through *gasification and plasma arc gasification*. And the resulting gas is burned to produce electricity and steam. Waste disappear completely, and the gas is converted into energy.

An innovation in European countries can be defined by The Zero Waste International Alliance as: "*Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use. Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health*".

Also, the WEEE (waste electrical and electronic equipment) is a revolutionary

method in recycling, but very expensive. However, waste electrical and electronic equipment in the EU has a rapid growth. If treatment is properly applied, then it can provide significant effects on the environment and human health.

CONCLUSIONS

In conclusion, the process of recycling is essential both in terms of maintaining a healthy natural environment and for improving indicators on the quality of life and public health.

Recycling waste can be considered as the cornerstone of the entire environmental issues, including giving it some solutions on the conservation of natural resources and energy, and in terms of maintaining a healthy and unpolluted environment in all aspects.

At the same time, it can keep part of the present natural resources at our disposal to aid recycling.

In this context, Romania has recovered a large gap with the advanced European countries, both in terms of legal framework and especially, behaviours and attitudes that are to be improved and adjusted to European practice in the field.

REFERENCES

- [1] Ahmed bin Hamad Al-Rabaani, Mohammed Al-Mekhlafi, S.S, 2009, Attitudes of Sultan Qaboos university students towards some environmental problems and their willingness to take action to reduce them. *Journal of Social Sciences*, 5(1): 9-15
- [2] Baud, I., Johan, P., Furedy, C., 2004, Solid waste management and recycling: Actors, partnerships and policies in Hyderabad, India and Nairobi, Kenya. London: Springer.
- [3] Buenrostro-Delgado, O., 2001, Municipal Solid Waste: Perspectives from a Multidisciplinary Research. Universidad Michoacana de San Nicolas de Hidalgo, Mexico
- [4] Chang, N.B., Davila, E., 2008, Municipal solid waste characterization and management strategies for the Lower Rio Grande Valley, Texas, *Waste Management*, 28 (2008), pp. 776–794
- [5] Council Directive 2008/98/EC <http://ec.europa.eu/environment/waste/framework/>
- [6] Conroy, A., Halliwell, S., Reynolds, T., 2006, Composite recycling in the construction industry. Composites Part A: Applied Science and

Manufacturing Volume 37(8)August 2006, pp. 1216-1222

[7]Couth and Trois, 2011, R. Couth, C. Trois, Waste management activities and carbon emissions in Africa, Waste Manage., 31 (1)2011, pp. 131–137

[8]Environmental Data Centre on Waste, Eurostat <http://ec.europa.eu/eurostat/web/waste>;

[9]EC, 2012;

http://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_generation_and_landfilling_indicators

[10]Eurostat, 2009, <http://epp.eurostat.ec.europa.eu>;

[11]HM Revenue and Customs, (2015), <https://www.gov.uk/government/publications/hmrc-exchange-rates-for-2015-monthly>

[12]IPCC, 2006, Guidelines for Greenhouse Gas Inventories. Intergovernmental Panel on Climate Change,

<http://www.ipccnggip.iges.or.jp/public/2006gl/index.html>>(Retrieved 23.03.15)

[13]Malaysia Environment-Current issues-Geography, 2010, (on line)

[14]Moore, C., 2008, Synthetic polymers in the marine environment: A rapidly increasing, long-term threat. Environmental Research, 131-139

[15]NEPA, 2010

https://ceq.doe.gov/current_developments/new_ceq_nepa_guidance.html

[16]Pickering, S.J., 2006, Recycling Technologies for Thermoset Composite Materials—Current Status. Composites Part A: Applied Science and Manufacturing, 37, 1206-1215. <http://dx.doi.org/10.1016/j.compositesa.2005.05.030>.

[17]Ranjith, 2012, Ranjith, K.A., 2012, Sustainable solid waste management in India, A thesis submitted to the Department of Earth and Environmental Engineering, in partial fulfillment of the requirement for the degree of MSc in Earth Resource Engineering, Fu Foundation School of Engineering and Applied Science, Columbia University

[18]Waste Management: The Duty of Care - A Code of Practice, 2014,

<https://www.doeni.gov.uk/sites/default/files/publications/doe/waste-policy-duty-of-care-code-of-practice-2014.pdf>

[19]WRAP, 2013,

<http://www.wrap.org.uk/content/bring-recycling-guide>