

Plastic Packing Management and Recycling

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Abstract: This paper analyzes plastic packaging recycling current situation and legislative in European Union and Republic of Serbia. In the majority of the member states, the European Packaging Directive 94/62/EC and its amendments in 2004 and 2005 have been implemented in systems featuring producer responsibility. Development of Packaging Waste Management in Republic of Serbia is in its initial phase, Packaging Waste Legislation entered into force. Serbian Law on Packaging and Packaging Waste Management supports Producer Responsibility System, therefore obligated persons (producer, importer, packer/filler, distributor) are responsible for meeting annual recycling targets in Republic of Serbia.

Keywords: Recycling, Plastic packaging, Waste

1. INTRODUCTION

Plastic materials have replaced many conventional materials such as wood, metal, glass, leather, paper, etc. Plastics have low density, they are corrosion resistant, stable, easy for processing and have good isolating features. Plastics are still cheaper than conventional materials.

Plastic materials are commercialized during Second World War. Its annual production extremely expanded from 1 million tons (1939) to more than 250 million tons (2005) and is still expanding. Annual plastic use increase in Europe is 3-5%, while plastic use increase in construction is even higher, around 7 to 10%.

Recycling technologies are part of sustainable development. There are many definitions of sustainable development but one of the most important was defined by the World Commission on Environment and Development "Brundtland Commission" (1987): Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet

their own needs. There is example of end of life vehicles recycling in the paper [4] which is analyzed in terms of sustainable development and life quality indicators.

Plastic recycling has many advantages in comparison with other waste management methods, such as disposal and incineration.

Since plastic material production is growing there is more plastic waste every year as well. Plastic waste quantities and low biodegradability are harmful to the environment. Wastes of plastic materials end up in landfills, incinerators and oceans, although it can be used as cheap raw material.

Degradation period of plastic waste is very long and can be from 100 to 1000 years. Plastic waste is 10% of all waste by weight and 30% by volume because of its low density.

Incineration of plastic wastes results in toxic gases, dioxins and heavy metals emission, and ash obtained is toxic as well, therefore should be deposited in hazardous waste landfill. These facts lead us to conclusion that plastic incineration with all necessary treatments of hazardous by-products is expensive.

Plastic materials are obtained by processing crude oil, which is increasingly expensive and disappears. In addition, during production of plastic materials large amounts of carbon dioxide are emitted into the atmosphere. For example, during production of one kilogram of polyethylene, two kilograms of carbon dioxide are emitted into the atmosphere.

Plastic recycling results in reducing the amount of deposited plastic waste, in the less production of harmful gases, as well as less energy consumption in the production of end products compared to traditional manufacturing.

Recycling of plastic waste is of great importance in the Republic of Serbia, because it is mostly deposited in the official landfills, which are not sanitary, and illegal dumps, leading to the occupation and pollution of agricultural land and groundwater pollution. Both resources are among the most important natural resources of the Republic of Serbia.

2. PLASTIC PACKAGING

According to the Serbian Law on Packaging and Packaging Waste, packaging is product made of different materials and is used for proof closure, preparation for shipping and marking of goods. environment and people from the harmful effects of products. One of the most common use of plastics is in packaging purposes because it is lightweight, durable and resistant to cracking and moisture. Packaging protects the product from a variety of mechanical, chemical and microbiological influences, but also packaging is protecting the accommodation, storage, handling, delivery, presentation of goods and protection of its contents, and includes items that are used as auxiliaries for packaging, wrapping, binding, etc.

Figure 1 shows the consumption of

certain materials in the packaging sector. 53% of all goods are packed in the plastic packaging, twice more than in paper packaging. Figure 2 shows the mass consumption of plastics by sector in Western Europe. The largest consumer of plastic is packaging sector with a share of 35%.

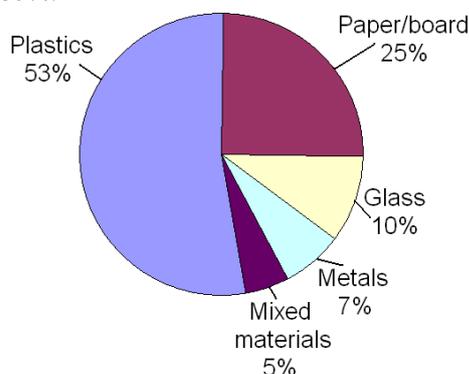


Figure 1 - The percentage of goods that are packed in certain packaging materials [11]

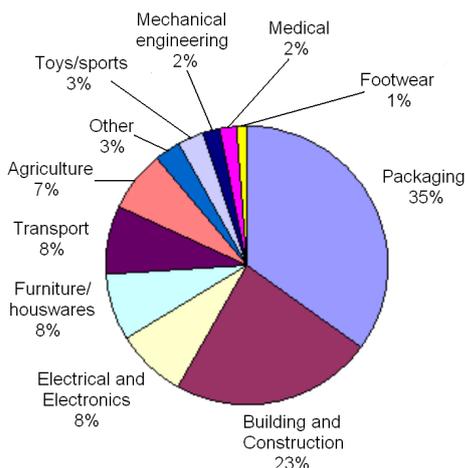


Figure 2 - Consumption of plastics by sector [12]

Table 1 shows the numerical labels and abbreviations for plastic packaging according to Serbian Regulation on the manner of numbering, abbreviations and symbols which the system of identification and marking of packaging materials is based on.

Material	Abbreviation	Numerical label
Polyethylene terephthalate	PET	1
High-density polyethylene	HDPE	2
Polyvinyl chloride	PVC	3
Low density polyethylene	LDPE	4
Polypropylene	PP	5
Polystyrene	PS	6

Table 1-The numerical labels and abbreviations for plastics

3. PLASTIC PACKAGING RECYCLING IN EUROPEAN UNION

In recent years, plastics are becoming crucial for technology development. Although it seems less than 1% of the total waste produced in western Europe, the EU has focused on plastics recycling and reuse in different sectors: packaging, automotive and electrical and electronic appliances.[15]

The EU Directive on Packaging and Packaging Waste (94/62/EEC) is introduced in 1994. Directive covers all packaging that circulates in the market of the Member States and all packaging waste regardless of whether it is used or dropped in industrial, commercial, residential or any other level, regardless of the material used. [13]

Recycling targets for the first five-year period, i.e. till 30 June 2001 set by the Directive on Packaging were: between 25 % as a minimum and 45 % as a maximum by weight of the totality of packaging materials contained in packaging waste will be recycled with a minimum of 15% by weight for each packaging material.

Targets for recycling for the second five-year period, which should have been fulfilled by the end of 2008 are: between 55 % as a minimum and 80 % as a maximum by weight of packaging waste

will be recycled. The plastic contained in the waste package should be recycled at least 22.5% by weight.

Directive 2005/20/EC complements the Directive on Packaging Waste in terms of setting a later deadline for the 10 new EU member states (Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovakia) by 31 December 2012 at the latest.

Directive on Packaging and Packaging Waste (94/62/EC) and its amendments in 2004 and 2005 was generally implemented properly and recycling goals are generally achieved.

Majority of EU member states have a special entity which is in charge of the environment, therefore it is in charge of waste management policy as well. The responsibilities of local authorities are to implement policy, and apply adopted regulations. Some regulations that are not adopted at the national level can be made within local authorities jurisdiction. [16]

In the EU member states obligated persons (producer, importer, packer/filler, distributor) often have the choice to organize recycling of packaging waste themselves or to pay state fees for recycling.

3.1. Green Dot System

Green Dot System is a system of environmental labeling type II according to ISO 14020. Green Dot Symbol indicates that the financing of collection, sorting and/or recovery of waste package is provided by the packaging manufacturers.



Figure 3 - Green Dot Symbol

In most EU member states Directive 94/62/EC on packaging and its

amendments in 2004 and 2005 was applied by Producer Responsibility System. More than 136,000 companies are incorporated in the funding of recycling and more than 300 million people in Europe sort their packaging waste within the system of collecting, primarily Green Dot System [14].

All Green Dot Systems have in common that actors who need to meet legal obligations in respect of packaging (packaging manufacturers, importers, fillers, packers, traders) founded the organization, which is in charge of fulfillment of obligations. Organization for recovery of packaging in Europe, Pro Europe (Packaging Recovery Organization s.p.r.l.) is responsible for issuing licenses to European manufacturers to use Green Dot logo. There are 33 members of Pro Europe organization. There is organization in each EU member state except Denmark which is member of Pro Europe Organization. The countries that are not EU members but have this kind of organization are Canada, Croatia, Iceland, Norway, Turkey, Ukraine and Serbia.

Under the auspices of the Pro Europe Organization all Green Dot Systems are working on the development of packaging recycling efficiency and simplification of goods trade at the international level.

4. PLASTIC PACKAGING LEGISLATIVE IN REPUBLIC OF SERBIA

According to the Law on Packaging and Packaging Waste („Službeni list RS“ br.36/09) management of packaging waste in the Republic of Serbia is regulated by the Law on Waste Management, the Law on Communal Activities and this Law. Some other regulations apply on packaging and packaging waste: for human safety and health, health safety of the packed products, as well as conditions for the transport of products.

Till entering Law on Waste Management („Službeni list RS“ br.36/09) into force on 23 May 2009, Law on Waste Materials Treatment („Službeni list RS“ br. 25/96) was in force, which only companies that produced waste, bound in the regulated use of the waste, but not specifically recycling.

Under the former Law on Waste Materials Treatment and Law on Communal Activities municipalities had the great competence to organize waste management themselves. According to the Law on Waste Management there are also a great number of duties assigned to local governments. Local government regulates the system and method of selection and collection of waste for recycling in accordance with a special program that, at the proposal of the Ministry, is determined by the Government. The restriction of competence of local governments depends on other laws and regulations, which are made or are to be made.

According to the Law on Waste Management polluters must pay the full cost of the consequences of their actions. Cost of waste creation, treatment and disposal must be included in the product price. This means that ultimately the cost of waste treatment, which includes recycling will be borne by the product buyer.

Law on Packaging and Packaging Waste supports the principle of producer responsibility, therefore the obligated persons (manufacturer, importer, packer/filler, distributors) are responsible for meeting recycling targets. Within one year from the date of entry into force of the Law on packaging, i.e. until 23 May 2010 obligated persons shall sign agreements with operators or obtain a license for its own management of packaging waste.

Regulation on the establishment of the Plan to reduce packaging waste for the period from 2010 until 2014 entered into force. There are only general goals for

recovery and recycling for the years 2010 and 2011. For the period 2012-2014 there are goals for the recycling of certain materials as well (Table 2). The question is how the objectives for the first two years

will be achieved, or if it is assumed that they have already been achieved remains to be proven, because accurate official data about recovery and recycling rates do not exist.

		General Targets				
		2010	2011	2012	2013	2014
Recovery	[%]	5.0	10.0	16.0	23.0	30.0
Recycling	[%]	4.0	8.0	13.0	19.0	25.0
		Specific Recycling Targets				
		2010	2011	2012	2013	2014
Paper/ cardboard	[%]	0.0	0.0	14.0	23.0	28.0
Plastic	[%]	0.0	0.0	7.5	9.0	10.5
Glass	[%]	0.0	0.0	7.0	10.0	15.0
Metal	[%]	0.0	0.0	9.5	13.5	18.5
Wood	[%]	0.0	0.0	2.0	4.5	7.0

Table 2- Recycling Targets for the period 2010-2014

Recycling targets for plastic packaging for years 2012, 2013 and 2014 are 7.5%, 9% and 10.5% respectively. In the European Union legislative recycling target for plastic packaging to be achieved till the end of 2008 was 22.5%, but for new EU members deadlines were delayed, and latest deadline is till the end of 2012. Member States successfully fulfilled plastic packaging recycling goals so far. Most EU members achieved 22.5% in 2006, which means that Serbia significantly lags behind the EU member states. On the other hand, too high recycling goals in the Republic of Serbia would lead to unstable situation in the market.

Figure 4 shows the Symbol for packaging that is recoverable by recycling according to Serbian Regulation on the manner of numbering, abbreviations and symbols which the system of identification and marking of packaging materials is based on.



Figure 4 - Symbol for packaging that is recoverable by recycling

Most of the necessary legal acts for the management of packaging and packaging waste came into force in Republic of Serbia. The Government should define the conditions for the exemption of fee paying. In most member states fee does not have to be paid if obligated persons directly or indirectly provide waste management in accordance with the regulations and achieve recycling targets. If recycling targets are partially met, part of fee has to be paid.

The Directive on the criteria for exemption from payment of duties on equipment that is used directly for environmental protection is adopted. According to Article 1 of the Directive the list of criteria for the release of legal and other persons from payment of import duties on equipment that is used directly for environmental protection are established. However, the Directive does not contain a list of criteria, only a list of equipment that comes into consideration for release, depending on the opinions of authorities, which are not listed as well. This equipment includes equipment for handling and treatment of waste.

The Ordinance on the amount and conditions for the award of incentive

funds, which refers to the reuse and recovery of waste as secondary raw materials or for energy production, is adopted. It applies only to waste tires, other types of waste are not included.

5. PLASTIC PACKAGING RECYCLING IN REPUBLIC OF SERBIA

The last and only national data on the composition and amount of waste are in the National Waste Management Strategy 2003 which is made by the Ministry for the protection of natural resources and environment. According to the survey (measurements on representative samples were not made) from 160 municipalities, waste production is estimated to 0.8 kg/capita/day in the Republic of Serbia. The percentage composition of the waste is not done. Individual municipal waste composition analyses were done by almost all municipalities, but there is no national recommended or approved methodology. [17]

On the basis of the performed analysis of experts from the GTZ (German Agency for Technical Cooperation) a proposal by the methodology that would match the Republic of Serbia is adopted. This methodology was used by ENE Center of the University of Novi Sad in research for the project "Determination of the composition and the amount estimation of waste in order to define strategy for secondary raw materials management within sustainable development of the Republic of Serbia".

Some of the results of this research are that the Republic of Serbia plastic packaging waste has share of 3.73% and plastic bags 5.61% of the municipal waste. According to the EU Directive on Packaging and Packaging Waste plastic packaging bags are considered plastic packaging as well. Plastic bags also fit into the definition of the packaging in the

Serbian Regulation on the criteria for determining what may be packaging. Therefore we come to the conclusion that plastic packaging waste (including plastic bags) has share of 9,34% (by weight) of the total municipal waste. [10]

Current waste management practices in the Republic of Serbia is mainly carried out at the bottom of the hierarchy, i.e. waste is disposed. Organized collection of waste by public utility companies were implemented in 60-70% of the population of the Republic of Serbia, that is about 5 million people. Public utility companies usually transport collected waste directly to inadequate landfill, where waste is thrown in an uncontrolled manner, without covering or compressing, or compliance with the minimum protection of public health.

Company	District	Settlement
Interhem company	Belgrade	Belgrade
3 R industrija	Belgrade	Belgrade
Go&Mac	Belgrade	Belgrade
Hemigum	Šumadija District	Bare
Reciklat	South Banat District	Plandište
Greentech	South Bačka District	Novi Sad
A+	Mačva District	Šabac
Empas	Morava District	G. Milanovac
Pima	Morava District	
Saltinženjerig	Morava District	Čačak
Nives	Niš District	Niš
N-Plast	Morava District	Jagodina
Grossit	Zlatibor District	Požega
Zlatar plast	Zlatibor District	Bistrica
T.R. Recycle	Pčinja District	Vranje
Ekoplast	Toplica District	Vladičin Han

Table 3 -Companies in the Republic of Serbia engaged in recycling of plastic packaging in 2008

According to data from the former Agency for recycling in the Republic of Serbia

about 15% of waste was recycled in 2008, while around 3% was recycled in 2003. In neighboring countries, the percentage is 15 to 40 or even 50%.

According to the database of the former Agency for recycling for 2008 there are 16 companies involved in recycling of plastic packaging in the Republic of Serbia (Table 3).

Lack of enforcement of the former Law on Waste Materials Treatment and too low penalties resulted in partial fulfillment of the obligations. Many waste holders have demanded "Certification on categorization of waste" since 2007, but after they have got it most of the waste holders have not reported on waste sorting and taking over waste.

In the Republic of Serbia 32 public utility companies (PUCs) separate certain waste at source. In recent years, the PUCs in many settlements have initiated selective collection of plastic packaging, mainly PET. The biggest motivation is to reduce the disposal of plastic waste that occupies a large volume of landfill and slowly decomposes. In the public utility companies additional separation and baling have been usually done. The companies sell bales, usually to private companies. Some of private companies are dealing with primary plastic recycling and some of them are dealing with the producing the end products as well. The most common practice is that baled or ground plastic are exported.

5.1 Regionalization of waste management

Large number of analysis come to the conclusion that the regional waste management is the most efficient solution. National Waste Strategy of Republic of Serbia also suggests this type of waste management. Foreign companies which participate in waste management in Serbia opt for regionalization. Regionalization of waste management in the Republic of

Serbia is in its initial phase. According to the National Waste Management Plan 29 regional landfills should be built, which would have several hundred thousand users. Usually there is facility for separation in the vicinity of a landfill, where is carried out further separation of certain types of wastes for recovery before disposal. The waste management regionalization includes the construction of regional recycling centers. [11]

Foreign investors who participate in the management of waste in the Republic of Serbia signed agreements to take over waste management in some municipalities in certain period or created partnerships with local public utility companies. In the municipalities where were established partnerships regional landfill were built or are to be built, the collection of waste with separation was established, the area of collecting waste was expanded, there have been investments in vehicles and containers. Signed contract did not include the construction of landfill in municipalities where taking over waste management is established. [17]

The regionalization in the public sector is slow, because municipalities are trying to keep the old system of waste management because of social reasons.

6. CONCLUSIONS

In the Republic of Serbia Law on Waste Management is imposing closing old landfills that are not sanitary and opening new sanitary landfills, where waste disposal will be much more expensive, especially for materials that slowly degrades and are often part of hazardous waste. The plastic packaging is one of them. Recycling of plastic packaging in the Republic of Serbia will become more profitable, and its development should start as soon as possible.

Law on Packaging and Packaging

Waste in the Republic of Serbia obliges obligated persons (producer, importer, packer/filler, distributor), end users, operators in the regulated management of packaging waste, including recycling, in the near future.

As most economic and most efficient packaging waste management model has proven to be one where the obligated persons (producer, importer, packer/filler, distributor) itself mostly through other organizations meet recycling targets for municipal and non-municipal waste. If it would be an option in the Republic of Serbia under optimal conditions (sufficiently long periods for obligation fulfillment, the existence of stimulation and appropriate penalties) obligated persons will probably choose that kind of waste managing. The recycling of plastic packaging would slightly increase the cost of the product if the system would be properly introduced according to the experiences of EU member states. Many major manufacturers of plastic packaging in the Republic of Serbia are part of multinational companies, whose representatives in other countries are already a part of such systems of waste management. Therefore transfer of know-how about packaging waste management to licensed manufacturers in the Republic

of Serbia would probably be intense.

In the Republic of Serbia in 2006 was established the association for the management of packaging and packaging waste, Sekopak Ltd. Sekopak is a member of Pro Europe organization since October 2009. It was founded by part of the Serbian Industry, which is involved in the production and packaging operations and aim at taking care of packaging waste in accordance with regulations.

Private, mainly foreign companies are interested in waste management in the Republic of Serbia. It is likely to be more and more municipalities to cooperate with the companies due to the difficult economic situation. The companies that are already involved in waste management in the Republic of Serbia are for many years involved in it in other countries. Their interest is to establish a regionalization as quickly as possible, because of faster return on capital. This way of waste management would quickly create the conditions for the establishment of recycling facilities.

Until the establishment of recycling facilities in the Republic of Serbia most of the plastic packaging waste will be exported.

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