

PLASTICS IN THE HOUSEHOLD WASTE

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ABSTRACT

The global population growth in the last decades has caused an ever increasing consumption of materials and natural resources, which consequently generated more solid waste, impacting negatively on the environment and requiring a sustainable waste management system. These discarded materials are mainly composed of plastics, glass, paper, metal and organic waste. Plastics are used in various sectors, and very often have a brief period of use, which accelerates their discard. Besides collection and recycling of PET-bottles, there are no significant activities of integrated plastics waste management in Republic of Croatia so far. In the paper, an investigation of the composition of the plastic household waste will be presented as well as several waste management strategies concerning amount and types of waste and its distribution.

Keywords: household waste, plastic waste, recovery, recycling

1. INTRODUCTION

Generally waste is any material or substance that is of no further use and has been discarded. If not properly managed, waste can cause pollution and adverse impacts on the environment. Disposing of waste that could be reused or recycled is often a waste of resources, a lost opportunity and a waste of money. [1]

Municipal waste, commonly known as trash or garbage, is a combination of all of a city's solid and semisolid waste. It includes mainly household or domestic waste, but it can also contain commercial and industrial waste with the exception of industrial hazardous waste (waste from industrial practices that causes a threat to human or environmental health). The types of trash that are included in municipal waste are: biodegradable waste (food and kitchen waste, yard or green waste, etc.), recyclable waste (paper, glass, plastic waste, metals and aluminum cans), inert waste (the waste that is not necessarily toxic to all species but can be harmful or toxic to humans, e.g. construction and demolition waste), composite waste (items that are composed of more than one material, e.g. clothing) and household hazardous waste (medicines, paint, batteries, light bulbs, fertilizer and pesticide containers and electronic waste like old computers, printers, and cellular phones). [2]

The system of collecting and recycling waste PET packaging in the Republic of Croatia was established in 2006 and has been functioning very well ever since. However, apart from PET bottles, in municipal solid waste there are also other types of plastic waste that could be recycled, and these include little bottles of cosmetic products (shampoos, shower-gels, cleaners, detergents, softeners, etc.).

2. ANALYSIS OF PLASTIC WASTE IN HOUSEHOLD WASTE

The most common composition of waste generated in the Croatian households is presented in Figure 1 which shows that the mass share of the plastic materials in the total waste accounts as little as 5% (our analysis of waste from households in Zagreb in 1994 showed that the plastics accounts for 7,3% of the total household waste). This results first of all from the fact that plastic materials are of relatively low

density compared to other materials. Therefore, this percentage is not to be neglected since in spite of low mass of plastic materials their volume share in the household waste is much greater.

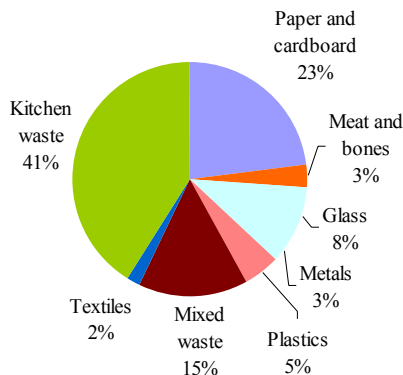


Figure 1. Composition of waste in Croatian households according to mass

An analysis was carried out regarding the quantity (kg) and type of plastic packaging waste (excluding PET bottles in the deposit-refund system) generated in a household during a 30-day period. Three households participated in the study. Household 1 consists of four members (one retired person, two employed persons, one student) located in a rural region. Household 2 includes also four members (two employed, two schoolchildren), living in an urban region. The third household has three members and consists of one retired and two employed persons living in rural environment.

For each single item of waste plastic packaging the type of thermoplastic stiffness (rigid – R, flexible – F) and its mass (g) (using a digital scales) have been determined. The data on total mass, number, and average mass of waste plastic packaging for every material have been presented in Table 1.

Mass shares of single types of plastic packaging materials for all households are presented in Figure 2. High-density polyethylene (HDPE) makes up the largest share, whilst poly(vinyl chloride) (PVC) and expanded polystyrene (EPS) the lowest.

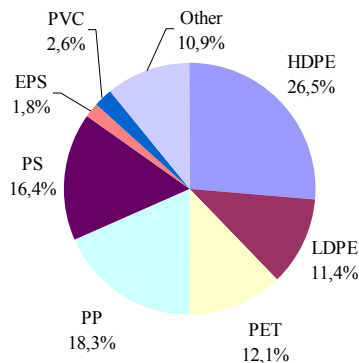


Figure 2. Mass shares of single plastic materials in households

Many factors influence the quantities of the collected waste plastic packaging. First of all, the number of household members (the household with 3 members collected the least plastic packaging), then the age of the members (in Household 2 two members are schoolchildren who as a rule produce larger amounts of plastic packaging waste), place of residence (Household 2 which collected most plastic packaging waste is located in urban environment, whereas Households 1 and 3 are in a rural area), etc.

Nevertheless, it may be concluded that monthly an average citizen collects from 0,5 to 1 kg of plastic packaging, i.e. 6 to 12 kg annually.

Table 1. Share of individual plastic materials in households during one-month period

Material	Data	Rigid plastic packaging	Flexible plastic packaging	Total
HDPE	Mass, g	1561	699	2260
	Pieces, no.	140	169	309
	Average, g	11,15	4,1	
LDPE	Mass, g	37	934	971
	Pieces, no.	3	104	107
	Average, g	12,3	9,0	
PET	Mass, g	1036	0	1036
	Pieces, no.	27	0	27
	Average, g	38,4		
PP	Mass, g	1430	164	1594
	Pieces, no.	53	41	94
	Average, g	27,0	4	
PS	Mass, g	1399	0	1399
	Pieces, no.	91	0	91
	Average, g	15,4		
EPS	Mass, g	151	0	151
	Pieces, no.	10	0	10
	Average, g	15,1		
PVC	Mass, g	220	1	221
	Pieces, no.	7	1	8
	Average, g	31,4	1	
Other	Mass, g	305	623	928
	Pieces, no.	54	90	144
	Average, g	5,6	6,9	
Total mass, g		6139	2421	8560
Total number of pieces		385	405	790
Total average, g		15,9	6,0	10,8
Average mass of collected plastic packaging waste per household member, g		558	220	778

3. RECOVERY OPTIONS OF PLASTIC WASTE

About 1,74 million tonnes of municipal waste was produced in the Republic of Croatia in 2009. Most waste ends up in landfill sites; 13% of household waste is currently separately collected; but only 18,6% of this separately collected waste is actually recycled. [3]

The ever increasing waste problems of recent years have made it imperative to develop both new ways of reducing material usage and recycling process. The technologies applicable to the recycling of plastics, and the end use of the recycled plastic, are dependent on the grades of plastics collected; the mixture of plastic types and the degree of contamination are also of concern. When collecting waste, attention must be paid to separating the plastics as much as possible. Mixed material streams have to be sorted before qualified recycling process can begin. Sorting by hand (the most usual) can be replaced by automated sorting technologies. [4]

Following sorting, each plastic type can either be melted down and moulded into a new plastic object (mechanical recycling) or broken down (depolymerised) into a petrochemical product or monomer, which will then be transformed again into plastic (chemical or feedstock recycling). In energy recovery, i.e. incineration, the plastics behave as a fuel: 1 tonne of plastics gives off as much energy as 1 tonne of oil (plastics are in fact frozen oil).

Co-combustion of plastics with municipal solid waste (MSW) is the cheapest options, but unfortunately, there is no plan for an incineration plant in Republic of Croatia in the near future. For bottles, mechanical recycling has the best energy balance. By reason of the fees-model of the Croatian Packaging Ordinance nearly the total beverage packaging waste (including PET bottles) is collected and recovered. For dirty films or small items of packaging, the recycling at any cost can lead to

economical and ecological aberration. The energy balance of co-combustion comes very close to mechanical recycling if the steam is well valorised (urban heating and power generation). [5]

The Eko Velebit Company was allocated the concession on collection and recycling of waste polyethylene and polypropylene packaging in Croatia. Waste polyethylene and polypropylene packaging (e.g. shampoo, oil and detergent containers), marked with HDPE (2), LDPE (4) and PP (5) are collected and recycled into pellets, but at present, only some minor pilot projects of collecting plastic household waste in the regions neighbouring company have been carried out. The company produces so-called plastic lumber as well, of plastic waste that is extremely dirty and highly mixed with all sorts of plastics. Plastic profiles can be used in many applications such as making parts of the road accessories (curbs, fences, stops) or park accessories (benches, tables, walkways, terraces).

4. CONCLUSION

In Zagreb, at the beginning of March 2011, a pilot project was started of separate collection of useful waste on a sample of 8,000 households in the area of the city of Zagreb. The main objective of the project is to determine the possibilities of reducing the quantity of waste that is deposited at the waste disposal site by separate collection of useful waste at the place of origin (paper, glass and plastics) and by their recycling or re-usage for energy generation (bio-waste). For this purpose, on the mentioned areas, groups of containers for separate collection of waste have been located. The collection of the separately collected waste per types in the area of the pilot project is performed once a month.

Trial collection is most likely to indicate the problems that may be expected with the establishment of the system of separate collection of waste plastic packaging at the level of the entire Republic of Croatia. One of the first problems that will most probably be encountered is the motivation of the citizens to separately collect plastic packaging. Appealing for ecological awareness of the citizens may yield results to a certain extent, but no such success can be expected as in case of collecting PET bottles which includes the very important positive factor of the refund compensation. In case of collecting other plastic packaging, the situation fails to be completely clear, due to the large quantity of different packaging units, i.e. the impossibility for refund per item of packaging unit.

The charging system of the collection of communal waste from the households is based on the size of the premises, which should be changed in the future and a new system should be adopted charging the costs of handling communal waste according to the quantity and property of waste. This would lead to the reduction of the costs for the households that collect separately various types of waste (glass, paper, plastics) and it would motivate the population to sort the waste at its point of origin. Without a change in the charging system there is no clear advantage of separate collection of any kind of waste, so that no major response by the population is to be expected.

5. ACKNOWLEDGEMENT

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