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The problem of preparation the food packaging waste for recycling in Poland

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ABSTRACT

Waste segregation 'at source' has become more and more common in many countries all around the world, including Poland. There is a divergence in the literature about whether householders' segregation efforts should be included in a cost-benefit analysis of recycling system. Most papers concerning this issue is based on situation of highly developed countries. Some studies ignore the problem assuming that the efforts are balanced by satisfaction of contribution to the sustainability. However, such an assumption seems to be not suitable for reality of post-communist Central European countries, like Poland.

This paper provides the view of the problem from the perspective of Polish conditions. On the basis of experimental data, a simple approach to assess the profitability of washing the food packaging waste is presented. The experiments involved over a hundred people with various washing-up habits. The methodology applied allows to avoid controversial assumptions concerning moral aspects of recycling. The best result has been obtained in case of cleaning the glass waste with cold water. In other cases the average washing cost has exceed the market value of recyclable materials. The results point out a need to instruct Polish householders how to treat used food packaging waste.

1. Introduction

Anciently, all waste produced by human was a biodegradable substance – a useful material for the nature. Developing civilization discovered new materials, not known to biosphere, however range of negative impact on the nature was very limited at the beginning. New substances, like for instance metals, were too valuable for people to dissipate in the external environment. Nowadays, human civilization can obtain a variety of not biodegradable chemical compounds. Industrial technologies enable mass production of goods at low costs. It is particularly noticeable in case of plastic and glass stuff. From environmental point of view, plastic and glass are non-renewable materials made of compounds, which should be conserved. Therefore, the plastic and glass waste should be returned to the economy to be used again in production processes.

Plastic industry has achieved dynamic growth during last 50 years all over the world. The production of synthetic polymers has increased more than 100 times since the 1970s (Dongsu et al., 2002; Buchan and Yarar, 1995). Polypropylene, polyethylene, polyvinyl chloride and polystyrene are now widely used in everyday household life as excellent material for domestic equipment and appliances, food packaging, clothes and many different applications. A lot of plastic articles we use have turned out to be not durable and there is also a variety of articles, which are created for one use only (especially packaging). Because of the above-mentioned factors, a rapid increase in amount of plastic waste can be observed worldwide (Patel et al., 1998; Dongsu et al., 2002).

Glass is another material, which is widely used in economy. The largest sector of the EU glass industry is the production of glass containers, representing more than 62% of total glass production. The products are bottles and jars, which are widely used for the packaging of drinks, food, perfumes and cosmetics, pharmaceuticals, and others. A progressive growth of glass container production was observed at the turn of 20th and 21th centuries: glass production increased by 19% over 10 years then (Hurley, 2003).

High rate of packaging production results in a considerable and growing share of plastic and glass waste in the overall municipal waste stream amounting in the capital of Poland, to 16.5% and 11.3%, respectively (den Boer et al., 2010). What contributes to this process are also marketing efforts leading to the shortening of the life cycle of many commonly used products and creating the tendency of attributing exaggerated importance to packaging.

In Poland, 12.0 million tonnes of municipal waste is produced yearly, out of which 10.0 million tonnes is collected, wherefrom 0.86 million tonnes (8.6%) is recycled (Różańska and Sobczyk, 2011). The average composition of municipal waste in Poland is presented in Table 1.

It can be observed that a considerable percentage of waste plastic (47%) and glass (89%) is packaging waste. On the other hand, an average inhabitant of Poland produces yearly about 54.7 kg of packaging waste including plastic waste (14.1 kg) and glass waste

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Table 1
The average municipal waste composition in Poland.

Fraction	Share, %
Paper, cardboard	26.6
Glass	9.8
Plastics	13.2
Metals	3.5
Textile	1.2
Organic waste	32.3
Others	13.4

Source: Kucharczak et al. (2010).

(25.4 kg). Taking into account the above data, as well as the share of ferrous and non-ferrous metals in waste, the mass and value of recyclable material included in packaging waste can be estimated. In Poland, about 2.1 million tonnes of packaging waste is generated yearly, worth about 130 million € (den Boer et al., 2010; Różańska and Sobczyk, 2011).

According to the regulations concerning packaging waste and waste hierarchy (Directive on packaging and packaging waste, 1994; Directive on waste, 2008), plastic and glass waste should be reused and recycled. Contrary to the principles, only 28% of plastic and 39.7% of glass packaging waste are returned to the economy in Poland (Eurostat, 2007).

There are a number of problems connected with recycling in case of municipal waste:

- recyclable materials are mixed together and need to be sorted; unsorted municipal waste is worthless,
- recyclable materials are contaminated with organic substance and other pollutants,
- the financial value of recovered materials is low.

The best solution for sorting the municipal waste is segregation 'at source' meaning that the waste is segregated by household occupants. Sorting of municipal waste may be also carried out by a sorting plant, but solution like this demands extra money, so entire waste management becomes more expensive for local authorities. Sometimes the two ways are integrated: waste is preliminarily segregated 'at source' and obtained fractions are sorted ultimately at a sorting plant, as it takes place in waste management system of some Polish towns (e.g. Lodz).

There is a lot of food packaging within municipal waste. They often cause a problem to recycling system because of leftovers inside. For this reason local regulations of waste collection often provide for an obligation of washing or rinsing pieces of food packaging before placing them in a recycle bin (local regulations in exemplary municipalities: Lodz, Warszawa-Targowek, Trzebinia, Stare Babice). Remains of food, which are not removed from containers, often make packaging material very difficult to process, moreover the organic substance can undergo biological decomposition processes. Thereby the plastic and glass containers should be prepared for separate collection, otherwise the recycled material is worthless from recycling enterprise's point of view.

The obligation of washing the used food packaging makes recycled material more valuable and useful, however washing process introduces additional costs into the whole recycling system. Local cleansing departments usually neglect the cost of washing, because it is incurred by householders. However, water used for washing is an economic raw material with substantial financial value and also is a kind of natural resource that should be conserved. Thus there is a question emerging: is the washing of used food packaging economically justified? The question particularly concerns plastic and glass waste material, as its value is relatively low compared to other recycled material such as aluminium.

Table 2
Variables affecting the costs of recycling.

Factor costs	Average hourly earnings of production workers in 1996 (Bureau of Labor Statistics) Opportunity cost of capital based upon Moody's bond rating Price of regular gas Cost of waste disposal
Scope of services	Recyclables are collected from multi-family dwellings Number of curbside recycling collections per month Community offers staffed facility for households to drop-off recyclable materials Community offers un-staffed facility for households to drop-off recyclable materials The percentage of eligible households participating in curbside recycling
Collection practices	Recycling containers provided to households Recyclable materials are separated by collectors Recycled materials are separated in a centralized facility Municipality levies a variable fee for waste collection Size of collection crew for recyclable materials Recyclables collected on the same day as solid waste collection City crews collect recyclable materials using city trucks City owned and operated materials recovery facility processes recyclables Specialized recycling truck used to collect materials
Exogenous variables	Population density of municipality (persons per square mile) State mandate or recycling goal is very significant for continuation of recycling Number of years a community recycling program has been in operation

Source: Bohm et al. (2010).

There are not numerous surveys indicating some value of the additional effort that householders have to spend on waste segregation, rinsing and possibly transporting compared with disposal in a single garbage bin. The literature shows a divergence about whether or not householders' segregation efforts should be included in a cost-benefit analysis of recycling system. Most papers concerning this issue are based on situation existing in Scandinavia, Australia, USA or other highly developed countries. Some studies notice the problem, but ignore it assuming that the costs of the additional activities are roughly the same as the benefits resulting from satisfaction of contribution for the environment conservation. However, such an assumption seems to the authors of this paper to be not suitable for totally different reality of post-communist Central European countries (see the last paragraph of Section 2).

The main objective of this study is to provide the overview of the issue from the perspective of situation existing in Poland. In order to avoid controversial assumptions concerning moral aspects of recycling, a simple approach was applied to assess the profitability of washing the food packaging waste. The results were obtained on the basis of experimental data.

2. Literature review

There is a number of publications concerning costs of recycling system of municipal waste. Varied cost factors influences the costs and are taken into account. They are depicted in Table 2.

Taking into account factors contained in Table 2, Bohm et al. (2010) compare costs of municipal solid waste collection and disposal services and curbside recycling programs. The survey was