

SEGRAGATION OF PACKAGING WASTE AS AN ELEMENT OF ECO-LOGISTICS

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Abstract

Typical logistic process concerns actions which relate to product delivery to the customer. New approach to environmental protection, especially sustainable development concept forced another step, e.g. after their used, goods move from the customer to the distributor or to the manufacturer who has to organize shipping not only of the defective product, testing the product, dismantling, repairing, but also, what is important in this case, recycling or disposal of used product. It is very important especially in the case of packaging. Packaging should follow the 3R's hierarchy: reduce, reuse, recycle. Reusable packaging systems require a closed-loop logistics system. The first step of this logistic system is well organized segregation of packaging. To achieve good segregation people should be aware of problem with packaging waste. In Poland, like in other countries of European Union, waste segregation, not only packaging waste, is demanded. In the paper process of packaging waste segregation in Poland, connection with eco-logistics and reverse logistics, its organization in Poland were presented.

Keywords: Packaging waste, segregation, eco-logistics, reverse logistics, environmental awareness

1. INTRODUCTION

When shopping, together with target products, customers buy the packaging. This package is designed to protect the product during transport, facilitate its storage and provide information about the product, its content, manufacturer, or expiration dates. Unfortunately, after removing the product from the packaging, this packaging becomes waste. Most manufacturers, selecting packaging for their products, should take into account, which material was used to produce this packaging and whether they can recycle it and reuse it.

Appropriate segregation of garbage and waste is not a tiring task, and most of the packaging waste, e.g. glass, paper, plastic and metal, is a valuable source of secondary raw materials, which, when properly sorted, can be recycled and reused. This allows to save natural resources, energy, and reduce the amount of waste in landfills, which consequently can reduce the negative impact on the environment. Selective collection of packaging waste also reduces fees for garbage disposal, which in turn reduces the cost of living.

To make re-use of packaging waste or its recycling possible, there is a properly organized logistics system based on eco-logistics and reverse logistics needed. There is a need of properly prepared containers for different types of packaging waste, but also properly organized reception of such sorted waste [1,2].

In the paper process of packaging waste segregation in Poland, connection with eco-logistics and reverse logistics, its organization in Poland were presented.

2. PACKAGING AND WASTE PACKAGING

According to the Act on packaging management and packaging waste, the packaging is defined as "products placed on the market, made of any materials, intended for the storage, protection, transport, delivery or

presentation of any product, from raw materials to already processed goods" [3]. So understood packaging according to this Act includes [3]:

- packaging unit, for transmitting the product to the user in the place of purchase, including also consumption product, such as disposable dishes,
- multipacks containing multiple unit packages of products, regardless of whether they are transmitted to users, or are transmitted to selling points, that can be removed from the product without compromising its features,
- transport packaging, used to transport products in packaging unit or multipacks in order to prevent damage, with the exception of containers for transport by road, rail, water or air.

Product packaging aim is to encourage potential customer to buy the product. It contains information about the name of the product, its composition, producer, expiration date. It is responsible for protection of the product from the damage and helps the customer to transport this product to home. Due to the need to protect the environment, and thus the need to use recycled materials, also product packaging should be recycled and reused [4].

Definition of the packaging waste was also included in the Act on packaging management and packaging waste by packaging waste. According to this Act by packaging waste it can be understood "all packaging including reusable packaging withdrawn from the re-use, constitute waste within the meaning of the waste legislation, with the exception of waste generated in the production of packaging" [3].

3. REVERSE LOGISTICS AND GREEN LOGISTICS

Packaging should follow the 3R's hierarchy. The first R as reduce. Packaging should be reduced prior to the manufacturing stage, by designing and marketing products for the first "R". This means reducing the number of layers, materials and toxins at source. The second R as reuse. Packaging should be designed to be reusable, refillable, returnable and durable to the greatest extent possible. The third R as recycle. Packaging should be designed to be recyclable and/or made with recycled content.

Logistics of reusable packaging is becoming more and more popular. Disposable containers most often used in trade, transport, manufacture or storage of product, produce consistently high costs associated with their acquisition, disposal and forwarding. Such packaging has also a greater impact on the environment [5].

Logistics packaging waste is based on two types of logistics: eco-logistics and reverse logistics. Therefore both concepts in relation to the waste should be defined.

Eco-logistics can be defined as the realization of optimal solutions in the area of the collection, removal and direction to recycling or liquidation of various types of wastes that are characterized by a high negative impact to the environment and society [6]. Eco-logistics as an integrated system can be described as follows [7]:

- It is based on the concept of the management of the re-circulatory flow of material streams in the economy and the flows of information related to them.
- It guarantees the readiness and ability of an effective planning of segregation and processing as well as recycling of waste according to the accepted process rules and also technical and technological rules that fulfill the standardizing requirements and environmental protection rules.
- It facilitates decision making on technical and organizational levels with the aim of a minimization of the negative effects of the environmental impact that accompany the realization of the processes of supply logistics, re-engineering production, the logistics distributions and servicing in the logistic chains of supplies.

Within eco-logistics, the eco-logistics of packaging waste has a special place, because waste due to its ever-increasing quantities creates recently a growing threat to the natural environment [8].

With eco-logistics is related reverse logistics. Reverse logistics according Dowlatshahi is [9] is a process in which a manufacturer systematically accepts preciously shipped products or parts from the point for consumption for possible recycling, remanufacturing or disposal. Meaning of the reverse logistics in comparison to normal, forward logistics is presented in **Figure 1**. The reverse logistics is increasing and will only increase more in the future due to reusable and returnable packaging, and logistics chains need to be able to adapt to this increase [10-11].

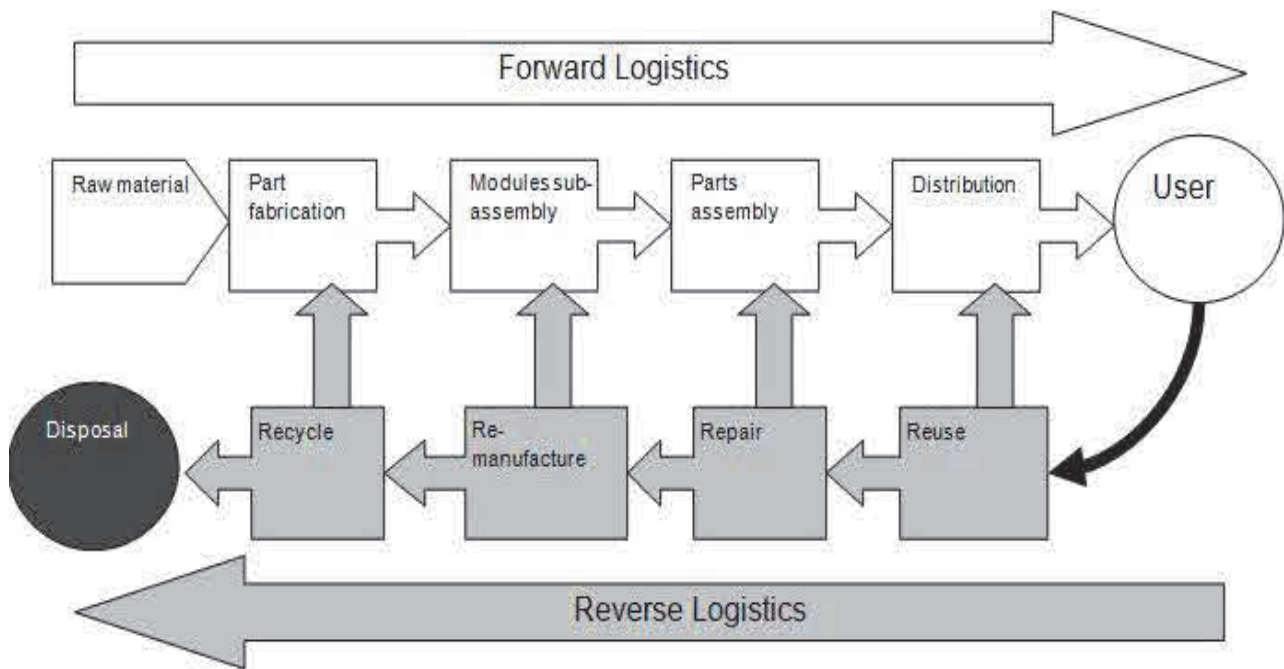


Figure 1 Logistics and reverse logistics [12]

4. PACKAGING WASTE SEGREGATION

According to the Central Statistical Office in 2014 average resident of Poland has produced 268 kg of household waste. It was one of the lowest ratios among European countries. The countries that produce the largest quantities of waste are: Japan (one resident produces 1000 kg household waste per year) and the USA (864 kilograms per capita). In Europe, most waste in 2013 were produced in Denmark (747 kg), Cyprus (624 kg) and Germany (617 kg). Average European citizen produces annually approx. 481 kg of waste [13].

In 2013, 156.9 kg of packaging waste was generated per inhabitant in the EU-28. This quantity varied between 46.7 kg per inhabitant in Croatia and 210.4 kg per inhabitant in Germany [14].

The first step in the use of packaging waste in accordance with the eco-logistics and reverse logistics is appropriate segregation of this type of waste. Segregation in Poland concerns not only packaging waste, but overall waste. However, the situation related to the use of waste in Poland is not as good as in other European Union countries. From the total amount of municipal waste in the EU 31% are disposed on the landfill, 27% was recycled. In Poland, it was respectively 53% and 21%. In Poland less waste was also burned or biological processed.

From the 4,846,080 tons of packaging placed on the Polish market in 2014 2,694,170 tons were recycled. Therefore Poland achieved almost 56% of recycling of the packaging waste. This is a correct level in comparison to the target level of recycling of packaging waste specified in the Act of 13 June 2013 on packaging management and packaging waste [13].

Legal regulations on packaging and packaging waste in Poland result from the legislation:

- Act of 11th May 2001 on obligations of entrepreneurs in term of management of certain waste and on product fee (OJ 2007, No 90, item 607, with amendments),
- Act of 13th June 2013 on packaging management and packaging waste (OJ 2013, item 888),
- Regulation of the Minister of Economy and Labor of 25th October 2005 on the detailed method of dealing with packaging waste (OJ 2005, No 2019, item 1858 with amendments).

The regulation defines a specific way of dealing with packaging waste, including, among others, a method of collecting of the packaging waste made of : paper, glass, plastic, aluminum, steel, multi-material.

The Act amending the Act on maintaining cleanliness and order in municipalities and other acts introduces the need to segregate the municipal waste, including packaging of products purchased by residents of the municipality [15]. Thanks to this Act, more and more people separate waste, including packaging waste. According to the act all waste should be divided into paper, plastic, metal and glass. However, it is also acceptable used in many municipalities a simplified division into dry waste (recyclable), wet waste and glass.

It is possible to mention several ways, which can have effect on the reduction of the packaging waste:

- segregation of the packaging waste,
- processing of sorted waste,
- purchasing a smaller amount of products,
- selection of least packed products,
- selection of packaging that can be easy to process,
- actions aimed to reduce their volume and weight (e.g. reducing the weight of mass of glass packaging as a result of strengthening them by coating a solution of tin tetrachloride, titanium compounds or plastics),
- limitation of introduction of plastic bags on market.

Separate collection of the waste packaging goes in stages. At the beginning of the track there are households where residents, in accordance with the laws and municipal regulations, segregate all waste dividing it into so-called fractions. This is called "sorting at source". The most common solution is the system with three-fraction selection into mixed waste, dry segregated and glass. It should be emphasized that the best results in the recovery of secondary raw materials is obtained when there is carried out selective collection system with multi-fraction selection (e.g. glass, paper, so-called light fraction, i.e. plastic, cans, cartons for liquid food , wet fraction, i.e. organic waste, etc.).

Collection of the packaging waste from a manufacturer should be done in a selective manner with a separated individual types of packaging waste. All packaging waste must be submitted to further their recovery and recycling.

Packaging waste management and its objectives are presented in **Figure 2**. According to **Figure 2** in the packaging waste management there are involved many groups of people. These are residents, usually consumers of products, manufacturers and suppliers of packaging and products but as well as public administration and units involved in direct management of this type of waste. The objective is not only the recovery of the waste at the level set by law, but above all, reduction of the risk to the environment throughout all life cycle of the packaging waste.

Recycling of secondary raw materials helps to reduce raw materials, which in turn contributes to the protection of natural resources of the earth. It also reduces the amount of space in landfills.

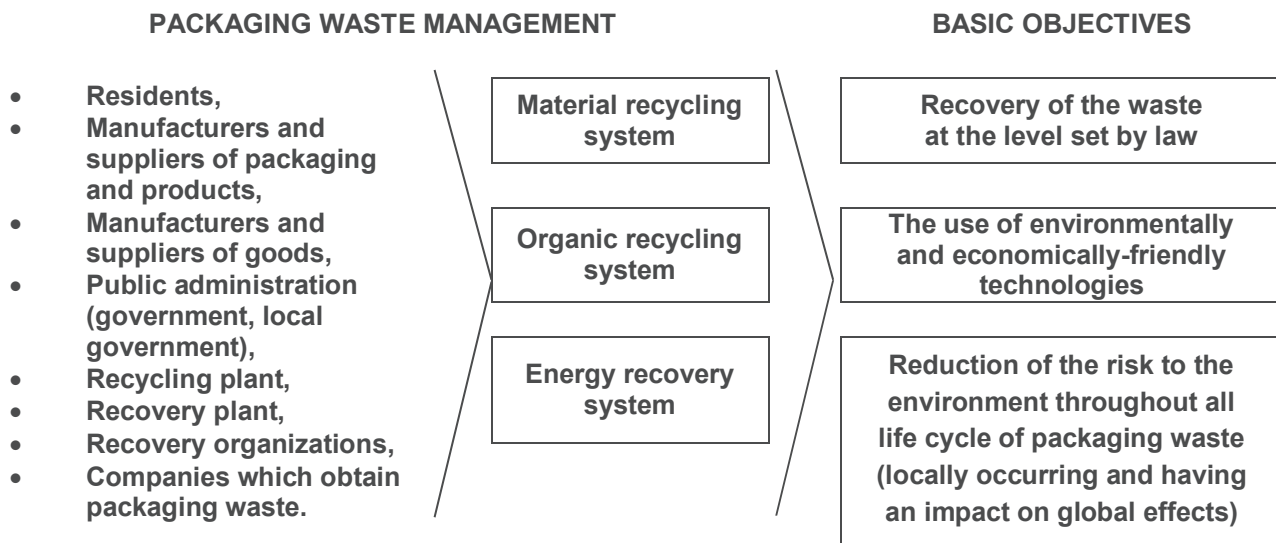


Figure 2 Schematic approach of packaging waste management systems with separated recovery and recycling [16]

5. ENVIRONMENTAL AWARENESS

The most important element related to waste management, including packaging waste, is to change the attitude of society and to improve awareness in this regard. It is up to people to decide whether segregation take place. And this concerns not only households, habits which later have results into behavior at work, and therefore segregation of waste by different types of enterprises or other organizations.

It can be observed that new concept of environment awareness appears. This concept can be defined as: the extent to which residents are interested in the topic of the environment and its protection, what are their beliefs about the degradation of the environment and that have the knowledge of possible action to support its protection. Green behavior means activities positively affecting the environment, which can be taken by every man.

People in Poland are slowly beginning to increase their environmental awareness. Many people, not only in big the cities, began to segregate household waste, including packaging waste. Many people are interested in a material of which the packaging has been done, or if the packaging is recyclable and what they have to do with it after unpacking the product. An important element of packaging waste is a disposable bag. Since some time, lots of people, going shopping, take with them reusable bags.

To develop the environmental awareness there is a need of a proper knowledge management focused on this subject. It is the task of enterprises that sell their products in packaging. Such packaging shall include information not only about the product itself or the manufacturer, but also the packaging and how to deal with it. So there is need of proper education in the field of recycling in order to develop appropriate attitudes and behavior.

A pilot actions, appeals of authority and legal orders, that orient the actions and behavior of society, can be really helpful. Many people listen to famous people and trying to proceed in the same way. Environmental awareness is promoted also as an element of fashion which is followed by many people. Changing the mentality of society is an important step towards sustainable development and environmental protection.

6. CONCLUSION

New approach to environmental protection, especially sustainable development concept forced change of the attitude to packaging waste management. Now the manufacturer not only produces goods, has to organize

shipping of the defective product, testing the product, dismantling, repairing, but also, what is important in this case, has to organize recycling or disposal of used product and its packaging.

Logistics of reusable packaging is becoming more and more popular. Disposable containers most often used in trade, transport, manufacture or storage of product, produce consistently high costs associated with their acquisition, disposal and forwarding. That's why packaging waste management is so important in case of the enterprises.

We have to remember that suitable packaging waste management will reduce its number in the environment and save resources of the natural environment. We should note that this waste management is connected not only with enterprises. Also users of packaged products should pay attention to what they buy. Because it is a customer who decides in the end what happens to the packaging and packaging waste.

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