Lucian BARSAN, Anca BARSAN

STRATEGIES FOR PACKAGE WASTE REDUCING THROUGH A RATIONAL AND EFFECTIVE DESIGN

Abstract: *The paper presents a number of regulations which should be respected when designing a package. Package represents a large percent of the total waste, therefore we should focus on this 'type' of product to reduce the resources used and also to reduce the waste through reusing and recycling. Design is strongly involved in this activity analysing the package lifecycle and trying to respect some rules, which represent the fundaments for a design strategy. Regulations regarding materials choosing, materials combinations, choosing the most adequate process are presented. Either the package is reusable or not, it must be recyclable. The possibility of simply dismantle the package for sorting the materials represent another requirement for the design process. Examples of good practice are presented as a case study.*

Keywords: *design, package, recycling, optimization, sustainable development, waste.*

1. INTRODUCTION

The waste represents an important problem and also a challenge for the present society. Package design could contribute to this problem solving.

Basically, the modern society problems related to waste are connected to some factors:

- Quantity. Human modern society produces too much waste, large amounts being unjustified;
- Quality. So many useful and valuable materials are in the disposed of products;
- Materials variety. Too many materials are combined (as components) to build a product.

Packaging represents a significant amount in the total quantity of waste. Reducing the waste coming from this „source" represents a primary goal and design can give solutions including the reducing of the package waste *quantity, quality* and *diversity of materials*.

At the European level, the 94/62/EC Directive, on Packaging and Packaging Waste states that *'all the EU countries should work in finding solutions, from the package design stage to the waste recovery system'* [8].

According to this directive, in the second stage of its application, meaning by the end of 2008, "60% as a minimum by weight of *packaging waste* should be recovered or incinerated … and between 55% as a minimum and 80% as a maximum by weight of packaging waste should be **recycled**". Also, the same directive claims that the following minimum recycling targets for materials contained in packaging waste should have been attained:

- 60 % by weight for glass;
- 60 % by weight for paper and board;
- 22,5 % by weight for plastics, counting exclusively material that is recycled back into plastics;
- 15 % by weight for wood.

At first sight, the numbers seem small considering, for example, that 40% of glass and paper is not recycled, which means it is lost for good. Weather with paper things are better because it will degrade within few months to one year, a glass bottle will degrade in about 400 years [9]. These targets could be reached and even exceeded with a little more effort from all the factors involved which are basically, *people* – managers, designers, customers, authorities, etc.

2. THE PRODUCT END-OF-LIFE OPTIONS

The EU Directive 94/62/EC on Packaging and Packaging Waste [8] settles that *"the management of packaging and packaging waste should include as a first priority, prevention of packaging waste and, as additional fundamental principles, reuse of packaging, recycling and other forms of recovering packaging waste and, hence, reduction of the final disposal of such waste"*. Part of this directive refers to the designers' activity and requires the paradigms changing in the design process. The options at the end of the useful life are known (see Figure 1); they are true for products and package as well [3]. Designers' responsibility is great because the options for each product depend on their decisions and solutions. For packaging they are 'responsible' for all three factors, previously mentioned: quantity (i.e. mass/volume), quality and variety.

The possibility of recovering the package after its first use involves a certain strategy as concerns the design, starting with the anticipation of the reusing context – user (who), need (for what), number of cycles. Also the possibility of recycling the package when it is out-of-use involves a special attention given to this option during the design process. As no one of the above options is available, incineration should be an option to think about and design for. Even if the option is landfilling, design is involved in fulfilling this option safely.

Many things have been done regarding improving the design and make it more open to the present realities, yet many of these regulations, recommendations, or indications remained unapplied. The present legislation imposes rules as concern recovering, selection or waste landfilling, starting with household selection and ending with the eco-dumps with a reduced environmental impact. Some countries respect them, other do not. Whether companies or people reuse and recycle more or less is an education matter but definitely they must have all the conditions created to do it, and design is responsible for this aspect [1], [6].

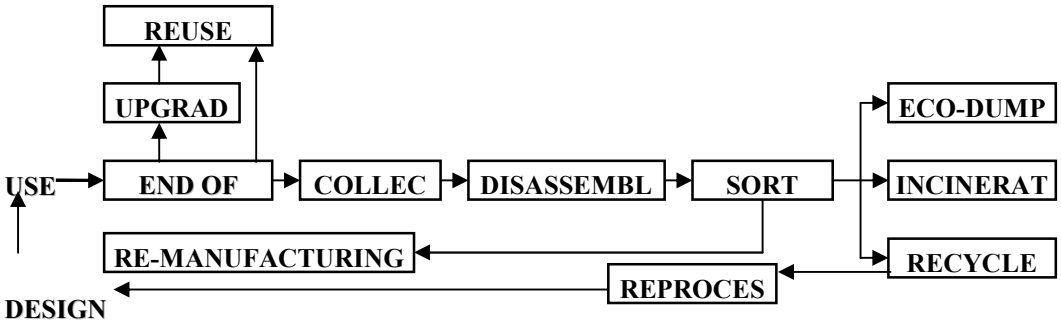

Fig. 1 The end-of-life options.

3. DESIGN STRATEGIES

The design of a package must follow the same steps like any other product (Figure 2). It starts with establishing the requirements list, starting from which, the designer identifies the package functions.

The conceptual design phase creates the principle of solution/the concept, which will be developed in the next phase, the embodiment design, in order to become a project. Embodiment design is the step in which designer should take into account all the constrictions of the design process in order to find the optimal solution. For the "product-package" the restrictions are connected to aesthetic and ergonomic principles, production methods and technologies, assembling and packing techniques, but also, the most important, the possibilities of reusing the package or recycling the materials [5].

The choice of package materials is an essential activity of the embodiment design phase. Usually, the designer has multiple variants of materials between he can choose. For example, beverages can be packed in plastics, metal (aluminium and tin cans) or glass.

When choosing the package material the designer must have information about the nature of the product, about its physical and chemical properties and possible hazards for the *user*, or the *environment*. Also, the designer should have all the information regarding the raw material source, meaning the distance on which it is transported, the *quality of the resource* (cotton vs. bio-cotton, wood from secular forests vs. cultivated forests and so on), the exploitation costs, social implications (children might be involved and slavery work) etc.

As regarding the end-of-use options, designers need to give top priority to the possibility of reusing the package. Either it will be used for one, or multiple cycles, designers must provide the possibility of 100% recycling the package at the end of its life, whenever this will happen. Then is the manufacturer's job to cooperate with other factors involved in the use, recovery and recycling chain to ensure that recovery is carried out in the most cost-effective manner.

A package can be reused for the same purpose, or a different one. This is the highest level in recovering the products, package as well, and should be preferred whenever is possible.

3.1 Less material involved – less waste

The next priority for reducing the environmental impact is minimising packaging. Fewer packages mean cutting resources use at source. Still, recycling is necessary because it feeds the system with raw materials, other than the virgin ones.

Optimization from this perspective involves creating a simple design, a simple structure, using a reduced variety of materials. All materials should be recyclable in order to keep this option. Re-using a package is most of the cases, the customer option and depends on the package quality i.e. the aspect and functionality are still at an acceptable level.

The material reducing may be obtained by giving up a package layer or partly reduce a layer, more specific, the first layer [1]. It is compulsory to avoid using hazardous materials or which might affect in some manner health and safety of users, during the packing process, transportation unpacking or repacking during use. No mixing materials should be accepted and solutions that permit disassembling and material sorting for facilitating the recycling should be preferred.

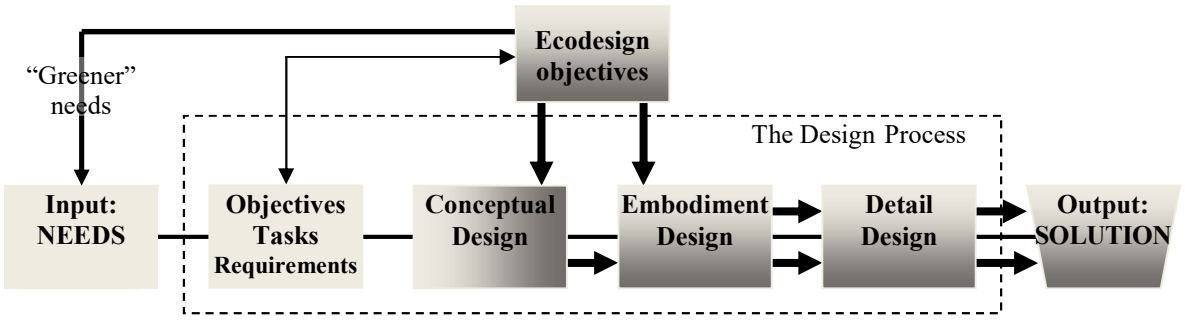

Fig. 2 Strategy to better fulfil the ecodesign requirements [2].

3.2 Changing the materials

The opportunity of materials changing comes when one of the following situations takes place: new materials are available, materials are expensive, rare, or from depleting sources, untrusted source/exploitation, far from the place of processing/using, polluting or energy intensive processing and many others. [3]

The materials changing can lead even to better solutions, considering the materials research and the technological progress and, as previously assumed, without putting on risk the product quality and its technical performances. Here are some examples for already successful replacements:

- Water-based glues and inks;
- Brown paper (unbleached);
- Kraft paper for fast food packaging.

In any situation, and as a conclusion, the resource used should respond the requirements imposed by the concept of sustainable development in all three aspects: economic, ecologic and social [7].

3.3 Avoid hazardous materials

Hazardous materials involve putting on risk humans, other living creatures, and environment as well.

It is possible that the materials themselves to be the dangerous outputs to occur during raw materials extraction or when processing them for transforming into products or half-products. These can be different emissions contaminating the air, soil or water (surface or underground).

Their toxic effect can also occur during product using, or when the product becomes a waste at the end of its life. If materials cannot be recycled, the possibility of incineration is considered; the process of materials burning can also be a source of hazardous substances (gases or ashes).

Therefore, designers should know about the risks and consequences of using such materials and avoid specifying use of materials that are hazardous or that generate hazardous waste at any stage of their life cycle.

In order to identify the environmental impact, the whole process, from extraction to end-of-life, should be evaluated. For performing this job several assessment instruments exist and should be used [1],[4].

3.4 Avoid package material contamination

One challenging subject related to recycling, and especially with package recycling is represented by material contamination. This means that that package material is mixed with product waste e.g. food, dyes, body care products etc. Obviously, this leads to difficulties in recycling the materials because the implications of hazardous products, for example.

Solutions exist for avoiding this process, but unfortunately this depends a lot on customers, the product users who should not dump packages that still contain traces of product.

Design gives solutions and work for reducing the number of products susceptible to contaminate the package, by introducing special layers or covering the package surface with non-adhesive substances [1].

4. CASE STUDY: STUDENT PACKAGE DESIGN

The students from the Industrial Design program attending the Package Design class presented their projects developed considering the above mentioned restrictions. Their goal was to design a useful package in balance with the contented/wrapped product.

This short selection (Figures 3, 4 and 5) shows besides the students imagination and creativity, the way they understood and apply the strategy of package designing for fulfilling the constrictions imposed by this 'environmental friendly' approach.

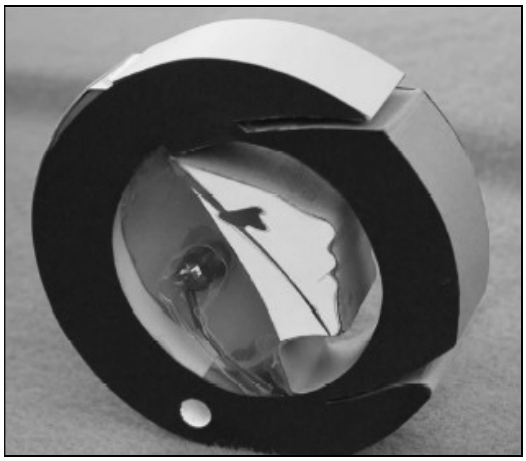

Fig. 3 Package design for headphones.

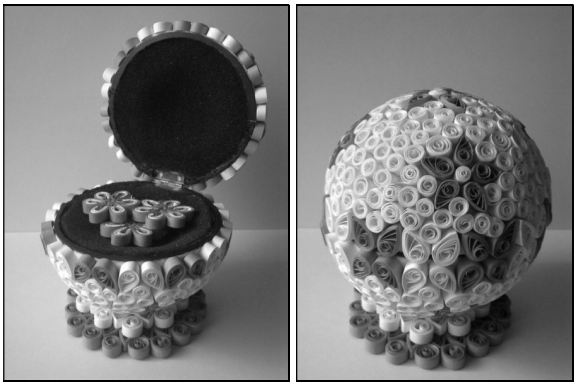

Fig. 4 Package design for jewellery.

Fig. 5 Package design for soap bar.

Every design step is subordinated to this strategy. Carefully choosing the functions and an optimal combination for a balanced concept is combined with a

professional research regarding the customer target group and a comprehensive benchmarking. The design constrictions resulted from all these actions and activities permitted the solution optimization in total subordination to the conditions imposed by the packed product.

The materials were carefully selected and are in perfect match with each other and with the product. The solutions are simple involving simple, low in cost and environmental impact.

The first sample (Figure 1) is a package for headphones designed for people who have a passion to listen music from portable devices. The main material is cardboard suitable for the short life of the package. The front part is provided with a transparent window for permitting the client to see the product. The package chromatics is in shades of grey – neutrals – that are supposed to highlight the green curved lines. The package graphics suggest the domain of the product, on one hand, and facilitate the access to the inside product, on the other.

Figure 2 presents the second package of the selection. It belong to another category, it is a package for jewellery. Paper is the main material, but the originality of the package is in the technique used to create the small units and the way they are assembled into an appealing object. It can be reused to keep the original, or other jewellery, thus it has a longer useful life. However, it is totally recyclable, even if it is partly coloured, because eco-dyes (water-based) are used. The opening system is metallic and is detachable therefore it can be recycled. The jewellery support is textile and is removable to recycle separately.

The third example (Figure3) is a package for solid soap. The material used is mainly textile with a supplementary layer of paper. The accessories are textile – the cord – and plastics/or bone – the buttons. The package system is completed with a paper label attached to it. Paper and textile is recyclable, buttons and cord can be reused. The solution does not include hazardous materials, glues, inks or dyes. The package is practical and good looking.

5. CONCLUSION

The design process involves respecting the constrictions related to different areas including functionality, style/aesthetics, safety, ergonomics, dimensions/mass/volume, costs etc. As concerns the environment protection, the constrictions involve prioritizing the end-of-life options. Usually, the package has a shorter life, thus it becomes waste very quickly. Consequently, all the resources involved in creating and building the package should be carefully exploited. Solutions that involve package reusing should be preferred, but in the end it will be disposed of. Thus, the recyclability objective should be present in the process.

Simplicity is a principle that leads to resources saving and helps finding design solutions based on fewer materials – as sort and quantity – cheaper, more abundant materials or coming from renewable and requiring simpler techniques or fabrication technologies.

Avoiding using hazardous materials represents another constriction for the design process. The risks can be for humans, but also for the environment, therefore a LCA should be performed in order to avoid any potential harm during the entire life cycle.

In this paper the authors tried to separate that part of the EU regulations related to waste that depend on design and give solutions to fulfil them in a way that do not affect the package functions. The examples presented as case studies suggest that the Industrial design students learned about these design constrictions and successfully applied them. The designs are simple, using safe materials, can be reused and materials can be recovered for recycling.

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Authors:

Prof. PhD. Eng. Lucian Barsan, University Transilvania of Brasov, Department of Product Design and Environment, E-mail: lbarsan@unitbv.ro, Phone: +40 745098019

Prof. PhD. Eng. Anca Barsan, University Transilvania of Brasov, Department of Product Design and Environment, E-mail: abarsan@unitbv.ro, Phone: +40 745098012.