

# RECYCLING AS A CHALLENGE FOR THE FLEXIBLE PACKAGING INDUSTRY

**Dorijan Naletina**

*Rotoplast Ltd., Croatia  
dorijan13naletina@gmail.com*

## **ABSTRACT**

*Flexible packaging has been playing a crucial role in all industries, food industry in particular, and it has taken on even more significance in the times of the pandemic. The European Commission is trying to additionally support and endorse this industry's benefits. In the following years, the focus is directed towards the recyclability of the flexible packaging, therein fostering a more circular economy. Flexible packaging market participants have been working intensively on advancing the manufacturing processes. Some European countries have already developed sustainable methods for flexible packaging recycling, and new technologies should enable others to join in on this endeavour. It is the recyclability of the flexible packaging that ensures the path towards a sustainable product. The challenge is the lack of or vague regulations, which makes progress and eco-friendly policies difficult. This industry faces further investments in research and development and in new materials and machinery to meet the requirements of sustainable production.*

**Keywords:** *flexible packaging, Packaging Directive, recyclability, waste*

## **1. INTRODUCTION**

Flexible packaging brings many benefits to different industries, especially food and chemical industry [1]. Due to the COVID-19 pandemic, habits of the consumers have changed, causing the flexible packaging market to expand rapidly. Flexible packaging products can be used instead of glass, cans or hard plastics and they can be easily flattened and stored once the product is consumed or used [2]. In general, consumers favour flexible packaging products to rigid packaging [3]. The European flexible packaging industry is keen on becoming eco-friendly and using the resources more efficiently. This goal is big and worth the effort because in that way, the waste will be reduced, and the resources reused with the minimum environmental impact. This can be achieved by designing new flexible packaging solutions for many products to be safely delivered to the consumers. Smart resource management then will be to use as fewer materials as possible to reduce waste [4]. This process of becoming circular has been fully running for some time now on the European flexible packaging market. All the players in the industry are engaged and hurry to achieve the goals of this valuable plan [5]. The future of economy lies in recycling and using the resources in a healthy and green way. This also means using less materials, as is the case with the flexible packaging [6]. Members of the EU should take measures to stimulate recycling and help reduce the amount of packaging that cannot be recycled [7]. In order to increase the resource efficiency, but to stay eco-friendly at the same time, the flexible packaging industry focuses on optimising recyclability. It is constantly evolving for a more sustainable future, as can be seen in the example of Flexible Packaging Europe which was among those who initiated CEFLEX\*, the industry project to enhance the performance of flexible packaging in the circular economy [4]. Since recyclability is in the main focus of the flexible packaging industry, its challenges will also be placed in the focus of this paper. The paper is structured in four sections. After the introduction, the second section gives the overview of the literature and analyses the Packaging Directive. The third section focuses on circularity and design of flexible packaging for an eco-friendlier future. The conclusion is presented in section four.

## **2. LITERATURE REVIEW AND PACKAGING DIRECTIVE**

Flexible packaging products are usually constructed from the materials such as paper, plastic film, foil and come in the form of a bag, film, lidding, liner, overwrap, pouch, rollstock, sleeve, or wrap [8]. Many consumer goods, especially food and healthcare products, need to be protected and delivered safely to the consumers. Furthermore, packaging should also be the product of a green and resource-friendly management.

### **2.1. Brief literature review of recyclability and circularity of flexible packaging**

Many EU Member States already use effective methods for recycling packaging waste, but a clearer framework for all the Members is needed in order for the industry to become circular and sustainable in the future [5]. It is crucial for them to come together and sort out their priorities. This can be achieved through education and collaboration [6]. As has already been mentioned, the focus must be placed on using fewer materials and producing flexible packaging that will produce less waste [9]. In the last years, many owners of different brands have transferred to flexible packaging. The reason for that they see in the operational advantage and satisfying the need of the consumers [10]. Although recycling of flexible packaging has been introduced in many European countries, efforts are continuously made to develop new technologies [4]. With the aim of preserving the physical and social environment and to reduce waste, companies have been trying to innovate, to create new materials and achieve a new level of recyclability. Flexible packaging can be better recycled and can be the path towards sustainable development [1]. Flexible multilayer packaging is the topic of the work by Pauer et al. (2020) Although multilayer plastic packagings have great protective properties, there are issues with their recyclability. The authors have confirmed that there is a strong positive correlation between packaging weight and potential environmental impacts. The issue with the multilayer packaging is that the films are difficult to peel off and therefore difficult to recycle properly. [11]. This is supported by the work of Mumladze et al. (2018) who suggested that Multilayer Flexible Packaging Waste (MFPW) represents the largest fraction of packaging waste and is mainly composed of multiple plastic films laminated with Al foil. [12]. A solution is proposed by Coltelli et al.. They suggest usage of polymers from biomass to reduce waste production. Since layers in the multilayer flexible packaging are made of different type of polymer, each layer needs different recycling treatment [13]. Additionally, multilayer materials cannot be recycled in the same waste flow because they can contaminate other materials [14]. Because of this, flexible packaging is now being challenged as the best solution for sustainability. The recyclability of the flexible packaging is also brought to question because it must be collected within a recognized waste stream, and not mixed with other waste [15]. Circular economy is a system built on the premise of reducing, reusing and recycling because waste is considered to be a valuable resource. Used and/or broken products can be fixed and reused. Some can be directly reused, and the rest can be recycled [17]. The goal of circular economy is to redefine the growth by placing the focus on the positive social influences [18]. Sustainability is the key objective of all companies and flexible packaging seems like a logical solution, especially to maximize shipments [2]. Good circular design should be encouraged and rewarded. The aim is to follow EU Green Deal climate neutrality and 2030 recyclability goals and produce flexible packaging as recyclable, lightweight, resource-efficient format [5]. It is not easy to switch from traditional to circular systems. There are steps and methods that need to be followed and the change is to happen gradually [18].

There are three principles connected with circular economy [16]:

#### **1) Designing the waste**

Biological components can be easily composted. Technical components (polymers, alloys and other artificial materials) are designed to be reused with the minimal energy

consumption and with retaining the quality (the process of converting the by-products, waste materials into new materials or products of better quality and higher value).

**2) Keeping the products and materials in use**

Products have to be designed as to be restored and reused.

**3) Natural systems recovery**

By giving valuable nutritional substances back to the soil and other eco-systems, we can replenish our natural resources.

Circular economy is important because it enables waste reduction and better resource-efficiency. It presents waste as a valuable resource, improves recycling of valuable materials and, finally, minimizes environmental footprint of the production and consumption [17]. The European Commission adopted the new circular economy action plan (CEAP) 2020. It is Europe's new plan for sustainable growth. It proposes that all packaging on the EU market should be reusable or recyclable in an economically viable way by 2030 [19]. In line with that, CEFLEX initiative pools over 160 European companies, associations and organisations representing the entire value chain of flexible packaging. Their goal is to tackle the barriers to circular economy and make all flexible packaging in Europe circular by 2025 [20]. They wish to develop advanced infrastructure for collection and sorting flexible packaging waste and see flexible packaging waste as a valuable resource for further production and development of new and sustainable solutions [21].

## **2.2. Packaging Directive**

EU rules on packaging and packaging waste aim at dealing with packaging waste which is growing by the minute and causing environmental issues. These rules and regulations target all levels, including packaging design and packaging waste management. One of the goals is to bring the Member States together under the same roof and create a uniform framework for waste management [22]. Waste prevention is the most efficient way of improving resource utilization and reducing the impact on the environment. Therefore, it is important that Member States take necessary measures to stimulate the increase of the share of reusable packaging that is placed on the market. They should also try to motivate companies in the flexible packaging industry to reuse the packagings themselves. Since the reuse of packagings suggests avoiding placing new packaging solutions on the market and increasing the amount of the waste, when putting the product on the market for the first time, companies should consider reusable packaging [7].

The Packaging Directive aims to [22]:

- harmonise national measures on packaging and the management of packaging waste
- provide a high level of environmental protection
- ensure the good functioning of the internal market.

The regulations concerning waste management can be vague or there can happen that necessary regulations are non-existent. Some are unspecific and can be interpreted differently by different parties. Consumers i.e., producers of e.g., food products want to create the same packaging for all the markets. However, the regulations that specify acceptable combinations of the materials that are considered recyclable i.e., that can be properly collected and recycled is not uniform for all the markets (countries). Therefore, one and the same product needs to be separated into several sub-products to adjust to different requirements on the different markets. This poses a problem because each new product has to be separately prepared in the process of the packaging production, which in turn, creates considerably more rejects proportional to the number of the sub-products.

This is contrary to the concept of sustainability and eco-friendliness because the process produces “unnecessary” additional waste for the same product because it is made with different materials.

### 3. DESIGNING FLEXIBLE PACKAGING AS A BETTER ENVIRONMENTAL SOLUTION

Since the early 1950s, the flexible packaging industry has been developing and making huge steps towards new age of packaging and waste management. It has been introducing new trends, aiming at innovative packaging design and sustainability [8]. Flexible packaging is special and unique because it does not put add weight to the product. Flexible packaging represents the thinnest form of product protection, reduces the storage space and transport costs. There are two types of flexible packaging considering the layers: mono-layer (consisting of one material) and multi-layer packaging (two or more materials). Polyethylene foil is used in food industry mainly to tie many items together, such as beverages. It is also used for packaging magazines and papers [1]. Of course, mono-layered packaging is more easily recyclable because there is only one material and no need for separation. On the other hand, the process of recycling multi-layered flexible PE packaging is more complex because each layer of the packaging needs to be separated and recycled in different way [23]. Despite that, multi-layer flexible packaging is a better choice than traditional packaging solution because it is lightweight and less costly to ship, while keeping the food fresh and safe. One more advantage of multi-layer packaging is that its structural and graphic design is easily customizable [24]. There are many more benefits to flexible packaging compared to rigid packaging solutions. It has a less negative impact on the environment and fewer materials are required for its production. Moreover, flexible packaging saves space in storage, transportation, and landfills [23].

Flexible packaging has the following sustainability benefits [2]:

- Material/resource efficiency
- Lightweight/source reduction
- Transportation benefits due to inbound format and lightweight nature
- Shelf-life extension
- Reduced materials to landfill
- High product-to-package ratio
- Beneficial lifecycle metrics (carbon impact, fossil fuel used, water consumption).

Flexible packaging is considered easily recyclable and sustainable [6]. CEFLEX helps defining recyclability and proposing guidelines for recycling and agreed design. A great number of experts gathered in this organization can help legislators outline uniform regulations. Many companies have already invested in the adaptation of their flexible packaging portfolio to the 'Designing for a Circular Economy' guidelines (D4ACE) for plastic-based household consumer flexible packaging. The aim is to foster and stimulate the implementation of the guidelines to be sustainable and make flexible packaging circular [5]. As listed earlier, most usual materials used in flexible packaging production are paper, foil, and film and the challenge lies in the multi-layered packaging and its “complicated” recyclability [6].

There are some points of criticism concerning flexible packaging recyclability [6]:

- 1) **The layers are separated with difficulty.** This criticism falls on the bonding agents that fix the layers together and they are supposed to be strong. The layers should stick firmly together to avoid spillage, spoilage and other issues. This should be taken into consideration when dealing with recyclability and searching for solutions for recycling multi-layered flexible packaging.

- 2) **Using the film that is outsourced from non-renewable petroleum in flexible packaging.** The film allows heat-sealing and is used as a moisture barrier and a tie layer. Bioplastics that can be used instead are not necessarily the better solution because petro-plastics simply perform a better job. Also, the use of bioplastics does not reduce the number of layers in the packaging.
- 3) **Flexible packaging does not divert waste from landfills.** Although it is a little bit more difficult to recycle, it does not mean it is not sustainable. All efforts are aimed towards finding the perfect solution, but optimal choices for waste management need to be considered while circular economy is being introduced.
- 4) **The sustainability of flexible packaging needs to be supported.** The benefits of flexible packaging for sustainable development and waste management need yet to be proven. There are trade-offs being made for an optimal end-result.

It is important to note that the expiry date for new (recyclable) materials is definitely shorter than for those standard, traditional combinations of materials because of the weaker barrier. The shorter the shelf-life of a product is (e.g. cold meats and many other fresh products), the higher the costs of many different processes connected to production and packaging. Higher costs arise because planning is made difficult and there are losses due to much reject material. Logistical costs are increased in the transportation as well (something that is usually transported once, now, will have to be transported two times, and the consequence is additional cost and more CO<sup>2</sup> emission. The pursuit of a more sustainable packaging will prompt a new wave of investments in the machines because current machinery for manufacturing bags and other products are still not adjusted to new materials that act differently when processed in the machine. The production with this new (recyclable) materials in the existing machines causes significant increase of reject material which undoes the good effect of recyclable materials. For example, during the production of packaging comprising two polyethylene (the same type of material), there are issues arising in the production machine. Due to the combination of the materials, there is stretching occurring under the influence of higher temperatures. When the machine is restarted, there is more reject, and this happens until adequate quality of the packaging is achieved. The machinery that is developed for such new materials and combinations have better cooling options and other technical and technological specifications. Investment in new packaging machinery is inevitable if the companies in the flexible packaging industry want to maximize the possibilities offered by new recyclable solutions. It is necessary to stimulate and financially support investments in research and development of the recyclable flexible packaging in order to, as soon as possible, achieve better characteristics of the packaging regarding the shelf-life, so that such products can be commercially produced and be available for all the manufacturers of flexible packaging. This is the only model that will enable the same conditions and availability for the entire flexible packaging industry and create desirable environmental effect.

#### 4. CONCLUSION

The common goal for all the participants in the flexible packaging industry should be making uniform regulations on a global scale to have the most positive effect on the environment and to balance and reduce the costs for everybody in the production chain. Furthermore, the goals should include the prevention of frequent changes of the regulations that lead to changing the labels on the products (especially in food industry). This has negative influence on the costs and the environment because food manufacturers order less packaging from “fear” of the regulations being changed again and they would not be able to use the packaging supplies. If this happens, the packaging in stock is no longer usable and has to be destroyed.

It should be pointed out that the biggest positive effect on the environment and production costs is when larger amounts of packaging and finished products are produced at once. It is therefore crucial that the regulations do not change that often so that everybody is able to plan and reduce costs. Also, the changes in regulations should be announced early enough for everyone to have time to prepare and adjust. Once, there were only several types or flavours of a specific product (juices, snacks, chocolate, coffee...). But today, the number of the sub-products is significantly higher, which additionally increases the costs and environmental impact, and new sub-products are being introduced continuously. It would be ideal, but hardly to be expected, if the manufacturers would change this and stop introducing new sub-products. It is crucial to stimulate and financially support any investments in research and development of the recyclable flexible packaging products. This would enable better characteristics for such packaging regarding the shelf-life and such materials could be commercially produced and available. This model would offer equal opportunities and availability for the entire flexible packaging industry and create the desired effect on the environment.

### LITERATURE:

1. Ambipak magazin (27.04.2021). Fleksibilna ambalaža. Retrieved 03.08.2021 from <https://ambalazaipakovanje.com/znacaj-fleksibilne-ambalaze/>
2. Paul, S. (06.05.2021). Flexible Packaging Makes Sense. Retrieved 20.07.2021 from <https://www.packagingstrategies.com/articles/96179-flexible-packaging-makes-sense>
3. <http://hr.lankerbags.com/news/flexible-packaging-29228667.html>
4. FLEXIBLE PACKAGING EUROPE. Our vision for flexible packaging in a sustainable Europe. Retrieved 28.07.2021 from <https://www.flexpack-europe.org/en/sustainability/vision.html>
5. Packaging Europe (08.07.2021). How could revisions to the EU's Packaging and Packaging Waste Directive affect flexibles? Retrieved 02.08.2021 from <https://packagingeurope.com/how-could-revisions-to-the-ppwd-affect-flexibles/>
6. Sterling, A. (04.01.2021). Flexible Packaging: Hard to Recycle, but Green. Retrieved 18.07.2021 from: <https://www.packworld.com/design/flexible-packaging/article/21219628/flexible-packaging-hard-to-recycle-but-green>
7. Europski Parlament i Vijeće Europske unije (14.06.2018.). DIREKTIVA (EU) EUROPSKOG PARLAMENTA I VIJEĆA od 30. Svibnja 2018. O izmjeni Direktive 94/62/EZ o ambalaži i ambalažnom otpadu. Retrieved 12.08.2021 from <https://eur-lex.europa.eu/legal-content/HR/TXT/PDF/?uri=CELEX:32018L0852&from=ES>
8. Flexible Packaging Association. An Overview of The Flexible Packaging Industry. Retrieved 23.07.2021 from <https://www.flexpack.org/industry-overview>.
9. Perfect Packaging. Recycling. Retrieved 12.08.2021 from <https://perfectpackaging.org/recycling/#@40.77027075200147:-95.93705549677736zoom:4>
10. <http://hr.lankerbags.com/news/flexible-packaging-29228667.html> (Accessed on 07.08.2021)
11. Pauer, E., Tacker, M., Gabriel, V., Krauter, V. (2020). Sustainability of flexible multilayer packaging: Environmental impacts and recyclability of packaging for bacon in block. *Cleaner Environmental Systems*, Vol. 1(December 2020), 100001.
12. Mumladze, T., Yousef, S., Tatariants, M., Kriūkienė, R., Makarevicius, V., Lukošiuūtė, S. I., Bendikiene, R., Denafas, G. (2018). Sustainable approach to recycling of multilayer flexible packaging using switchable hydrophilicity solvents. *Green Chemistry*, 20(15), pp. 3604-3618.
13. Coltelli, M. B., Gigante, V., Cinelli, P., Lazzeri, A. (2019). Flexible food packaging using polymers from biomass. In Morganti, P. (ed) *Bionanotechnology to Save the Environment*, Basel: MDPI, pp. 272-298.

14. Deloitte Conseil (2017). Deloitte Sustainability Blueprint for plastics packaging waste: Quality sorting & recycling. Final report. Retrieved 17.08.2021 from: [www2.deloitte.com/content/dam/Deloitte/my/Documents/risk/my-risk-blueprint-plastics-packaging-waste-2017.pdf](http://www2.deloitte.com/content/dam/Deloitte/my/Documents/risk/my-risk-blueprint-plastics-packaging-waste-2017.pdf)
15. Marrone, M., Tamarindo, S. (2018). Paving the Sustainability Journey: Flexible Packaging Between Circular Economy and Resource Efficiency. *Journal of Applied Packaging Research*, 10(2), pp. 53-60.
16. <https://www.mmu.ac.uk/media/mmuacuk/content/documents/w2rin/5756-R4GM-IO4-Croatian-v4.pdf>
17. <http://www.ra-igra.hr/sto-je-cirkularna-kruzna-ekonomija/>
18. Bening, C. R., Pruess, J. T., Blum, N. U. (2021). Towards a circular plastics economy: Interacting barriers and contested solutions for flexible packaging recycling. *Journal of Cleaner Production*, Vol. 302 (June 2021), 126966.
19. European Commission (2020). Circular Economy Action Plan. For a cleaner and more competitive Europe. Retrieved 17.08.2021 from [https://ec.europa.eu/environment/pdf/circular-economy/new\\_circular\\_economy\\_action\\_plan.pdf](https://ec.europa.eu/environment/pdf/circular-economy/new_circular_economy_action_plan.pdf)
20. CEFLEX. Creating a circular economy (online). [ceflex.eu/](http://ceflex.eu/) (Accessed on 12.08.2021)
21. [sustainablepackaging.org/circular-economy-flexible-packaging-ceflex/](http://sustainablepackaging.org/circular-economy-flexible-packaging-ceflex/)
22. [ec.europa.eu/environment/topics/waste-and-recycling/packaging-waste\\_en](http://ec.europa.eu/environment/topics/waste-and-recycling/packaging-waste_en)
23. Swinheart, A. (12.08.2014). Is 100% recyclable packaging possible? Retrieved 13.08.2021 from <https://www.packagingdigest.com/flexible-packaging/100-recyclable-flexible-packaging-possible>
24. The Challenge of Recycling Flexible Packaging Retrieved 28.07.2021 from <http://www.flairpackaging.com/news/Recyclingchallenge>