SAT-ONLINE-P-2-BFT(R)-05

DEVELOPMENT AND MARKETING TRENDS OF FLEXIBLE PACKAGING MATERIALS

Assoc. Prof. Nataliya Kulyk, PhD

Department of Machines and Apparatus of Food and Pharmaceutical Productions National University of Food Technologies, Ukraine E-mail: nataliya.kulyk@ukr.net

Student Mariia Alipatova,

Department of Machines and Apparatus of Food and Pharmaceutical Productions National University of Food Technologies, Ukraine E-mail: maria.alipatova@gmail.com

Abstract: The paper reviews the main aspects of current market status of flexible packaging materials. The properties of the materials are indicated, which determine their advantages in comparison with other packaging materials. The current data of the analysis of the flexible packaging materials market are provided. The main trends in the flexible packaging development are considered, such as: individualization and convenience; optimization (design) of materials and processes; concern for human health and food safety; packaging in a pandemic and after COVID-19; e-commerce and contactless delivery, environmental aspects. The role of flexible packaging in circular economy implementation is defined. Examples of modern flexible packaging designed to meet the requirements of the circular economy are given.

Keywords: flexible packaging; polymer materials; monomaterials; recycling; sustainability; circular economy.

INTRODUCTION

Packaging is inseparable part of food and non-food products. It ensures their preservation, compliance with sanitary norms and aesthetic requirements, ease of sale and use, promotes product competitiveness, protects the rights of producers and consumers in the market. Trends in the food market are forcing packaging manufacturers to develop a strategy for the future. Competitiveness forms the demand for high-quality, relatively inexpensive and optimal, packaging. Packaging made of flexible polymeric materials (FPM) best meets these requirements. The features of such packaging are the use for its manufacture of polymer films and other flexible materials, the thickness of which does not exceed 250 microns. For companies, which produce and use flexible packaging, as well as for consumers of packed products, it is important to understand the trends of its development (Schreder V.L., Krivoshey V.M., Kulyk N.V., 2021).

EXPOSITION

Properties and advantages of flexible packaging materials

Modern FPM, which include polymer films, paper, aluminum foil, as well as combined multilayer materials, have significant advantages over other packaging materials. Their production consumes the least amount of resources: raw materials, energy, human labor, that is why they have the least impact on the environment (Schreder V.L., Gavva A.N., Krivoshey V.N., 2015). This ensures high efficiency of its use in terms of weight of the packed product.

FPM is resistant to loads, corrosion, impermeable to water vapor, gases, odors, can be transparent or impermeable to light, have excellent sealing properties (Coles R, McDowell D, Kirwan M.J. 2004). Packaging of them has a significant surface area, which is used for printing, providing information in accordance with the law, communication with the consumer. FPM helps to obtain creative forms of packaging, which in combination with a variety of printing design attract the attention of consumers and promote products on the market (Schreder V.L., Krivoshey V.M., Kulyk N.V., 2021).

An important characteristic of FPM is efficient recycling on packaging machines. And this list of benefits can be continued: it is constantly growing, because FPM packaging is the fastest to react on today's new challenges and offers innovative packaging solutions.

FPM packaging is characterized by a variety of structures, types, formats, functionality and applications. And the ability to combine different FPM in the manufacture of multilayer packaging materials satisfy the requirements for packaging of almost all food, pharmaceuticals, cosmetics and other products.

Market situation

Today, FPM packaging is one of the most widely used types of packaging in almost all world markets. In fig. 1 shows the global structure of the use of packaging from different packaging materials for food products and beverages. Ahead - packaging with FPM with a share of 37%. Together with rigid polymer packaging they occupy 63% of the market (Plastics – the Facts, 2019).



Fig. 1. The structure of packaging from different packaging materials for food and beverages (by number of units)

Production and use of FPM packaging are growing. In recent years, its growth rate has exceeded the growth rate of all other types of packaging (rigid plastics, metal, paper, cardboard, corrugated cardboard and glass). According to the report of Plastics Recyclers Europe "Flexible Films Market in Europe", the total demand for flexible films of all types of polymers in 2018 was 13-15 million tons, and the demand for films of all types of PE - 8.5-9.0 million tons. In addition, 1.2–1.3 million tons of film were produced from secondary PE. PP and multilayer films based on it accounted for 2–2.5 million tons. Demand for all other films (PET, PVC) and biodegradable films was 2.5–3.5 million tons. 23% of films are used for food packaging (among them the share of monofilms of all types of PE - 40%, PP - 35%, multilayer films - 20%, 5% - films of other polymers) (Marketers inform, 2020).

The structure of the use of PE films in the European market is shown in Fig. 2. (*Flexible Films Market in Europe: State of Play*.2020) In general, the European packaging industry uses 81% of the total number of PE films, including 23% for food packaging.



Fig. 2. The structure of PE films by main areas of use (by tonnage)

Studies show that the majority of FPM for food packaging are monomaterials from all types of PE (40%) and PP (35%). Approximately 20% are multilayer films of different polymers, 5% - on films of other polymers. Biaxially oriented PP is widely used for packaging of chips and snacks due to its rigidity, increased transparency, resistance to oils and fats, as well as water vapor barrier properties.

Futhermore, PP is used for packaging of confectionery and bakery products, groceries and other food products. For multilayer FPM, along with PE or PP use PET (as a barrier against moisture and chemicals), aluminum (as a barrier against moisture, oxygen and UV) and PA (as a barrier against oxygen and for the strength of packaging material). These materials are used to pack coffee, meat products, sauces and ketchups, cheeses, ready meals, animal feed and other foods (Schreder V.L., Gavva A.N., Krivoshey V.N. 2015).

41% of films from different types of PE are stretch film (18%) and shrink film (14%), which are used for wrapping and packaging of products in group packaging and transport packages on pallets. PE film, which is supplied in rolls (9%), is used for lamination, as well as for packaging household goods (bags for washing powder, tablets for the dishwasher, as well as other goods).

A special place is occupied by polymer bags made from PE film (22%), which include shopping bags, bags of various uses and garbage bags (Marketers inform, 2020).

Main development trends

FPM packaging responds quickly to changes due to consumer expectations, legal requirements, environmental aspects. It is constantly improved through the use of innovative materials and technologies. Among the main current trends in the development of flexible packaging, which are likely to affect the industry in the coming years and will determine the level of such packaging in the future, we can highlight the following: individualization and convenience; optimization (design) of materials and processes; concern for human health and food safety; packaging in pandemic conditions and after COVID-19; e-commerce and contactless delivery (What the future could hold for flexible packaging, 2020).

The result of urbanization, accelerating the pace of life and focusing people on professional and personal development is a reduction in free time. Busy consumers want to buy products and goods in portion and convenient packaging, which saves time. FPM packaging offers a wide range of formats and solutions for easy food consumption. Smaller pack sizes are in line with the growing number of individual households in many industrialized countries. The ability to easily open packages and integrated items that provide re-closure, allow you to use such packaging and consume products with better mobility. Heat-resistant packaging, which can be heated together with the product, provides convenient and fast consumption of ready meals (Schreder V.L., Gavva A.N., Krivoshey V.N. 2015).

In a competitive environment, it is extremely important to work with the highest possible level of efficiency. Achieving even higher speeds at each stage of production and reducing order execution time will be a key factor for further development. New opportunities and innovations in packaging design require certain changes in the operation of packaging and packaging equipment, so manufacturing companies will have to adapt their production, respond quickly and efficiently to these changes. Experience shows that the most effective way is to work closely with manufacturers of packaging equipment and materials with companies that use them (Schreder V.L., Krivoshey V.M., Kulyk N.V., 2021).

Materials in contact with foodstuffs is subject to strict legal requirements. As demand for maximum health and food safety grows, standards and norms are going to become even stricter. All participants in the value creation process, from raw material suppliers to brand owners, will have to work even more closely to create packaging solutions that improve the quality, freshness and safety of food (Coles R, McDowell D, Kirwan M.J., 2004).

The global pandemic is creating new challenges for the packaging industry, including flexible packaging. Consumers and retailers are now taking hygiene more seriously than ever before. People wash food packages after purchases, retailers disinfect warehouses, and e-commerce platforms provide contactless delivery. Packaging can contribute to this problem by increasing barrier protection, for example, by applying a durable antimicrobial coating to the packaging, which looks most effective for flexible packaging.

Many consumers who used to buy groceries and goods in stores now shop online. In addition, many e-commerce platforms work with local stores to deliver their products home. It is likely that this trend will continue even after the lockdown and pandemic, so many people will continue to buy without leaving home. Previously, product packaging was designed to stand out on store shelves. However, it now needs to be developed for appropriate perception on websites and in applications. This opens the way to innovation in order to attract the attention of the audience on the Internet and social networks.

The move to e-commerce also means that people will choose contactless delivery, especially when it comes to food. Improving the packaging design can make it easier to minimize contact between the delivery agent and the recipient. The use of technologies such as QR codes and digital engagement through physical packages will be crucial. It will be necessary to communicate with the end user using the infographics on the package (Schreder V.L., Krivoshey V.M., Kulyk N.V., 2021)

Flexible packaging and sustainability

Sustainability is not a new trend in the market of any packaging, but it continues to be a major factor contributing to its development. Flexible packaging uses less materials than other types of

packaging, saves resources and energy during production, and can be transported more efficiently, minimizing fuel consumption and CO₂ emissions (*Flexible Packaging Europe*,2020).

The multilayer structure of high-performance flexible packaging provides advantages in operation during all term of its use, but at the same time it is necessary to pay attention to conformity to modern requirements concerning processing of materials.

In the conditions of introduction of the circular economy the question of handling of packaging after its use is extremely actual. From the three possible scenarios (reuse, recycling or biodegradation) for flexible packaging, the last two are the most realistic. However, in order to implement them, it is necessary to have a clear idea of what the scenario is and how it will be implemented. To do this, you need to correctly define the requirements for future packaging (*Our Vision for Flexible Packaging, 2020*).

In the future, packaging will continue to provide reliable protection, functionality, provision of information, as well as marketing function (Fig. 3). But to these basic requirements are added no less important conditions, the fulfillment of which is necessary for the implementation of a circular economy. New packaging solutions should ensure that the packaging used has a minimal impact on the environment and global warming. Waste generated after the use of packaging should be recycled without environmental pollution (Designing for a Circular Economy, 2020).



Fig. 3. Requirements for flexible packaging in a circular economy

In order for flexible packaging to meet the packaging requirements after usage, in order to ensure that its collection, sorting and processing processes can be properly ensured, appropriate structures need to be developed (Designing for a Circular Economy, 2020)/ One such structure is a multilayer polymeric material (Alexandrov O.M., 2020), the packaging of which can be used for some products.

Such packaging of PE-monofilm doy-pack has already been developed and used for Frosch detergents (Werner & Mertz GmbH and Mondi Group) (Fig. 4a), Finish 0% for dishwashers (RB and Drukpol.Flexo) (Fig. 4b), sorbent for cats (Alico SA) (Fig. 4c). All of them not only keep the products without losses for a certain period, but, most importantly, after use, the products can be recycled.







Fig. 4. Doy-pack for Frosch detergents (a), Finish 0% tablets *for dishwashers (b) and sorbent for cats (c), made of PE monofilm*

B

According to experts, the recycling of used PE packaging within Europe could be tripled over the next decade. This requires increasing the growth rate of collection and processing of polymer materials in general (*Flexible Films Market in Europe: State of Play, 2020*).

Thus, it is expected that the PE film production sector can use a total of 36% of the total amount of secondary raw materials: the EU demand for PE can increase from 3.6 to 5 million tons of recycled PE by 2030 compared to only 1, 8 million tons in 2018 (*Flexible Films Market in Europe: State of Play, 2020*).

But not for all products packaging from monofilms of different structure can provide reliable protection during storage. Some products (coffee, sauces, ketchups, cheeses, meat products, etc.) require the use of barrier materials. Of course, reliable protection is provided by composite materials that contain a layer of aluminum foil in combination with layers of polymers. But such structures do not meet the requirements of a circular economy, because their processing is quite complicated and economically impractical. It should be noted that recycling technologies are constantly evolving, so it may happen that the combined materials with a layer of aluminum foil will be effectively processed by pyrolysis technology soon. Today, structures with aluminum foil are trying to replace. Combined materials that include layers of different polymers, like barrier ones, are increasingly being used to replace such structures.

The further development of the flexible packaging market is closely linked to the development of the recycling system. It is necessary not only to develop technologies for processing multilayer materials from different polymers, but also to ensure the required quality of processed products, as well as to develop technologies and applications for these products. It is necessary to improve the economic performance of such processing, creating favorable conditions at all stages - from harvesting to production of various products from recycled films (What the future could hold for flexible packaging, 2020).

CONCLUSION

Packaging from flexible packaging materials occupies a leading position in the market and has great prospects for development due to the small amount of resources for manufacturing, a variety of structures, functionality and recyclability. Flexible packaging is fully able to meet the demands of society as individualization, ease of use, care for the health and safety of food, especially the implementation of packed products in a pandemic COVID-19, environmental requirements. Public demands and compliance with the conditions for the introduction of a circular economy will determine the development of flexible packaging materials in the near future.

REFERENCES

Schreder V.L., Gavva A.N., Krivoshey V.N. (2015). *Packaging from polymer films*. Kyiv: IAC "Packaging".

Coles R, McDowell D, Kirwan M.J. (2004). *Food Packaging Technology*. Blackwell: Oxford, UK. ISBN 1-84127-221-3.

Schreder V.L., Krivoshey V.M., Kulyk N.V. (2021). Polymer packaging: monograph. Kyiv, Print Media.

(2020). Marketers inform. Packaging, 6, 16–18.

Alexandrov O.M. (2020), Innovative developments for polymer packaging. *Packaging*, 6. 24–27.

Flexible Packaging Europe. Available at: https://www.flexpack-europe.org/en/

Our Vision for Flexible Packaging. Flexible Packaging Europe's. June 2020. Available at :: https://www.flexpack-europe.org/files/FPE/sustainability/FPESustainability_Vision_June2020.pdf

Designing for a Circular Economy. CEFLEX. Available at: https://guidelines. ceflex.eu (2020). *Flexible Films Market in Europe: State of Play. Plastics Recyclers Europe*. Brussels, (2020). What the future could hold for flexible packaging. *Packaging, 1*. Available at:

https://packaging360.in/ news/what-the-future-could-hold-forflexible-packaging

(2019). Plastics – the Facts 2019. *PlasticsEurope*, 2019.