



DELIVERABLE D.T2.2.2 REPORT BASED ON THE OUTCOMES OF THE BUSINESS SUPPORT SERVICE (CHEMOSVIT FOLIE)

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1. TRENDS IN EUROPE

1.1. BIOPLASTICS

Plastic waste has increasingly been interfering with ecosystems and waste management in recent years, which is related to the growing production and consumption of plastics. These include products with a short life-cycle period, which are mainly packaging materials (films, pockets, bags) and articles intended for single use (plastic cutlery, trays, cups, jars, thermo-boxes for food, etc.). Due to the nature of use, these plastic products have a recycling problem, with their vast majority being made of synthetic plastics with very good durability practically against all types of degradation (thermal, light, oxidative, hydrolytic, biological). If these materials come into the natural environment, they remain in it for several decades to centuries. Gradually they get in the form of microparticles in the food chain and today there is nothing exceptional to detect these materials in fish bodies or in drinking water.

The proposal for a directive of the European Parliament and the European Commission of the 28.5.2018, under the heading "A European Strategy for Plastics in A Circular Economy" clearly declares the need to tackle plastic waste problems, in particular by reaching 100% recycling of all packaging plastic materials by 2030. This directive mentions to reduce the impact of several plastics products on the environment which represent about half of all disposable plastic items in marine litter found on European beaches. Europe has a responsibility for addressing the problem of marine litter originating from Europe and pledged to act on a global level, particularly through the G7 and G20 groups, but also through the implementation of the objectives of the United Nations in the field of sustainable development. The problem with the waste is naturally cross-border and waste originating from one country can have an impact on other countries by moving in the marine environment.

Addressing the ever-deteriorating situation in the field of the accumulation of plastic waste in the environment is looking for a long time in two basic ways: a) recycling of plastic materials in terms of material or energy recycling; b) manufacture and use of biodegradable plastic materials. From the point of view of the target of solving problems with plastics and plastic waste in connection with the protection of the environment, the production and the use of biodegradable plastic produced from renewable sources of raw materials is prospective and real sustainable alternative. Biodegradable plastics are able bio-degrade under conditions of controlled composting, as well as in the wild (land, water, sea water). The use of compostable biopolymer produced exclusively from renewable resources is in its essence an innovative concept.

1.2. PACKAGING MARKET

The comprehensive research employed in the future of Global Packaging to 2022, shows that packaging demand will grow steadily at 2.9% to reach \$980 billion in 2022. Technological improvements in the food processing sector, changing lifestyles, growth of the organized retail industry, and increasing popularity of food delivery services are the major driving factors behind the growth of flexible packaging market globally. The global flexible packaging market is expected to grow from USD 252.34 Billion in 2017 to USD 370.23 Billion by 2025 at a CAGR of 4.91% during the forecast period from 2018-2025, according to the new report published by Fior Markets.

Biodegradable packaging has quickly become an essential part of the global packaging market aiding to the ever-increasing consumer awareness and importance of eco-friendly substitutes. Major manufacturers of packaging are now looking to differentiate their products from those of their competitors by providing best possible biodegradable packaging products as per consumer demands. The demand for biodegradable packaging is increasing and will continue to increase as the companies utilize packaging like a medium to protect and promote the safety of the environment along with their products. Due to increasing degree of consumer awareness, and generic and contract manufacturing activities in Europe and North America, the developed geographies are expected to register maximum growth. In line with existing but also forthcoming EU legislation, is clear that the most viewed from the ecology perspective are plastic products with a short period of life, particularly disposable plastic items, mainly covering packaging materials. In many

applications, especially in food, plastic packaging is not possible to substitute e.g. by paper. Paper that has significantly worse barrier properties than plastic barrier film materials. At the same time, existing plastic film materials, most often available as shopping bags, or pockets do not meet the requirements for packaging food, in particular in the following parameters: - have weak mechanical properties; - have a very low barrier capability, in particular high permeability of oxygen and water vapor; - from an ecological point of view, it is either problematic to biodegradation, or contains a high proportion of plastics produced from fossil sources of raw materials.

Customers are becoming more aware of the environmental impact of their lifestyles. As fears over climate changes and Western consumption patterns continue to put a strain on the world's resources, environmentally conscious citizens are attracted to companies that share their concerns about environmental degradation. Customers want details of who manufactured a product and what they believe in. Sustainable production is therefore gaining in importance as customers choose brands that reflect their own values, lifestyles and worldview.

1.3. REGULATORY ENVIRONMENT

Environmental regulations play a role in motivating more biopolymer consumption in the longer term, especially with regards to recycling and composting. The European Union has introduced specific legislation requirements that support the environment friendly production, via legislation such as the Packaging Waste Directive and the new law banning single-use plastic items such as plates, cutlery, straws and cotton buds stick by 2021.

Biobased plastics, in which the fossil carbon is replaced by bio/renewable-based carbon, offer the intrinsic value proposition of a reduced carbon footprint and are in complete harmony with the rates and time scale of the biological carbon cycle. The process carbon footprint arising from the conversion of feedstock to final product is computed using life-cycle assessment (LCA) methodology.

2. COUNTRY SPECIFIC DATA – SLOVAKIA

2.1. MARKET IN SLOVAKIA

Slovakia has a problem with the increase of packaging and packaging waste. Between 2010 and 2016, the number of packages placed on the market increased from 436 thousand to 518 thousand tones. The volume of packaging waste increased from 278 to 360 thousand tones. In the latter case, this is an increase of almost 30 percent. Both trends called the Slovak Republic's waste prevention program for the years 2019 – 2025 as "unfavourable".

When the photo of the river full of the plastic bottles was discovered, it showed a warning finger in Slovakia. There was no remote country whose problems could be overlooked. It was a river Bodva and it was clear that with plastic waste we have a problem too. The Slovak market will come a year of billions of plastic bottles and roughly 345 million cans. Despite the sorted collection it manages to collect about something more than 60 percent of bottles and an unknown percentage of cans. The rest ends in landfills.

Or in nature. Freely determined beverage packaging distorts the ecosystem, sail on the rivers, seams and remove something. For example, the water dam Ružín must be cleaned regularly. Each year it catches hundreds of cubic meters of waste, which means the cost of tens of thousands of euros. The European Union calls for up to 90 percent of plastic bottles to be collected within ten years. The System of backup PET bottles and cans will begin to work since 2022. The lowest deposit per bottle will be 12 cents, per tin 10 cents.

Compared to the EU in 2015, Slovakia produced 106 417 ton of the plastics waste. In Slovakia, 19.6 kg of waste from plastic packaging per person was produced and 54% of plastics from plastic waste was recycled. In the EU it was 31 kg of plastic waste per person and 40% was recycled.

2.2. MULTIMATERIAL PRODUCTS

Advances in technology have improved product quality and versatility made from biodegradable plastics, while lowering production costs. This leads to better performance and provide economic incentives to motivate biopolymer market acceptance. The technology development will provide many new types of bioplastics for packaging and better ways of producing bioplastics. These developing bioplastics will offer varying degrees of bio-renewability and biodegradability.

2.3. BIOPLASTICS AND BIOCOSMOS MARKET IN SLOVAKIA

In Slovakia, it is difficult to talk about a market for products made of biodegradable plastics or packaging made from the bioplastics market and biocomposites. There are several marketing activities aimed at showing the advantages of this type of products, mainly in the ecological aspect, but their sale rate is negligible. It can be said there is no market developed for the paper-bioplasic packaging products yet. On the other hand, it has a good potential to develop as demand for such products is rising as it is seen from activities of PANARA company. All the players involved in the value chain of the paper-bioplasic packaging are already well represented, the only question is, how and when they will get started with new products business and trading.

3. ECONOMIC FEASIBILITY STUDY ON SOLUTION

CHEMOSVIT FOLIE, A.S. is the largest company in the group CHEMOSVIT, A.S. in commercial manufacturing activities, it manufactures, processes and sells packaging materials. It belongs to large players in the conversion of flexible packaging films in Central Europe. The company's main business activities include the production of foils (LDPE, LLDPE and cast film), printing (gravure, flexo-printing and offset printing), lamination (solvent, non-solvent and water adhesives) cutting, manufacture of pockets and bags, laser perforation, Application of UNI codes (also in direct contact with food).

In the Chemosvit group we deal with packaging applications made from renewable sources, such as maize. Since 2012 we have been participating in a project of developing biodegradable film called NONOILEN in cooperation with the STUBA and PANARA. In the work together we have developed and tested two types of films, which we are ready, in cooperation with our customers, to apply on the market. Their greater expansion is mainly hampered by a higher price, but this is also a matter of legislation and recommendations that should be prepared and adopted at European Union level.

Flexible packaging is very effective in terms of properties and low weight packaging, very well protecting the nutritional qualities of food and vitamins, are elastic and they have a very good barrier against external influences, allow for a treatment in the protective atmosphere, and have very good use even in medicine. This perspective on applying biodegradable materials, including paper/biodegradable plastic materials, we certainly see, because also from the above it follows that the benefits significantly outweigh the problems. And these problems have solutions not only in biodegradable packaging, but also in the completion of infrastructure and awareness or education of the population. It is necessary to create a legislative environment that minimizes landfill and, conversely, promote recycling and composting.

Chemosvit will innovate their product portfolio in the packaging segment through substitution of their current conventional packaging products by bioplastics 100% renewable biodegradable material NONOILEN. Chemosvit will focus on film blowing production of innovative garbage bags/bin bags (for processing of (biological) waste in gardening or in agricultural), transparent packaging films for fresh vegetables, fruits, bakery products (e.g. salad bags - bags with thickness around 20 microns, apple and potato bags), unprinted and printed bags for pellets packaging, transparent

packaging for flowers. With potential extension to other plastic packaging products - shopping bags (key product of the bioplastics industry), stretch films for pallets packaging.

3.1. CALCULATION OF THE TOTAL COST OF NEW PACKAGING MATERIAL

Some biodegradable materials are two to three times more expensive to produce than comparable non-biodegradable materials. However, non-biodegradable materials have their own hidden costs. For example, conventional plastic/paper packaging material is cheaper than biodegradable ones, but when you factor in the eventual cost of remediating the toxic chemicals they release in landfills, paper/biodegradable plastics materials are a more attractive choice.

The main components of new bioplastic NONOILEN is polylactide (PLA) and polyhydroxybutyrate (PHB). Therefore, the price and availability of these materials is crucial for success of this new material. While PLA is already widespread bioplastic material with relatively stable market conditions, PHB market is still turbulent. Demand for PHB is still in its infancy and one of the main PHB market barriers is unstable price. In years 2013 - 2014 the price per 1 kg of PHB was about 5€. However, the monopolization of the European market for production of PHB combined with unstable demand resulted in the price increase, while currently the PHB prices are between 2-10€ per kg. The new generation of NONOILEN uses thermoplastic starch and the price can be lower. Blending starch to the mixture forms films which are not such transparent comparing PLA/PHB mixture, but on the other hand they are better degradable in soil and even in sea water. Excellent is printability of these materials.

Since the price of the paper base is about six times lower in comparison with the price of films from synthetic polymers and biopolymers, there is a great space for the production of multilayer combined coat paper using water dispersions of biopolymers by lamination and adhesive lamination, or by extrusion while maintaining competitive advantage of paper. Current theoretical and practical knowledge in the field of the modification of the surface structure of the paper give the real prerequisites for the achievement of the proposed objectives in the field of technology of surface refinement.

3.2. BENEFITS

Biobased plastics, in which the fossil carbon is replaced by bio/renewable-based carbon, offer the intrinsic value proposition of a reduced carbon footprint and are in complete harmony with the rates and time scale of the biological carbon cycle. The process carbon footprint arising from the conversion of feedstock to final product is computed using life-cycle assessment (LCA) methodology.

Currently, the penetration of biodegradable plastics is increasing (mainly in packaging and injection molding). The key drivers for increasing demand of biodegradable plastics are favorable government outlook toward green procurement policies, shift of consumer toward green packaging, and compostability of biodegradable plastics. The technological developments and innovations are identified as key strategies to expand the biodegradable plastics market. Solutions will benefit from the innovative technology of the production of qualitatively new biodegradable, environmentally friendly and easily recyclable packaging materials based on paper, biodegradable polymers and their combinations. New technologies, that expand the range of products for packaging, will have a good performance and to be competitive on the domestic and foreign market.

Green image of companies and end-users-customers are becoming more aware of the environmental impact of their lifestyles. As fears over climate change mount and Western consumption patterns continue to put a strain on the world's resources, environmentally conscious citizens are attracted to companies that share their concerns about environmental degradation. Customers want details of who manufactured a product and what they believe in. Sustainable production is therefore gaining in importance as customers choose brands that reflect their own values, lifestyles and worldview.