

BEATA GÓRSKA / ORCID 0009-0000-4331-0218 / beata.gorska@lit.lukasiewicz.gov.pl

KRZYSZTOF WÓJCIK / ORCID 0000-0003-2191-1906 / krzysztof.wojcik@lit.lukasiewicz.gov.pl

EWELINA PAWLOWSKA / ORCID 0009-0001-9106-1305 / ewelina.pawlowska@lit.lukasiewicz.gov.pl

SIEĆ BADAWCZA ŁUKASIEWICZ, ŁÓDZKI INSTYTUT TECHNOLOGICZNY

BIOBASED PLASTICS IN THE LIGHT OF DYNAMIC LEGAL CHANGES

BIOTWORZYWA W ŚWIETLE DYNAMICZNYCH ZMIAN PRAWNYCH

ABSTRACT: We live at the time of a real legislative tsunami, connected with the policy of “Green Deal” and transformation oriented to closed economy. The policy of environmental protection is found in the very heart of the EU policy. In spite of the lack of the EU legislation concerning the bioplastics at this moment, certain legal changes are related to certain aspects of their application.

The Communiqué of the EU Commission, published at the end of 2022 is one of the documents outlining the direction of the future activity connected with the biobased, biodegradable and compostable plastics.

Key words: bioplastic, compostable packaging, biodegradable packaging

STRESZCZENIE: Żyjemy w czasach istnego tsunami legislacyjnego związanego z polityką „Zielonego Ładu” i transformacją na gospodarkę o obiegu zamkniętym. Polityka ochrony środowiska jest w samym sercu polityki UE. Mimo, że nie istnieją obecnie w UE akty prawne mające zastosowanie konkretnie do biotworzyw, to niektóre zmiany prawne dotyczą pewnych aspektów ich zastosowania.

Ogłoszony pod koniec 2022 roku Komunikat Komisji jest jednym z dokumentów wyznaczających kierunek przyszłych działań związanych z tworzywami sztucznymi pochodzenia biologicznego, biodegradowalnych i nadających się do kompostowania.

Słowa kluczowe: biotworzywa, opakowania kompostowalne, opakowania biodegradowalne

Bioplastics appear in our everyday life as an alternative to the presently dominating traditional plastics. They are employed in such applications as packaging, which constitute almost a half of demand on the discussed materials but also, in such sectors as agriculture, transport or construction industry.

In the Communiqué of the European Commission of 2021 on “Sustainable carbon cycles”, the ambitious goal was set; it is expected to help in the approximation of the European economy to climate neutrality. According to the mentioned objective, at least 20% of carbon used in chemical products and that one in plastics should originate from the sustainable non-fossil resources.

The current state of the knowledge on the sustainable development of products confirms that focusing exclusively on recycling and reuse is not sufficient as to limit the green house

gases (GHG) emissions and to reach the independence on fossil fuels. In order to pass really to the model of closed economy, it is necessary to replace the fossil-based fuels with the organic-origin materials, obtained by the sustainable methods.

Plastic materials of organic origin (bioplastics), biodegradable and compostable plastics are commonly perceived in Europe and at the international markets, as being more environment-friendly as compared to the traditional plastics which are based on fossil fuels and are not subjected to biodegradation. At the same time, together with the development of bioplastics, there was developed the knowledge on the conditions to be met as their production and application had a positive effect on the environment.

There is no currently EU law being specifically applying to bioplastics although certain regulations such as Directive on single-use plastic products (SUP) or Directive on packaging and

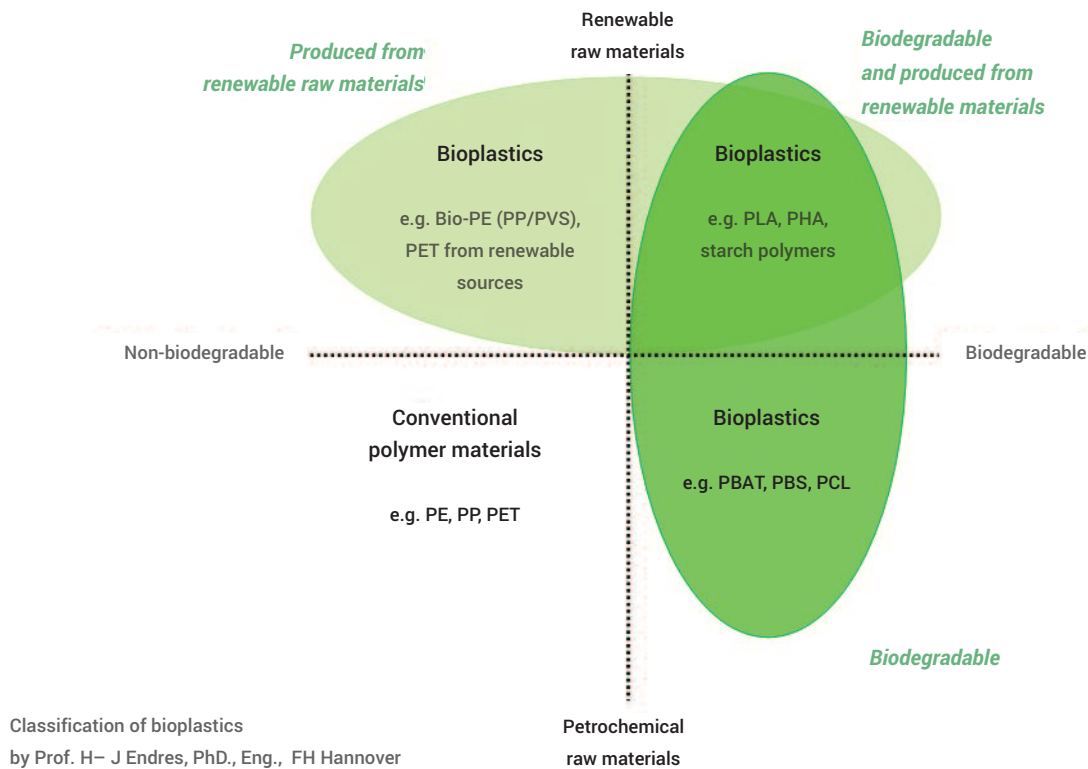


FIG. 1. CLASSIFICATION OF POLYMER MATERIALS ACC. TO THE EUROPEAN BIOPLASTIC ASSOCIATION

packaging waste together with the suggested amendments, concern certain aspects of the application of biobased, biodegradable and compostable plastic materials.

The Communiqué of the Commission, as published by the end of 2022 on the framework of the EU policy has a non-legal act character, i.e. it is not legally binding document but it reflects the opinions and intentions of the Commission concerning the mentioned materials and it will shape the EU policy such as initiatives connected with ecological statements, eco-design etc.

WHAT EXACTLY ARE BIOPLASTICS?

Bioplastics constitute a highly diversified group of materials. According to the European Bioplastic Association, the term 'bioplastics' includes the materials which are produced on the grounds of renewable sources, or are biodegradable, or combine the both mentioned features.

The materials, obtained from the renewable sources are wholly or partially made from biomass. The biomass for bioplastics may derive from such sources as e.g. maize (corn), sugarcane, or cellulose.

Biodegradability is a capacity to be subjected to chemical processes during which the microorganisms convert the

polymer material into substances such as water, carbon dioxide and compost (without participation of the process-supporting aids). The process of biodegradation is dependent on the environment conditions (such as temperature, humidity, etc). To illustrate better the introduced definition, the European Bioplastic Association has developed a model, showing the particular types of polymer materials. The mentioned model is presented in Fig.1.

CLASSIFICATION OF BIOPLASTICS

Bioplastics may be classified into three groups, according to the source of origin and capability to biodegrade:

1. Plastics coming from renewable raw materials but being not subjected to biodegradation – e.g. polyamide (PA), polyethylene terephthalate (PET);
2. Plastics subjected to biodegradation (biodegradable) but not deriving from renewable raw materials – e.g. polybutylene adipate terephthalate (PBAT) or polycaprolactone (PCL);
3. Plastics coming from biodegradable renewable raw materials – e.g. polylactide (PLA), polyglycolide /poly (glycolic) acid (PGA) or modified starch.

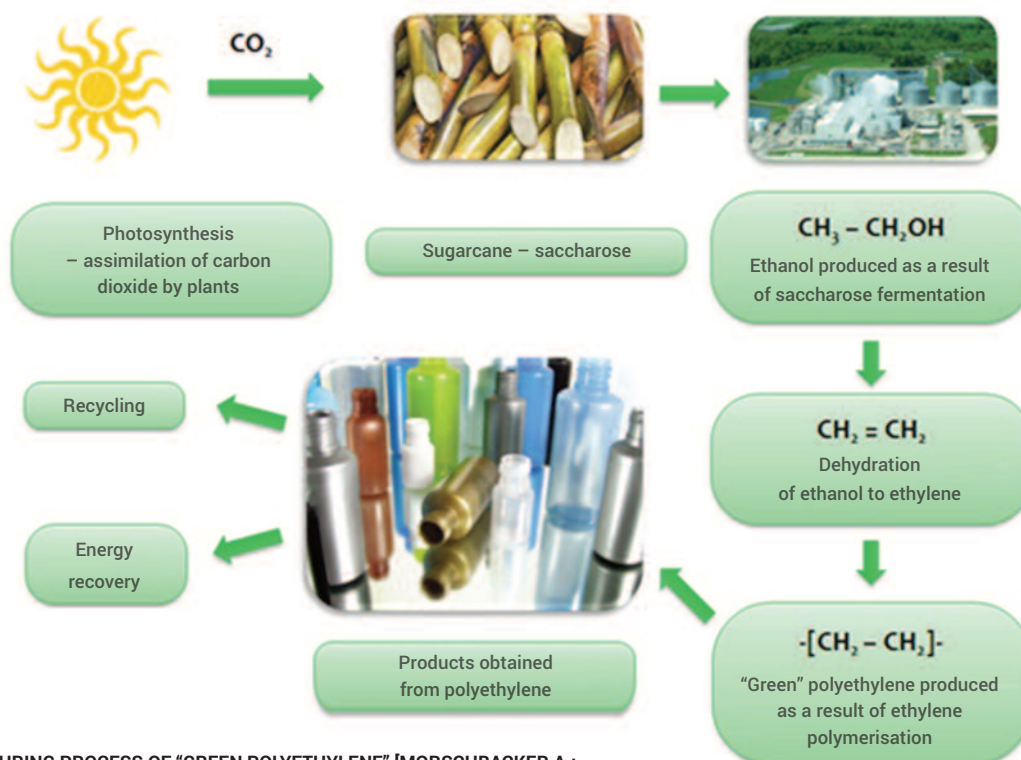


FIG. 2. MANUFACTURING PROCESS OF "GREEN POLYETHYLENE" [MORSCHBACKER A.:

BIOBASED PE – A RENEWABLE PLASTIC FAMILY, BRASKEM S.A., EUROPEAN BIOPLASTICS CONFERENCE HANDBOOK, 21-22, PARIS, NOVEMBER 2007).

Non-biodegradable polymer plastics produced from renewable raw materials have the properties identical as conventional polymer plastics, obtained from the fossils. The example of such material may be the so-called "green polyethylene" which is generated as a result of polymerisation of ethylene from ethanol, obtained during the fermentation process of plant raw materials. There are few types of the "green" polyethylene, e.g. high density polyethylene (HDPE) or low density polyethylene (LDPE).

BIODEGRADABLE BIOPLASTICS

Biodegradable polymer plastics may be classified according to the origin, into polymers obtained from renewable sources and the polymers obtained from the fossils.

The difference between the mentioned two types of plastics concerns only the origin of the raw material from which they are produced. The submitted classification according to the origin is, however, only theoretical as many producers employ the mixtures of polymers, deriving from the fossils as well as from the renewable sources.

So, what is, therefore, biodegradation? Biodegradation is a complex chemical-biological process, leading to decomposition of organic matter into simpler compounds by certain

microorganisms present in the environment. The biodegradation of packaging material runs gradually. At first, the process of degradation of the polymer takes place; under the favourable conditions, it is terminated by its polymerisation, i.e. decomposition into smaller fractions and generation of simple chemical compounds which constitute a nutrient for microorganisms. Fig.3 illustrates the difference between the degradation and biodegradation. If the process is ended at the stage of fragmentation, it means that the discussed above material was subjected only to degradation. The presence of the successive stage, being called mineralisation, means that the discussed material is biodegradable. The final product of degradation is biomass, water and gases: for aerobic conditions – carbon dioxide and for anaerobic conditions – methane.

The exemplified biodegradable polymers deriving from fossil sources include: synthetic aliphatic polyesters – polycaprolactone (PCL); polybutylene succinate (PBS); synthetic aliphatic-aromatic copolymers (AAC); water-soluble polymers – polyvinyl alcohol (PVAL).

The biodegradable polymers from renewable sources are the alternative to the discussed above polymers. The mentioned plastics may replace the classical polymer materials obtained

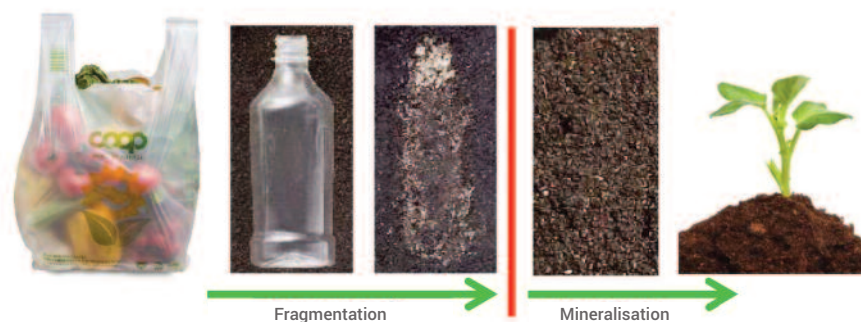


FIG. 3. DIFFERENCE BETWEEN DEGRADATION AND BIODEGRADATION

from petrochemical sources. The materials which deserve our attention include: polylactide (PLA), polymer-starch composites, polyhydroxyalkanoates (PHA) and, also, cellulose films of new generation. The so-called “double-green” plastics are characterized by the properties similar to those of classical polymer materials and they are attractive due to their growing availability at the market.

In 2022, the European Commission adopted the framework for the policy concerning obtaining, labelling and use of bioplastics and the application of biodegradable and compostable plastics. The policy frames were published in the European Green Deal, the action plan concerning closed economy and the strategy in the field of plastics, with the aim to contribute to sustainable management of plastics. The mentioned framework explains how, under what conditions and applications, the mentioned innovative materials may bring the profits to the environment. In the cited Communiqué, there were specified the conditions which must be met by the product, determined as “biobased product” (“biological-origin product”), “biodegradable product” and “compostable” product.

DEFINITION: “BIOBASED”

In the case of term “biobased” (bio-origin), the mentioned definition should be employed only when the participation of plastics in a given product is precisely and measurably specified. Besides it, the biomass must be obtained by a sustainable method, without harm to the environment. Obtaining of the discussed plastics should be consistent with the criteria of the sustainable development.

During the contacts with the consumers, the declarations concerning the biobased plastics should be referred to a real content of bio-carbon (carbon) in the product. The

mentioned declarations should be performed on the grounds of calculations with the application of C-14 (radio-carbon) method in accordance with the respective standard.

Such tests are carried out and utilized by more aware producers. In Poland, the certification of packaging materials, which are produced from renewable raw materials or with the participation of renewable raw materials, belongs to the tasks of the Łódź University of Technology – Centre of Packaging COBRO.

In relation to the content of renewable raw materials, the European Plastics goes by step further and announces the thesis that the minimum level of bio-products should be promoted at the same degree as the content of materials coming from recycling in the plastic products, being specified in the proposal for a regulation of the European Parliament and of the Council on Packaging and Packaging Waste (PPWD – Directive 94/62/EC). In the opinion of the mentioned above association, organic matter as well as the content of materials, coming from recycling contribute to reduction of dependence on primary fossil sources and GHG emissions and they should be supported in equal degree.

DEFINITION: “BIODEGRADABLE”

For biodegradable products, the conditions, environment and the required time framework of biodegradation process, as expressed



FIG. 4. MARKS, GRANTED IN POLAND TO THE PACKAGING, CONTAINING RENEWABLE RAW MATERIALS

in weeks, months or years, should be determined. The indicated time frames should ensure the minimum effect on the environment. Such statements should be based on the existing standards or certification systems. The products, which as being the waste, may get to the environment, including here the products covered with the Directive on single-use plastic products, can be neither announced nor marked as biodegradable ones.

DEFINITION: "COMPOSTABLE"

To avoid misleading of the consumers, only industrially compostable certified plastics (suitable for industrial composting) should be qualified as "compostable". Besides it, they should always possess information on their destination for industrial composting. A lack of the knowledge about the correct methods of collecting the compostable packaging is the universal problem. The resulting cross-contaminations of conventional and compostable packaging waste made from plastics lower the quality of the generated recyclable raw materials. In order to direct the products of this type to the appropriate stream of waste, they should be properly marked. The Commission recommends application of readable pictograms, specifying where a given product should go after use.

The industrially compostable plastics should be employed for the specified application only when the environmental profits resulting from their use are higher than from the application of conventional plastics. Moreover, the effect of the potential consumer behaviour should be taken into consideration.

In connection with the above facts, the proposal of the Commission concerning the regulation on packaging and packaging waste requires the application of packaging made from compostable plastics in relation to the products and applications in the case of which the reduction, re-use or recycling are not possible. Moreover, the plastics of such type should not be treated as the solution of the problem of inappropriate management of waste or littering of the environment.

According to the guidelines of the Commission, bioplastics suitable for composting under industrially controlled conditions (in bio-waste processing plants) will bring the measurable profits in such applications as tea bags, filtrated coffee capsules, removed together with the used coffee products,

viscous labels sticking to the fruits and vegetables and very light shopping bags.

The application of compostable plastics cannot obscure the priorities which include limitation of use of plastics and keeping all raw materials, including those of bio-origin in the life cycle as long as possible.

Summing up, the initiative of the European Commission relating to the first complex frames of the European policy in the field of bioplastics is important and necessary action – it also discovers the fact that there are still many areas, connected with the discussed materials, which divide the plastic sector and raises controversies. They include the problems connected with the assessment of the life cycle of bioplastics, utilization of land, evaluation of measurable profits for the environment, risk of cross-contamination of waste streams, and biodegradability in different environments. For the part of stakeholders, the potential of bioplastics is still promoted too carefully and the undertaken measures are still insufficient and do not reflect the main advantages of bioplastics, i.e. utilization of renewable resources for manufacture of plastic materials, and their contribution to the transformation leading towards a closed economy, being neutral in respect of carbon dioxide emission.

LITERATURE

- [1] Plastic Europe, www.plastics-europe.org
- [2] European Bioplastics Association
- [3] "Morschbacker A.: Biobased PE – A Renewable Plastic Family, Braskem S.A., European Bioplastics Conference Handbook, 21-22, Paris, November 2007
- [4] Plastic "Biotworzywa są szansą przyszłości COBRO
- [5] „Opakowania biodegradowalne” Hanna Żakowska
- [6] <https://pol.sciences-world.com>
- [7] EU policy framework on biobased, biodegradable and compostable plastics
- [8] Communication from the Commission to the European Parliament and the Council: Sustainable Carbon Cycles
- [9] [kierunekchemia.pl/PCC Rokita SA](http://kierunekchemia.pl/PCC_Rokita_SA)
- [10] REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on packaging and packaging waste, amending Regulation (EU) 2019/1020, and repealing Directive 94/62/EC
- [11] Relevance of Biodegradable and Compostable Consumer Plastic Products and Packaging in a Circular Economy; 2020

COBRO – Centrum Opakowań
ul. Konstancińska 11, 02-942 Warszawa
tel.: +48 22 842 20 11 w. 25, eko@lit.lukasiewicz.gov.pl

Safe
CONFERENCE
packaging **12**

*Save
the date!*

November 16-17th

Airport Okęcie Hotel, Warsaw

More details coming soon on Opakowanie.pl

