BIOPLASTICS, A WAY TO PROTECT THE ENVIRONMENT

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Abstract *The production of plastics, which needs to use raw material and is difficult to regenerate, has grown up a lot lately. Each year, over 70 millions tones of polymers are produced and they end up in waste deposits. Plastic production has high costs and their period of time to biodegrade is very long, harming the environment. A lot of methods to produce plastic was and is still being looked for to protect the environment. One of them is to produce the biodegradable plastic based on starch, protein composites. The paper presents the characteristics of raw materials, the technologies of producing and of using the bioplastics.*

Key words: bioplastics, environment, plastic

1. Introduction

The production of plastics, which use raw materials- difficult to regenerate- has grown up a lot lately. There are used between 500 milliards and one trillion of plastic bags worldwide, which makes some places to look depressing. These plastic bags' period to biodegrade can reach up to 1000 years.

2. The necessity of introducing the bioplastics

The process of replacing the plastics with the bioplastics is a necessity because, as I have shown above in the introduction, they have a very long lifespan. Since 1950 one milliard of tones of plastic have been thrown and they can remain in nature hundreds or even thousands of years. The negative effects of plastic bags are the following:

- during the burning , the plastic bags emit toxic gases;
- referring to the protection of the environment , the plastic bags are a problem because they are an important source of garbage for communities and they are also difficult to deposit (fig 1);

- they also represent a danger for sea life. Different species suffer because they swallow them or they get stuck between them. There are studies of American

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researches which prove that the plastic bag is a real source of danger for marine life (fig 2);

Fig. 1. Plastic wastes

Fig.2.a. Turtle drowned with a plastic bag **Fig.2.b**. Dolphin caught between pontoon and plastic wastes

- The negative effects are not only for the species living in the sea but also for those which live on earth;
- The plastic bags can suffocate or interrupt the digestion of the animals which consume them (fig 3);
- It is estimated that plastic bags kill at least 100 000 birds, whales, seagulls and turtles each year;
- The visual pollution of thrown bags is significant;
- The plastic bags can gather in swamps where dangerous microorganisms can grow, including insects which can spread malaria (fig 4);
- The plastic bags stuff the sewerage system of the cities;
- The production of plastic bags use 37 000 tones of plastic polymers which are made of non-biodegradable sources;

Fig. 3. A lion swallowing a plastic bag

Fig. 4. Infection outbreak

- Even if plastic bags can be recycled, just a part of them are collected and reprocessed;
- The plastic bag is considered a free convenience but the costs for just one household are between10- 15 dollars per year;
- The studies show that a plastic bag is used by a buyer for about twenty minutes comparing it with other types of packing materials which are used weeks, months or even years;
- Nowadays, in Romania the plastic bags fill the garbage deposits , are thrown in the streets or in parks, and flow on rivers courses;
- Recent studies have shown that a Romanian uses about 250 plastic bags per year, this estimation being an optimist one;

3. Solutions

The recycling of plastics is a very difficult process. One of the problems is the selection of the plastics, a process difficult to be automated, the selection being made manually. To select them , the workers look for the identification code of the different types of plastics. These are some of the reasons why it is necessary to replace the plastic with bioplastic.

The bioplastic, also called organic plastic is a form of plastic mass which was produced from sources possible to be regenerated, of biomasses as the vegetable oil, the maize starch or microbiota.

Another method to protect the environment of the negative effects of the plastic is to replace the plastic bags with paper or material ones. By replacing the plastic bags with cloth ones, we can use 6 plastic bags less per week, which means 24 a month and 288 a year.

4. Bioplastic production

The idea to produce bioplastics is not new, it has appeared since the middle of the 19th century. The bioplastics can be produced from natural polymers, natural monomers(PLA, poli-3-hydroxibutirats PHB), synthesis of fossil fuels (PCL), polycaprolactams, bio – polyethylenes derivates.

Some of the approaches are:

- (I) the modification of the existing materials;

- (II) the co- chemical polymerization of the known biodegradable materials;

- (III) the usage of biopolymers to obtain the plastic material.

I. Partially biodegradable bags are already being produced from fine matrices from polyethylene completed with starch. After the bag is thrown away, the micro-organisms eat the starch, leaving a fine structure of polyethylene which soon disintegrates. Fertec, (Feruzzi technology, Ricercae) in Italy and Warner Lambert in USA, produce biodegradable bags, based on starch from the plastic material.
The starch occupies up to 50% from the weight of Fertec material and the rest of it is a synthetic polymer. The material shows a partial biodegrading in Warburg test. The bags produced by Warner Lambert base on 80% starch and are called Novon. The bag Novon is biodegradable in garbage deposits compost controlled, aerobe and anaerobe in the aquatic medium.

The company has the capacity of production of over 25 000 tones per year since 1992. At present, the production of biodegradable plastic occupies just a small part of the market, comparing it with the petrochemical products, which are the conventional ones whose production raises over 100 millions tones a year.

II. "Biocenta" is a new biodegradable plastic. This was produced by Rhone Poulenc' s brand in Belgium , plastic materials, Tubiz. "Biocenta" uses additives which plasticize and accelerate the degradation with microorganisms.

The company of chemicals Sekisui developed a new biodegradable plastic material co- polymerizing two chemical products on the base of derivative aliphatic polyester. The product has the properties of plastic but it is completely biodegradable. This was conceived in collaboration with the Industrial Searching Institute, Osaka.

The material is based on a polyester which decomposes with the help of enzymes. According to the firm, this material is stronger than polyethylene, it has a higher melting point (over 90%) and it has a faster degree to biodegrade. A film of 100 microns is completely biodegradable in soil, in just two months.

III. The bioplastics

The biopolymers are obtained from the raising of microorganisms or from plants, which are genetically industrial, to produce these types of polymers. They are used to replace the plastic materials which are being used at present, at least in some domains. Poli-3-hydroxibutirats and the polylactide acid are types of polymers used as materials for bioplastic.

4.1 General

The polilactic acids and Sorona polymers are produced in a process having three stages. The raw material is present in the harvest, initially in the form of crops, crops remains or other biomasses, refined to increase the sugar plant production (first of all of glucoses and xyloses).

A secondary stage of production is the forming of subunities of monomers through fermentation and separation. Finally, the third stage stays in the traditional chemical production to form the polymers, which will finally be changed into bioplastic. (fig. 5)

4.2 Poli-3-hydroxibutirats

The biopolymer poli-3-hydroxibutirats (PHB) is a polyester produced by certain bacteria which process glucoses or starch. Its characteristics are similar to those of petroplastic polypropylene. The sugar industry in South America, for example has decided to extend the production of PHB at industrial scale. PHB can be distinguished first of all due to its physical characteristics. A transparent film at the point of melting of 130 degrees Celsius is produced, and it is biodegradable without wastes.

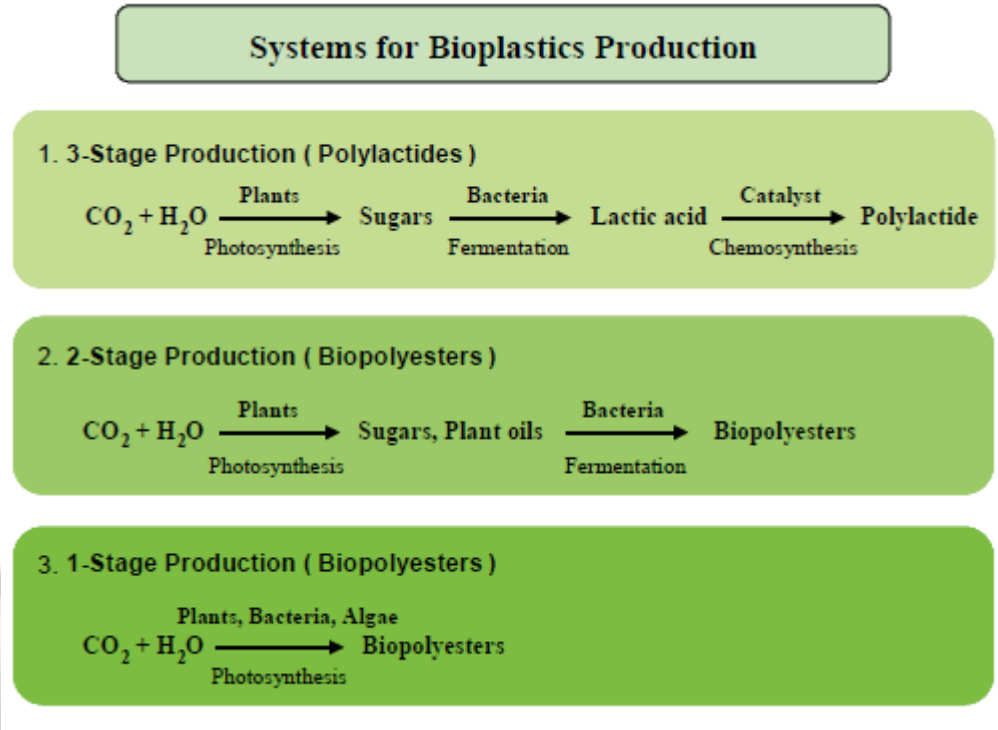

Fig. 5. The system of bioplastic production

4.3 The bio-polyethylene derivatives

From chemical and physical point of view, the bio-polyethylene derivatives are identical to the traditional polyethylene. Bio-polyethylene is not biodegradable, but it can be recycled. By using bio-polyethylene we can reduce gas emissions which have greenhouse effect.

The biotechnology industry provides ways to obtain the polymers. The biomasses in factories can be changed into glucoses, fatty acid, or other small molecules either as a product either as a waste flow\flux from the production of other processes. These small composites can be then changed into bioplastics through microbial fermentation or chemical polymerizing. For example, poli-3-hydroxibutirats (PHB), biocelluloses, xanthan, silk can be produced by recombining or through fermentation processes of some wild types of microorganisms.

Conclusions

According to figure 6, the production of biodegradable plastic masses is in a continuous increase, the majority of them being the biodegradable plastic masses based on regenerating raw materials.

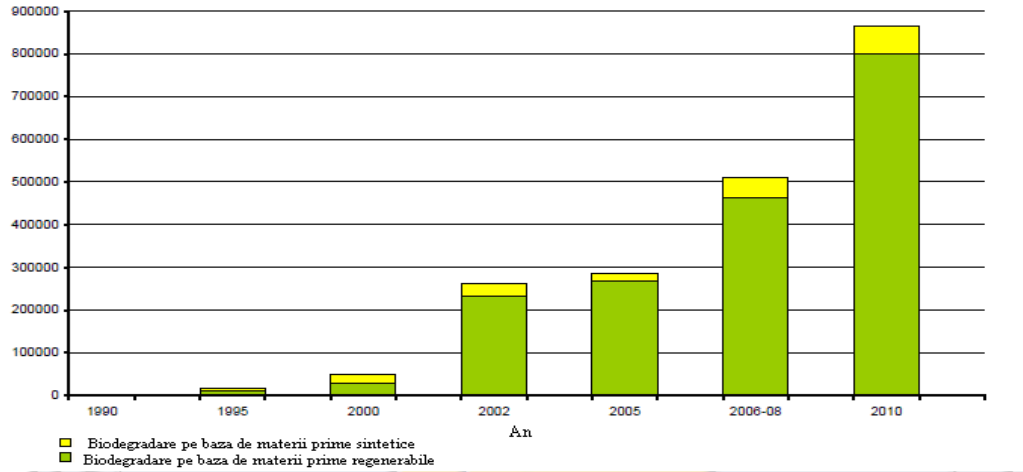

Fig. 6. Developments in production of biodegradable plastics

The bioplastics are much more easily recycled and with less work and energy consumption than the non-degradable plastic materials. The bioplastics degrade faster than the plastic masses produced from petrol so they disappear and are absorbed back in the soil faster and easier.

The PHB is 100% biodegradable, can be produced as thermoplastic and is 100% resistant to water , so it can be used as having the properties of a plastic material.

The PHB biodegradability was tested in different aquatic environments. In a study in the lake Lugano in Switzerland , different elements were placed at different depths in the water. It was estimated that a period of time equal to 5-10 years is necessary for the bottles in these conditions to biodegrade (supposing that there is no increase in the surface), while PHB material was degraded, 20 cm in the upper part of the sediment in just 254 days , at temperatures which weren't higher than 6 degrees Celsius.

The plastic materials degrade in about 400- 600 years or even more. Moreover, these are produced using non-regenerating sources and are also toxic. In comparison to plastic masses, the bioplastics need a shorter period of time to biodegrade as they are presented in the following table.

Table 1. The period degradation of bioplastics

The type	*The source*	*Toxicity*	*The period to degrade*
The polylactides acid (PLA)	Regenerating	Non-toxic	In soil:2- 3 weeks; In water: the exact period of time is not known but it is difficult to biodegrade at less than 6 degrees Celsius temperatures
poli-3-hydroxibutirats (PHB)	Regenerating	Non-toxic	In soil:4 weeks; In water: the exact period of time is not known but it can be digested
Polycaprolactams	Non-regenerating	Non-toxic	In soil:2- 6 weeks; In water: 8 weeks

Considering the costs, at a first glance, the bioplastic production is more expensive but in long term , the costs are justified by the benefits which are obtained for the environment.

R E F E R E N C E S

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