

# INVESTIGATION ON UTILIZATION OF BIOPLASTICS IN TURKEY

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**ABSTRACT:**In the last decades there has been a significant increase in the amount of plastic wastes all over the world. Increasing environmental concerns/legislative pressure for petroleum-based plastics waste and rapid increases in the cost of petroleum have enabled to the development of bioplastics. “Bioplastics” are polymers made from renewable resources such as corn, sugars, potatoes, etc., and this materials have a wide range of applications in packaging, consumer goods, electronics, transportation, construction, medical and many other fields. The global bioplastics market is thought to be growing at a rate of as much as 20% per year. Total consumption of bioplastics worldwide at an average annual growth rate of 13% from 2009 to 2014. Bioplastics are currently considered the way to go and may be the only alternative in the future as fossil resources become exhausted. Whereas the bioplastics has yet known in recently and bioplastics technology development is in adequate in Turkey. Firms in the plastic industry should to be act in partnership for developing bioplastic technology in Turkey.

## 1. INTRODUCTION

Plastic materials are currently considered very important materials due to their properties and performance over other materials such as metal and wood [Aguado and Serrano, 1999, Azapagic et al, 2003, Plastics Europe, 2008, Rosato and Rosato, 2003, Alvarez-Chavez et al, 2011]. So plastics are used in a wide range of applications and generated huge amounts of plastic wastes all over the world [Stevens, 2002]. The plastics have caused extensive environmental problems associated with their disposal [Wu, 2009]. Because of environmental pollution problems caused by using plastic made by petrochemicals, the development of environmental friendly materials has attracted extensive interest [Gaspar et al, 2005]. Nowadays, manufacturers and researchers are developing *bioplastic* materials that one of environmental friendly materials. Although the bioplastic utilization and production is known all over the world,

the bioplastic production has just started in Turkey.

The aim of this study emphasizes the importance of the production and use of bioplastic at different application areas.

## 2. WHAT IS BIOPLASTIC?

Generally, ‘bioplastic’ are made from renewable resources such as corn, sugars, potatoes, etc., and they can be degraded under controlled conditions of biodegradation [Karana, 2012; Sarasa et al., 2009]. There are four types of degradable plastics: photodegradable bioplastics, compostable bioplastics, bio-based bioplastics and biodegradable bioplastics.

*Photodegradable bioplastics* have light sensitive group incorporated directly into the backbone of the polymer as additives. Extensive ultraviolet radiation (several weeks to months) can disintegrate their polymeric structure rendering them open

to further bacterial degradation. However, landfills lack sunlight and thus they remain non-degraded [El Kadi, 2010].

The Business-NGO Working Group for Safer Chemicals and Sustainable Materials defines *bio-based bioplastics* as “plastics in which 100% of the carbon is derived from renewable agricultural and forestry resources such as corn starch, soybean protein and cellulose” (Business-NGO Working Group for Safer Chemicals & Sustainable Materials, 2007). The US Department of Agriculture defines bio-based plastics as “commercial or industrial goods, (other than feed or food), composed in whole or in significant part of biological products, forestry material, or renewable domestic agricultural materials, including plant, animal or marine materials” (The Biodegradable Products Institute, 2006) [Alvarez-Chavez et al, 2011].

*Compostable bioplastics* are biologically decomposed during a composting process at a similar rate to other compostable materials and without leaving visible toxic remainders. In order to designate a plastic as bio-compostable, its total biodegradability, its disintegration degree, and the possible eco-toxicity of the degraded material must be determined by means of standard tests (AENOR, 2001; Tuominen et al., 2002) [Sarasa et al., 2009].

*Biodegradable bioplastics* are fully degraded by microorganism without leaving visible toxic remainders. The term “biodegradable” refers to materials that can disintegrate or break down naturally into biogases and biomass (mostly carbon dioxide and water) as a result of being exposed to a microbial environment and humidity, such as the ones found in soil, hence reducing plastic waste, whereas bio-based sustainable materials (Haugaard et al., 2001;

Lagaron, Gimenez, & Sanchez-Garcia, 2008; Petersen et al., 1999). The fourth types of bioplastics are rather promising because of its actual utilization by microorganism [El Kadi, 2010].

### 3. THE BIOPLASTIC MARKET

Researchers have developed several tools to assist in decision-making about plastics selection. The plastics pyramid (Figure 1) developed by Thorpe and Van der Naalde in 1998 was an early attempt to visually display the life cycle hazards of different plastics to assist in materials selection. In this pyramid, bioplastic the bottom of the pyramid, indicating they are most preferable, as they are made from renewable resources, and theoretically are biodegradable and compostable [Alvarez-Chavez et al, 2011].

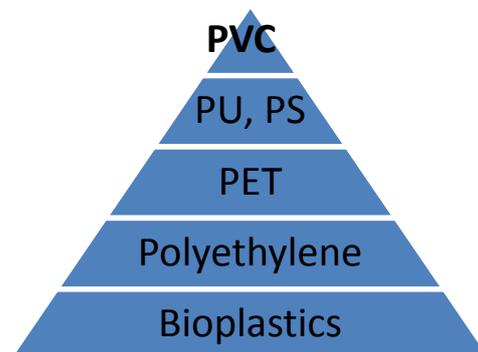


Figure 1: Plastics Pyramid (PVC: Polyvinyl chloride, PU: Polyurethane, PS: Polystyrene, PET: Polyethylene terephthalate)

Since the plastics pyramid was developed, bioplastics are much further along in their commercial development.

Packaging films and containers bioplastics are particularly interesting, since most of these products have a relative short service life and end up in landfills (Figure 2). Biodegradable bioplastic have been found to possess wide range of properties, which find

application in biomedical field like making bone plates and screws, in drug delivery carriers and tissue engineering scaffolds (Marquesa et al., 2002) [Kaith et al, 2010].



Figure 2: Bioplastic spoon

Many countries around the world have already begun to integrate these materials into their technologies. In America, McDonald's is now making biodegradable containers for their fast food. Other companies such as Bayer, DuPont [Iles and Martin, 2013], Dow Cargill, Nike and Danone etc. are also producing biodegradable packaging.

The global bioplastics market is thought to be growing at a rate of as much as 20% per year. Bioplastics approximately 10-15% of the total plastics market and will increase its market share to 25-30% by 2020. The bioplastic market reached over 1 billion US\$ in 2007 and it will be over 10 billion by 2020. More and more companies are entering and investing in this market. New applications and innovations in the automotive and electronics industry lead to market boom.

The Australian Government has paid 1 million dollars to research and develop starch-based bioplastics. Japan has created a biodegradable bioplastic that is made of vegetable oil and has the same strength as traditional plastics. All of these developments have been the world many years ago. However, the bioplastic markets have been developed in Turkey in the last years. Ministry of Environment and Urban Planning recently announced that merchants must use *photodegradable*

*bioplastic* bags. Approximately 250-300 tonnes of bioplastic materials were imported to Turkey in 2012. In the first half of 2012, the bioplastic producer industry Packberk undertook the bioplastic production in Turkey and now bioplastic materials have only been produced by this industry.

### 3. RESULT AND DISCUSSION

S.Berkeschin Michigian Univesity reported in March 2005 "Bioplastics: A Rebirth of Plastic". The future of biodegradable plastics show great potential. Here are the advantages of bioplastics materials;

*Independence;* Bioplastic is made from renewable resources: corn, sugarcane, soy and other plant sources as opposed to common plastics, which are made from petroleum.

*Energy efficiency;* Production uses less energy than conventional plastics.

*Eco-safety;* According to the one source, bioplastic also generates fewer greenhouse gasses [Yu and Chen, 2008] and contains no toxins.

The advancement of biodegradable technology has risen in recent years and there are growing signs that the public shows a high amount of curiosity in the product. With the variety of biodegradable plastics available in near future, there will be a place for them current plastics. There certainly are an abundant amount of materials and resources to create and fund more uses for bioplastic in Turkey.

### 4. CONCLUSIONS

In the future, bioplastics will replace to common plastics. Therefore, a new guide should develop for bioplastic usage and bioplastic waste management both in Turkey and the world. Also labeling legislation may lead to an "eco-label", based on a product's raw material usage,

energy consumption, emissions from manufacture and use.

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