Chapter 10
Plastics and Priority during the Recycling

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ABSTRACT

Increasing demand for post-consumer plastics recycling comes from growing environmental awareness and the need for sustainability as well as from legislative measures. Generally, the recycling of plastics is important in terms of natural resources preservation (oil, natural gas), energy conservation, saving of landfill spaces, reduction of greenhouse gas emissions, overall environmental protection, and economical benefits. The different types of plastics recycling result in valuable raw materials (mechanical and chemical recycling) or in a notable quantity of energy when plastic waste is used as a fuel (energy recovery). A priority during recycling is to create high quality pretreatment processes of post-consumer plastics in order to obtain the best possible product and to minimize recycling expenses. This chapter gives a general overview of plastics recycling, especially of pretreatment procedures, with an emphasis on poly(ethylene-terephthalate), polyethylene, and tire recycling processes. It reveals the main problems during these processes and states their analysis and possible solutions.

INTRODUCTION

The constant increase of plastics waste quantity is nowadays a serious environmental problem if such waste is not properly managed. Generally, polymer materials production spends nonrenewable resources i.e. fossil fuels like oil and natural gas. Nearly 4% of oil in the world is used to manufacture plastic and though this amount is not very large, the recycling of plastics will contribute to saving these resources, reduction of waste and bringing economical benefits. Extensive use of plastic materials is a result of

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their unique properties that conventional materials do not have; therefore up to 60% of their total application are packaging materials. One of the reasons for their wide application is because they are "light" materials (of low density) and the modern life will be unimaginable without polymer materials. Their low mass significantly contributes to the reduction of fuel consumption during the transport of goods and also reduces CO_2 emission. Namely, plastic is a unique material to be used in a broad range of products and every day they find new applications. For example: in medicine (drug carriers, contact lenses, artificial blood vessels), sport equipment and supplies, textile (very durable and nonexpensive textile materials), automobile and plane industry (very light materials, with remarkable toughness and durability). Unfortunately, the main problem concerning the polymer materials is that they are not biodegradable which makes it mandatory to find useful and environmentally friendly procedures for their post-use treatment. The recycling of postconsumer plastics is the process of recovering scrap or waste plastic and reprocessing the material into useful products, sometimes completely different in form from their original state. For instance, this could mean melting down soft drink bottles and then casting them as plastic chairs and tables. Plastics are also recycled / reprocessed during the manufacturing process of plastic goods such as polyethylene film and bags. This closed-loop operation has been taking place since the 1970s and has made the production of some plastic products amongst the most efficient operations today. Generally, there are several methods for plastic waste treatment but any uncontrolled processes like disposing to landfills and burning should be avoided due to negative impact on environment. The most efficient and highly recommended process of recycling is energy recovery (incineration), then follows reprocessing in melt (mechanical recycling) as simple and low cost technology while the most demanding process is chemical recycling.

To justify the recycling process of plastics and its ecological and economical benefits it is always needed to include life cycle analysis (LCA) to predict environmental impact of a product, process or an activity along their whole life cycle (from raw materials, production/manufacturing, use to disposal: „from cradle to grave“). During LC analysis every impact in each separate phase of life cycle of product is considered, as quantity of used materials, chemical agents, energy, produced waste as well as type of emissions. The role of LCA indicates and points out the weakest points of each life cycle phase that should be solved by diminishing the negative impact by offering the new solutions. Appling the LCA to the polymer material: in general, it could be seen that the highest negative impact they have in the last phase of life i.e. after disposal due to their nonbiodegradability. When polymer waste is disposed to the landfill it stays there for many years (50 years or even more) occupying a very huge space and when is found in nature it prevents the growth and development of plant, living organisms and animals. As the polymer materials have negative impact on the environment after disposal, the research community starts to study and develop various recycling technological processes, which are today well-known and offered successful solutions for this problem. It was realized that the polymer waste is valuable raw material that needs to be recovered due to preservation of nonrenewable resources in order to save energy and bring the economical benefits.

Thus, the mechanical recycling of plastic reduces CO_2 emissions from 1,000-1,700 CO_2-eq while incineration reduces it from 600 to 800 CO_2-eq (Plastics Europe, 2014). Plastic materials have high energy value, their average release of energy is estimated to 35 MJ/kg but the recommendation is material recycling due to the above mentioned facts. The future scenario includes focusing on specific tenets of polymer recycling processes and significant reduction of disposed quantity of plastic waste to landfill covered by the EU legislative „Zero Plastics to Landfill by 2020“.

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