

CHAPTER I

INTRODUCTION

Petroleum-based plastics dominate today's society because of their high strength, light weight, low cost, easy processibility, and good water barrier properties. Plastics now clearly rival metals in breadth of use and in severity of application. The volume of plastics used annually in North America has exceeded the combined total volume of steel and nonferrous metals since the early 1970s; the weight of plastics used is rapidly approaching that of all metals. The ever-growing production and use of plastic have led to an increase in the amount of plastic waste resulting in an increase in environmental pollution because most of synthetic macromolecules can not be assimilated by microorganisms. They are designed and manufactured to resist environmental degradation. This makes polymer waste management an urgent problem, needing environmentally compatible and friendly solution both short and long term, as soon as possible. The early waste managements are burning, landfill, and recycling that have their limitations. Burning can cause air pollution. Landfill requires much spaces and time. Recycling method is faced with the high cost of gathering and sorting. To overcome the problem, biodegradable plastics and photodegradable plastics were extensively studied.

Biodegradable plastics (or the natural polymers) derived from animals or plants such as gelatin or starch, biosynthetic polymers from microorganisms such as poly (hydroxybutyrate) (PHB) or poly (hydroxyvalerate) (PHV). They were developed to replace non-biodegradable polymers, especially those used in packaging materials. However, these polymers are more expensive than polyethylene (PE) or polypropylene (PP). Hence, they are not widely used. Nevertheless, they can be blended with synthetic polymers for reducing the cost and enhancing degradation in synthetic polymers.

Photodegradable plastics can also help to solve the problems of polymer waste and their use is more important every day as a result of new environment protection laws. There are two basic routes to design such materials: grafting photosensitive moieties onto the macromolecular chain, during or after the polymerization process, and adding low-molecular-weight chemicals that are organic compounds such as acetophenone, benzophenone or anthraquinone and inorganic metal compounds such as titanium dioxide (TiO_2) or zinc oxide (ZnO); both routes aim for photooxidation or photodegradation of the polymer.

The encapsulated particle (or microcapsule) is one of the great interesting additives for the degradation process with polymer. The encapsulated particle is the photosensitizer coated with biodegradable polymers. The degradation can be controlled by varying the coated thickness of the photosensitizer and the content of additive. This so called microencapsulation technique is a process of applying relatively thin coatings to small particles of solids or droplets of liquid. The thin coating material can be made from natural polymer such as gelatin or gum acacia. The small particles of solids or droplets of liquid are called core particles. The encapsulated particles can have wide range of sizes and wall thickness. There are a number of microencapsulation techniques which are coacervation or phase separation, interfacial reactions, and miscellaneous mechanical methods. The technique of simple coacervation, one of coacervation system, is widely used and suitable for water-insoluble compounds, both solids and liquids. Principle of this process is the reduction of the salvation of one polymeric solutes in a medium to form coacervate droplets to deposit and coat the dispersed phase. The coating is shrank and crosslinked to rigidize. This approach could be advantageous over previous methods because the degradation rate might be controlled by varying the coated thickness of the photoactivator and the contents of the encapsulated particles.

Therefore, the aim of this research was to control photodegradation of LDPE by incorporating encapsulated particles of photosensitizer. The simple coacervation technique

was used to prepare encapsulated particles. Benzophenone, gelatin, and formaldehyde were used as a photosensitizer or core particle, coating material, and hardening agent, respectively. Pure LDPE films and the photodegradable LDPE films containing benzophenone, gelatin, and encapsulated benzophenone were prepared by compression technique. The effects of coated thickness of the photosensitizer, controlled by varying amount of gelatin and hardening agent, and the contents of encapsulated particles on the photodegradation of the films were studied. The ratio of benzophenone and gelatin including amount of hardening agent were 1:0.5, 1:1, 1:2 and 1, 2, 4 ml, respectively. The amount of benzophenone, gelatin, and encapsulated benzophenone was varied from 0 – 5 %wt. The photodegradation was estimated by outdoor exposure test and accelerated weathering test. The effects of benzophenone powder and encapsulated particles contents on the degradation behavior were followed by observing the changes in weight loss, tensile properties, and carbonyl index (CI) of the films. The morphological change of the films was followed by scanning electron microscopy (SEM).



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