



CHAPTER I

INTRODUCTION

1.1 General

The advent of plastics has given rise to improved methods of packaging goods. For example, polyethylene and polypropylene plastic films, bags, bottles, styrofoam cups and blister packages have the advantages of being chemically resistant, relatively unbreakable, light in weight and translucent or transparent. The increasing use of plastics in packaging applications has created a serious waste disposal problem. Burning of these plastic materials is unsatisfactory since it adds to air pollution problems.

Unlike some other packaging materials, such as paper and cardboard, plastics are not readily destroyed by the elements of nature. Thus, burying them is not an effective means of disposal, and can be expensive.

At present there are two ways for combating the plastic waste disposal problem.

One means suggested for combating the problem has been the use of plastics compositions which degrade upon exposure to ultraviolet light. Plastics are made up of large molecules, the atoms of which are linked together to form chains. It has been suggested to introduce a "sensitizer group" along the polymer chain which would absorb the ultraviolet light of the sun and, using this energy, break the polymer chain. When the chains are

broken, the plastic loses its physical strength and becomes brittle, so that it is easily broken apart by natural erosion of the wind, waves, or rain into small particles which become part of the soil.

The other is appropriate selection of photoactive additives which are incorporated in the commercial plastic during processing.

1.2 Ultraviolet Light

An important thing to know is that ultraviolet is not a single entity, but is a wide band of wavelength [1]. The chief natural source of UV is the sun. Most of which is in the region between 300-400 nm.

Ultraviolet light is electromagnetic radiation in the part of spectrum between X-rays and visible light. It differs from light only in that its wavelength are too short to be seen by the human eyes. The boundary between visible light and UV light is usually taken to be radiation with a wavelength of 400 nm (4000 \AA). It is customary to divide the UV spectrum into near UV (300-380 nm) and far UV (200-280 nm), the adjectives near and far indicating the relative distance from visible light.

One effect of UV energy upon certain substances is a phenomenon that take place at the atomic level. UV energy affects the charge carried by the proton orbiting the nucleus of an atom. This forces the proton into a different orbit and produces the gloves we call ultraviolet fluorescence. Fluorescence, then, is produced by the material itself when its

atoms are excited by UV energy, the material is the light source. When the UV energy is turned off, the proton resumes its natural orbit and we no longer see it glow. On some materials the fluorescence lingers and disappears slowly after the UV source is removed. Here, the protons return slowly diminishing fluorescence called phosphorescence.

As far as practical applications of polymers are concerned, the sun is the most important light source [2]. The spectral distribution depends on atmospheric conditions and the latitude. Somewhat less than 10% of the sunlight at the earth's surface is UV light, about 50% is visible and about 40% is IR light. For laboratory and industrial irradiations various types of lamps are available. Emission spectra of several lamps are shown in Figure 1.1. Frequently, mercury lamps are used : low pressure lamps with two intense lines at 184.9 and 253.8 nm and medium pressure lamps with a great number of lines, the most intense one corresponding to 366 nm. For preparative purposes, high pressure mercury lamps are most suitable because of their high emission intensities. Most frequently used are the lines at 254, 265, 313, 366, 436 and 546 nm. Carbon arc and xenon lamps are utilized quite often in devices for accelerated weathering tests.

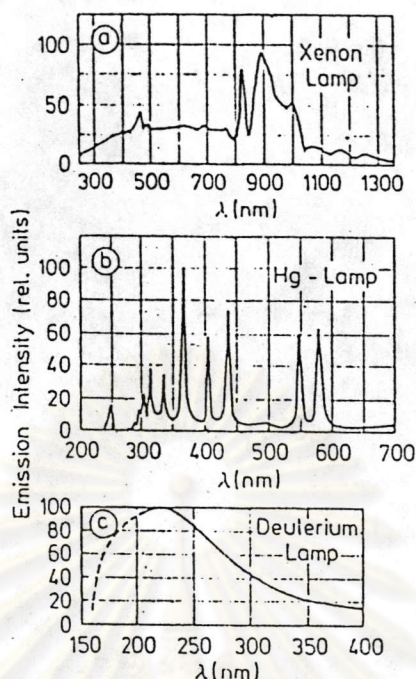


Fig. 1.1 Emission spectra of lamps. (a) Xenon lamp, Osram, XBO 1600 W; (b) High pressure mercury lamp, Philips, 1000 W; (c) Deuterium lamp, Original Hanau D 200 F, 200 W [2].

1.3 Polyethylene

Polyethylene, $(-\text{CH}_2-\text{CH}_2-)_n$, is the most extensively used thermoplastic. The ever-increasing demand for polyethylene is partly due to the availability of the monomer, ethylene, from the abundant raw material, associated gas, and naphtha. The ease of processing the polymer, its relative low cost, its resistance to chemicals, and its flexibility are also strong influences. All these and other factors lead to the strong market demand [3].

The two most widely used grades of polyethylene are low density polyethylene, LDPE, which has branched chains, and high density polyethylene, HDPE, which is predominantly linear. Low density polyethylene is produced by a free radical initiated

polymerization at high pressure while high density polyethylene is produced by a low pressure process with a metallic oxide catalyst of the Ziegler type.

The main difference between the two grades of polyethylene is that LDPE is more flexible because of its lower crystallinity. This lower crystallinity is caused by the presence of branches of two or four carbons along the backbone of the polymer. HDPE is more closely packed because of the absence of branches and thus the molecules become closer and less permeable to gases.

1.3.1 Physical and Chemical Properties

Probably the most important property of the polyethylene is the molecular weight and its distribution within a sample. Methods used to determine molecular weights are numerous. A widely used one is by viscosity determination.

Polyethylene is to some extent permeable to most gases. The higher density polymers are less permeable than the lower density ones. Polyethylene, in general, has a low degree of water absorption and is not attacked by dilute acids. Its overall chemical resistance is excellent. Polyethylenes are affected by hydrocarbons and chlorinated hydrocarbons and swell slowly in these solvents. Tensile strength of polyethylenes is relatively low; but impact resistance is high. The use of polyethylenes in insulation is due to the excellent electrical resistance properties.

1.3.2 High Density Polyethylene


All high density polyethylenes are made by a low pressure process in a fluidized bed reactor. The catalyst is either a Ziegler type catalyst which is a complex between an aluminum alkyl and a transition metal halide, such as titanium tetrachloride, or a catalyst of silica or silica alumina impregnated with a small amount of metal oxide, usually either chromium oxide or molybdenum oxide.

1.3.3 Application

Polyethylene is an inexpensive plastic which can be molded into almost any shape, extruded into fiber or filament, and blown or precipitated into film or foil. Films are rapidly growing application for HDPE resins, replacing paper and glass. Polyethylene bags are popular in supermarkets, fast-food outlets, and department stores, and for garbage. Because it is more flexible and more transparent, the low density polymer is used in sheets, films, and injection molding. High density polyethylenes are extensively used in blow-molded containers. About 85 percents of the blow-molded bottles is produced from HDPE.

1.4 Objective for this study

The objective of this work is to synthesize poly(phenyl vinyl ketone) (PPVK) as a photosensitizer for photodegradation of high density polyethylene (HDPE). Photodegradation of HDPE with and without PPVK will be studied both under natural and accelerated weathering. The concentration of PPVK, the molecular weight of PPVK and the thickness of film will be varied in order to see the effects on photodegradation of HDPE.



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย