CHAPTER I

INTRODUCTION

1.1 The Characteristics of HDPE and PET

1.1.1 High density polyethylene, HDPE

HDPE is an extremely versatile material which is used in many major plastics applications and which can be processed in a variety of ways. In comparison with other polyethylenes, HDPE is relatively stiff, has good environmental stress crack resistance and a softening temperature of up to 135 ^{o} C. Its excellent chemical resistance makes HDPE a popular material for bottles, drums, pipes, fuel tank and a wide range of household containers, vessels and toys. Good electrical insulation and non-polarity properties have led to applications in the electronics industry. Because of its low moisture absorbtion it is suitable to use as both flexible and rigid packaging. In flexible packaging, HDPE is used for heavy duty bags. Rigid packaging use as contains for fresh and frozen food and paint container.

1.1.2 Poly (ethylene terephthalate), PET

Toughness, clarity, recyclability, lightness, good resistance to chemical materials, good barrier quality makes PET one of the fastest growing resin in recent years. The amounts of consuming PET are increased many times in each year. So this kind of plastic tends to replace other commodity plastics in many applications.

PET has major applications in packaging products and has shared a lot of the carbonated soft drink bottle market. In recent years, the strongest growth has been in non-carbonated soft drinks, spirit, cosmetics and medical devices. PET's barrier and heat properties also make it for packaging of oil, coffee and peanut butter. It is also extruded into film and sheet. Crystalline PET has microwave applications. Biaxially oriented PET film is used for X-ray and other photographic film, magnetic tape, electrical insulation and food packaging.

1.2 Definition Regarding Plastic Waste

Before the generation of plastics waste can be discussed, some important terms must be defined. The classification of plastics waste will provide the easy way to work with various kinds of plastics waste. The simple classification system used is contained in the following definitions:

- *Waste plastics* consist of plastics resin or product that must be reprocessed or disposed of.
- *Industrial plastics waste* is a plastics waste generated by various industrial sectors.
- *Postconsumer plastics waste* is a plastics waste generated by a consumer.
- *Scrap plastics* are waste plastics that are capable of being reprocessed into commercially acceptable plastic product.
- *Primary recycling* is the processing of scrap plastic into the same or similar type of product from which it has been generated.
- *Secondary recycling* is the reprocessing of scrap plastic into plastic products with less demanding properties.

1.3 Future of Waste Disposal

For many years incineration and landfill were the main methods of solid waste disposal. Because of energy and materials conservation, as well as the concern about the environment, new waste disposal methods are being developed. Research suggests that the improved collection procedures and more effective legislation will result in an increase the percentage of collected waste. Open dump and open burning will be reduced. By the year 2000 approximately 30% of solid refuse will be recycled, large quantities of waste plastics will become for reprocessing into secondary products [12, 1993].

1.4 Approaches to Reprocessing Plastics

Plastics wastes are unsuitable for reprocessing by using standard plastic processing equipment. So the development of reprocessing is proceeding quite slowly. There are many reasons for its slow development.

a. Waste plastics tend to be highly contaminated with nonplastic substances that will destroy the processing equipment.

b. Various plastics present in the waste mixture used as feedstock are incompatible, resulting in a product having poor mechanical properties.

c. A feedstock with a consistent and reproducible composition is not always available. In order to be economically viable, the product must be mass produced.

Postconsumer plastics are waste obtained from returnable packages. Among these are milk bottles and drinking water bottles. This material

consists of not more than two types of plastic and contains only small amounts of nonplastic contaminants.

Since the products of reprocessing are competing with other low-cost products, the reprocessing has been primarily developed in countries where the competitive product are relatively expensive. Presently, Japan is the leader in reprocessing technologies, followed by the countries of Western Europe [12, 1993]. Various technical approaches to reprocessing are possible such as:

- Reprocessing using slightly modified standard plastics processing equipment. This has the advantage of readily available equipment but the disadvantage is frequent production problems and poor product properties.
- Reprocessing using special processing equipment. The advantages are fast production and a product with acceptable mechanical properties.
- Chemical modification of mixed plastics waste. The advantage is a product with good mechanical properties. The disadvantage is that material costs are increased without solving the processing problems.
- Use of plastic waste in combination with virgin plastic. This has the advantage that good products can be manufactured at low material cost, and the disadvantage that only certain type of relatively uncontaminated plastic waste can be used.
- Use of plastic waste filler in other plastic or nonplastic materials. This has an advantage that waste material is used to extend a more expensive material and a disadvantage in that the applications are limited.
- Use of plastic waste as a matrix in combination with low-cost filler. The advantage is that plastic waste acts as a binder, the mechanical properties are resulted by the filler. The disadvantage is that applications are limited.

1.5 Parameters Affect the Properties of Blends

1.5.1 Particle Size of the Dispersed Phase

In most case the feedstock of plastics waste contains a mixture of various plastic and nonplastic materials. In order to obtain good mechanical properties from reprocessing plastics waste products, the mixture has to be homogenized and mixed well together. Although the dispersion and particle size are studied, there are not much data in the mechanical data in literature about the relationship between particle size distribution and mechanical of the blend. The efficiency of dispersion was varied by using different mixing times and intensities. Particle size was shown to have influence on ultimate elongation and impact strength[2, 1981]. Decreasing particle size of dispersed phase improves the toughness of the blend. There is usually a limliting particle size which results in maximum properties, further reduction in particle size results in no further improvement.

1.5.2 The Processing Procedure

The properties of the blends were affected by the processing procedure such as compression, extrusion, injection blow molding, spinning. The selection of each processing depends on the useful products that are desired , also it depends on the type of the materials. For example, the amount of force from extrusion procedure provides less value than that from the injection blow molding. So the morphology of the blend system will differ.