CHAPTER I
INTRODUCTION

Worldwide, the problems associated with the production of large amounts of waste are recognized as one of the most serious one has to face in the following centuries. In the case of plastic waste the preferred solution, up to now, is recycling. Nevertheless, degradable materials can play an important role to reduce these waste disposal problems [1]. Polymers from renewable resources have attracted an increasing amount of attention over the last two decades, predominantly due to environmental concerns. Generally, polymers from renewable resources can be classified into three groups: (1) natural polymers, such as starch, protein and cellulose; (2) synthetic polymers from natural monomers, such as polylactide (PLA); and (3) polymers from microbial fermentation, such as polyhydroxybutyrate (PHB) [6].

Polylactide (PLA), a hydrolyzable aliphatic polyester known and used for a long time for medical applications (tissue engineering, bone fixation, and controlled drug delivery). PLA is the one of commercially available biobased materials that could become a material of choice, especially in packaging applications due to its good clarity, high strength and moderate barrier properties [8]. PLA is prepared by two ways, the polycondensation of lactic acid and the ring-opening polymerization of lactide. Higher molecular weight PLA is usually prepared by ring-opening pathway than polycondensation pathway [1,3] and cost of PLA is high due to expensive lactide. Nevertheless, PLA is stiff and brittle. The brittleness causes a problem in processsibility and high crystallinity reduces it rates of decomposition [7]. Therefore, PLA needs modification to moderately enhance the flexibility, improve the strength and processibility, increase the rate of decomposition for decreasing the global warming, and reduce the cost.

To overcome these limitations of PLA, grafting brittle polymer on copolymers is of great interest for developing polymeric materials, i.e. grafting copolymerization of PLA with poly(glycolic acid) (PGA) is a possible method to enhance the rate of degradation by disturbing the crystallinity of PLA [7]. Moreover, the plasticization of PLA is a method to improve the mechanical properties.

Starch/PLA blends has focused on the incorporation of dry starch into PLA to reduce the cost of the material while maintaining biodegradability. Blending of PLA with thermoplastic starch leads to blends with greatly improved ductility [9]. However, some plasticizers lead to leak or bloom. In 2000, Jacobsen S. studied the ring-opening polymerization of lactide by using catalytic extrusion with $Sn(Oct)_2$ as a catalyst. The resulting conversion was 99 %, indicating the complete reaction. This single-step reactive extrusion process required the shorter time to reach this conversion than the case of classical batch process [1].

All above ideas lead to the purpose of this research, the improvement of bioplastic PLA by grafting-from method via catalytic extrusion with $Sn(Oct)_2$ as a catalyst in order to make the production of PLA economically viable, enhance flexibility, and increase the degradation rate. Ethylene vinyl alcohol copolymer (EVOH) which has the reactive hydroxyl groups is a good backbone used to initiate the ring-opening polymerization of lactide. This leads to the high molecular weight of resulting polymer because EVOH backbone has high molecular weight and uses the higher content of PLA than backbone to generate the matrix of PLA. Furthermore, due to EVOH is the material that has water resistance, biodegradability, and good barrier properties, it is widely used in packaging applications.

Thereby, this work is studied in the processing parameter which is the screw speed influenced on the reaction time and mixing efficiency, LA/EVOH content affected to the morphology and compatibility between two components, and catalyst content gave the high conversion and the outstanding properties of resulting products.

OBJECTIVES

The objectives of this research work are:

1. To synthesize PLA by grafting-from method on EVOH via catalytic extrusion with $Sn(Oct)_2$ as a catalyst
2. To study the effect of screw speed, monomer/polymer content, and catalyst content on physical properties of the graft copolymer
3. To improve mechanical properties and processibility of PLA

SCOPE OF RESEARCH WORK

The scope of this research work will cover:

1. The preparation of crude EVOH-g-PLA by using catalytic extrusion process.
2. The isopropyl alcohol and chloroform extraction of crude EVOH-g-PLA received from catalytic extrusion process by using soxhlet extraction.
3. The characterization of extracted EVOH-g-PLA
4. The preparation of the films from crude EVOH-g-PLA by compression moulding process.
5. The investigation of crude EVOH-g-PLA test pieces.