CHAPTER 1 INTRODUCTION

1.1 Background

Plastic industry is one of the globally fastest growing manufacturing because plastic is widely used in various applications, for instance, medical devices, electronics devices, agricultures, textiles and packaging. Plastics also have numerous properties which make them better to other materials namely resistance to corrosion and chemicals, high strength-to-weight ratio and good durability [1].

However, the new plastic type, biodegradable plastic, tends to be the new alternative material because biodegradable plastic can be produced by using the renewable sources while the almost of commodity plastics have to be generated by petroleum-based products.

PLA, polylactic acid or polylactide, is well known as the biodegradable plastic which is made from lactide monomers, which nearly has the same properties as the common plastics. The biodegradable plastic production not only uses the renewable resources as raw materials but also solves the disposal problems and the environmental effects which are the main disadvantage of the petroleum-based plastic products [2].

From all the reasons mentioned above, the sponsor of this research, PTT Global Chemical Public Company Limited (PTTGC) which is a fully-integrated petrochemical and chemical company, combining visionary leadership and innovation in the chemical industry, aims to be the new global hub for bio-based polymers by means of the comparative advantages in bio-based feedstock availability in Thailand and in the South East Asian region.

Hence, the production of the high capacity of the plastic part becomes necessary. The plastic forming process can be finished in many ways such as injection molding, blow molding and thermal compression. Among all these forming processes, the injection molding is the most extensively used because of its economics to produce high capacity of complicated plastic structure [3].

There are three stages in each injection molding cycle namely filling, cooling and ejection stages. The most critical stage is the filling stage because it is related to the flowing of molten plastic from injection nozzle to fill in the desired shape of mold which results in the plastic defects e.g. flash, warping, bubbles as well as unfilled-sections. It is relatively difficult to control the flow behavior of molten plastic in filling stage since there are many injection molding parameters in filling stage, for instance, plastic type, mold temperature, filling time, injection pressure and specifically melt temperature.

Definitely, this research's sponsor frequently deals with a critical injection molding problem during the plastic product testing with the actual injection molding process

with customers, which lead to few days delay for each testing. The main sponsor's problem is the injection grade of PLA may not be filled up into the mold completely in filling stage which is called unfilled-sections defect. This problem might a result from improper injection molding parameters, for instance melt temperatures. Consequently, the investigation of plastic flow behavior and the effect of injection molding parameter on filling stage are necessary. Because the flaws or defects in plastic parts would not be noticed until a mold filling was made. Consequently, the investigation of plastic flow behavior and the effect of injection molding parameter on filling stage by employing their numerical simulation are useful and necessary.

Therefore, so as to save the sponsor's time and cost in plastic product testing to the customers and to comprehend the melt temperature effect on the PLA flow behavior in filling stage, the feasibility study of numerical simulation of biodegradable plastic (PLA) flow behavior in injection molding was performed by using the finite volume method which is implemented in the computational fluid dynamics (CFD) package, ANSYS CFX. The different melt temperatures were used in the simulation in order to verify the effect of melt temperature and plastic flow behavior on fill stage of injection molding process as well.

1.2 Objective

To perform the feasibility study of numerical simulation of biodegradable flow behavior in injection molding process

1.3 Scopes of work

1. The PLA injection molding simulation in filling stage using ANSYS CFX.
2. The preliminary PLA flow behavior model in filling stage

1.4 Expected results

1. The melt temperature effect on mold filling stage
2. The predicted flow behavior of PLA on mold filling stage of injection molding
3. The pressure distribution along melt flow advancement