CHAPTER 1

INTRODUCTION

The plastics industry is the major customer of the petrochemical industry in Thailand. There is a growing trend to improve the physical properties and cost competitiveness of polymers. Today, all processors use compounding as one of the preferred methods of upgrading the properties of existing polymers. Typically, additives are selected to enhance the physical properties of a formulation by mixing them with base polymer using a suitable type of compounding equipment. As the level of competitiveness has increased, so has the level of attention given to the specific types of compounding equipment chosen.

A wide variety of additives are available to reduce or eliminate the various types of degradation (thermal, mechanical, chemical, environmental). Additives are normally used in very limited quantities, so their uniform distribution in the polymer matrix is a prerequisite to a well-compounded product. One way of improving the dispersion is to use a multi-screw compounder. This has actually allowed a reduction in the amount of additives required, thus lowering additive costs and in many cases resulting in improved physical and processing properties of polymers.

The equipment used to compound additives into a polymer matrix must be capable of performing some of the following process tasks (Mielcarek, D.,1987)

- Incorporation and homogenization of additives without exceeding degradation temperatures

- Generation of high shear stresses for dispersion of nonreinforcing fillers or pigments

- Homogenization of two or more materials of differing melt viscosities without creating a stratified or layered final mix.

- Application of uniform shear stress and heat history to each particle

- Precise process control ensuring narrow temperature distribution throughout the melt stage

Color is probably the most common way of decorating plastics. Most plastic consumer goods are colored, rather than natural. Color is used as decoration for aesthetic, commercial and functional reasons.

Color is often employed to produce an aesthetic quality, such as beauty or artistry. A colored plastic flower pot, even if it be merely white, is more pleasant to look at than one that is natural. Color is also used as a symbol for a sensation of mood and to sell a product. In today's market, the color of a car could be as important for clinching a sale as its technical features. Often the commercial failure of a plastic product could be traced to the failure of the producer to satisfy the color demands of the consumer. In other words, color could make the difference between selling and not selling a product. Although the aesthetic and commercial values of color are the most important reasons for its use as decoration, its functional value is becoming increasingly important. Color has found functional use in industrial applications for identification, such as the coloring of wire and cables. Safety coding, such as yellow hoses for transferring hazardous liquids, is another example of color's functional value.

For coloring, dispersing a pigment in a polymer generally is difficult and expensive, requiring specialized equipment and techniques. So the author is interested to study about the technical problems in coloring plastics, more specifically the dispersion of pigment as colorant. One effective equipment for this is the twin-screw type. In the present study, the author uses a twin-screw kneader, instead of single-screw extruders (see chapter 2), since the former presents a new choice for the plastics industry.

The twin-screw kneader used is said to have many remarkable features. It could realize more efficient dispersion, mixing and kneading. Furthermore, excellent performance is obtained for heating, cooling and chemical reaction. For wide flexibility, various types of paddles are provided for specific actions: convey, mix-convey, mix, mix-reverse, and reverse-convey. Their flexible arrangement could be made to suit different requirements of mixing, kneading and retention time. Self-cleaning action is effected between paddles and barrel as well as between paddles themselves, so no material adheres to the paddles and barrel. Even though material is not pushed in from behind, it is all discharged smoothly by the revolution of the paddles. Because of self-cleaning action, raw material does not stagnate at one area and counterflow is not created. It assures perfect mixing and continuous kneading. Thus any material could be mixed continuously, ranging from low viscosity material such as liquid to super-high viscosity material over 100,000 to 1,000,000 poise. The characteristics of the twin-screw kneader are mentioned in details in chapter 3.

1.1 OBJECTIVES

In the present study, the effects of kneading conditions on the dispersion of pigments in polyethylene using a continuous kneader are to be investigated. High density polyethylene and iron oxide (inorganic pigment) are used. The main objectives of this work are as follows :

1.1.1 To study experimentally the parameters that affect the dispersion of pigments in polyethylene using a continuous kneader.

1.1.2 To determine the suitable kneading conditions on the dispersion of pigments in polyethylene using a continuous kneader.

1.2 SCOPE OF WORK

The parameters of interest are kneading temperature, rotational speed of screw, roller temperature and particle size of pigment. The scope of work is as follows :

1.2.1 To study the effect of kneading temperature on the dispersion of pigments in polyethylene.

1.2.2 To study the effect of rotational speed of screw on the dispersion of pigments in polyethylene.

1.2.3 To study the effect of roller temperature on the dispersion of pigments in polyethylene.

1.2.4 To study the effect of particle size of pigments on the dispersion of pigments in polyethylene.

1.2.5 To determine the suitable kneading conditions on the dispersion of pigments in polyethylene.