CHAPTER 1

INTRODUCTION

1.1 Problem Statement

Since plastics are widely used in facet of our life primarily because they are light, strong, chemically inert, and inexpensive. Plastics account for roughly a quarter of all solid waste by volume. Some polymer can be degraded by exposure to high temperature, oxygen and ozone, ultraviolet light, moisture, and chemical agents. Often multitude exposures, such as a combination of moisture and heat or oxygen and light, can result in accelerated deterioration (Joel,1995).

Polyolefin like polyethylene is the most dominant type of polymers used in daily life, especially, shopping bag . It is non-degradable polymer because of high molecular weight hydrocarbon that contains only carbon atoms and hydrogen atoms which linked with hydrogen bonds . The type of structure causes the chemical stability and shows hydrophobic property . Owing to very low-weight-to volume ratio, plastics tend to occupy more space than the other material in landfills . Furthermore, most plastics remain more or less unchanged in landfills even after a period of two decades that present a major waste disposal problem (Haung et al,1990) .

To reduce the volume of plastics waste to landfills, especially packaging, there are three alternatives to solve plastics waste problem : recycling, incineration and biodegradation . For recycling, commercial plastics is a significantly contemporary issue from many aspects such as the need to reduce the volume of plastics waste that is sent to landfills and to converse non-renewable petroleum resource. Most commodity plastics are now being recycling in United States and Europe that include poly (ethylene terephthalate) (PET) and polyolefins . However the total cost of producing recycling plastics, including collection and recycling is typically 20% higher than for the virgin resin . In the case of incineration, plastics can be burned to produce emission of carbon dioxide, nitrogen oxide, water vapor and thermal energy. On the other hand incineration of plastics waste can produce carcinogenic dioxins unless burning at very high temperature (Joel,1995).

Finally , biodegradation offers an attractive alternative to solve plastics waste problems. Consequently, there has been much activity in development of biodegradable packaging materials to replace non-degradable petroleum-based thermoplastics . Polymers such as chitosan (Pennisi, 1992), pullulan (Yen,1974) and poly (hydroxy butyrate-co-hydroxyvalerate) (Pool ,1989) had been investigated for packaging application . Another interesting biodegradable material is starch because of its low cost, its availability as agricultural surplus raw material (Wiedmann and Strobel, 1991) . However, films of pure starch are brittleness and suffer for poor water resistance (Whistler and Hillbert, 1944) . In order to be suitable for packaging, plastic films must meet standards for strength, flexibility, non-toxicity, oxygen impermeability, water resistance, and low cost of both starting and processing . Therefore, it is necessary to combine it with synthetic polymer to produce useful material . The major starch used in western and eastern countries is corn in either native or modified forms. Other type of starch that had been investigated included rice starch, potato starch, (Lim et al,1992) and maize starch (Loomis et al, 1993 and

Goerge et al, 1994) . However, no report on study of tapioca starch for preparation of biodegradable plastic .

1.2 Various types of starch

Table1.1 Amylose and amylopectin content and degree of polymerization of various starch (Whistler et al , 1980) .

Starch	Amylose % (w/w)	Amylopectin % (w/w)	Average DP amylose	Average DP, amylopectin
Corn	28	72	80	2,000,000
Potato	21	79	3000	2,000,000
Wheat	28	72	800	2,000,000
Tapioca	17	83	-	2,000,000
Waxy maize	0	100	-	2,000,000
Sorghum	28	72	-	-
Rice	17	83	-	-
Sago	27	73	-	-
Arrowroot	20	80	-	-
Amylomaize	50-80	20-50	-	-

DP= degree of polymerization

Table1.2 Average chemical composition of starch granules
(Whitler et al , 1980)

Starch	Moisture at 65%RH at 20 °C	Lipids % on DS	Proteins % on DS, Nx6.25	Ash %on DS	Phosphors % on DS
Corn	13	0.6	0.35	0.1	0.015
Potato	19	0.05	0.06	0.4	0.08
Wheat	14	0.8	0.4	0.15	0.06
Tapioca	13	0.1	0.1	0.2	0.01
Waxy maize	13	0.2	0.25	0.07	0.007
Sorghum	13	0.7	0.3	0.08	-
Rice	-	0.8	0.45	0.5	0.1
Sago	-	0.1	0.1	0.2	0.02
Amylomaize	13	0.4	-	0.2	0.07
Sweet potato	13	-	-	0.1	-

RH = relative humidity.
DS = dry substance.
N = nitrogen content .

Various types of starch has different chemical composition as revealed in Table 1.1 and Table 1.2 . It should be note that tapioca starch has chemical composition similar to several types of starch including corn starch . However, they are consist of amylose and amylopectin with quite different percentages, particularly by comparing to corn starch , as presented .

There are abundant starch available in Thailand, especially tapioca starch . Nowadays its major export is in the forms of animal feed pellets, dry sheets and powder . It is very cheap and over supply. It is thus worthwhile to explore the alternative utilization of tapioca starch as the starch-filled thermoplastic . Accordingly, this research work has been paid the attention on the incorporation of tapioca starch into low density polyethylene and focussed on the mechanical strength of resulting mixture .