CHAPTER I

INTRODUCTION

1.1 General Introduction

According to the previous studies, there is about 700 million cars in the world at present and will be about 1500 million cars in 2020; hence, fossil-based fuel oil usage will become greater in proportion to the increased number of cars. It was estimated that the fossil-based fuel oil will run out within the next 50 years [1]. Therefore, it is important to search for alternative energy sources, such as solar power, wind power, tidal power and biofuel, to replace fuel oil. Moreover, the car manufacturers must develop new technologies to work in conjunction with other kinds of fuel. Among these alternative energy sources, the most interesting one is biofuel because it can be looked upon as energy security since it is renewable and environmental friendly [2]. Currently, the use of biofuels has expanded worldwide. The major producers and consumers of biofuels are Asia, Europe and America [3]. Biofuels in Thailand consist of bioethanol and biodiesel. Bioethanol is an alcohol made by the fermentation of molasses, a by-product of sugar manufacture, so that it has unlimited availability. Ethanol can be used as a fuel for vehicles in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emission. This mixture is called gasohol. Gasohol comprises of 10 vol% ethanol and 90 vol% unleaded gasoline, which is referred as E10, is used in United States, Australia and Thailand. Brazil uses 100 vol% ethanol as fuel in about 20% of gasoline-powered vehicles and a 22 to 26 vol% ethanol-gasoline blend in all other vehicles [4]. The previous study in 2005 showed that carbonmonoxide (CO) and hydrocarbon emission in the four-stroke motorcycle engine exhaust is lower with operation of E10 gasohol as compared to the use of unleaded gasoline [5].

Metal corrosion caused by conventional motor fuels such as gasoline is not a serious problem because hydrocarbon fuels are inherently non-corrosive. However, the fuels containing alcohols such as gasohol or straight alcohol fuels have become a major problem because they corrode the automobile parts made from metal [6]. Therefore, the automobile part and fuel system must be designed specifically to use with gasohols.

Many engineering plastics are alternative materials for replacing metals, ceramics, and glasses in gasohol fuel system. This is mainly due to their intrinsic properties including corrosive resistance, easy molding, flexibility, light weight, recyclability and potentially lower cost. There are many useful plastics nowadays such as high-density polyethylene (HDPE) [7], polyvinyl chloride (PVC) [8] and polyamide 6 (PA6) [9]. Polyamide 6, also called nylon 6, is an engineering thermoplastic and is one of the most popular polymer with excellent chemical resistance, high mechanical strength, excellent mechanical performance at high temperature and good adhesion to reinforcements. Furthermore, the addition of glass fiber (GF) reinforcement is proven to improve the stiffness, strength, and the high temperature performance of this nylon [10-12].

The main purpose of this work was to study the influences of chemical substances in surrogate gasohol on the physical, mechanical, and thermal properties of glass fiber reinforced nylon 6 composites. The specimens were prepared by injection molding and compression molding of PA6/GF blends at various glass fiber contents and then immersed in chemicals (isooctane, toluene, aggressive ethanol and ethanol) for 16 weeks. The specimens were taken out from chemicals for characterization regularly until the end of experiment. The physical, thermal and mechanical properties of specimens were collected and analyzed.

1.2 Objective

To evaluate the influences of chemical substances in surrogate gasohol on physical, mechanical and thermal properties of PA6 and PA6/GF composites.

1.3 Scope of Work

1. PA6 resin (1015B), PA6 compound with 15 wt% glass fiber (1015GC3) and PA6 compound with 30 wt% glass fiber (1015GC6) were provided by UBE Nylon (Thailand) Limited.

2. Three of chemical substances in surrogate gasohol, namely, isooctane, toluene and aggressive ethanol according to SAE J1681 were used. Pure ethanol was also studied for comparison.

Note: Aggressive ethanol

- Synthetic ethanol 816.0 g, de-ionized water 8.103 g, sodium chloride 0.004 g, sulfuric acid 0.021 g and glacial acetic acid 0.061 g.

3. Physical, mechanical and thermal properties of specimens before immersion and after immersion in test chemicals were determined regularly until the end of experiment (16 weeks).

Table 1.1 List of properties evaluated

Property		Standard
Physical properties	Mass change	ASTM D570
	Diameter change	ASTM D570
	Thickness change	ASTM D570
	Volume change	ASTM D570
Mechanical properties	Tensile strength	ASTM D638
	Tensile modulus	ASTM D638
	Flexural strength	ASTM D790
	Flexural modulus	ASTM D790
	Compressive strength	ASTM D695
	Impact strength	ASTM D256
Thermal properties	Glass transition temperature	ASTM D7028
	Heat distortion temperature	ASTM D648