CHAPTER I

INTRODUCTION

1.1 The statement of problem

Natural rubber (NR) has a very uniform microstructure providing very unique and important characteristics such as the ability to crystallize under strain (strain-induced crystallization), and very low hysteresis. Application of NR in any materials gives the resultant with higher tensile strength, resilience, flexibility and resistance to impact and tear. The low heat-build-up and good "green" strength including high building tack are also the characteristics of the products containing NR. However, NR is poor resistant to oxidation, ozone, organic solvents, mainly due to its unsaturated chain structure and nonpolarity. These inherent drawbacks apparently cause limitations in the variety of NR usage, particularly for technical and engineering applications (Roberts, 1988). Thus, the chemical modification of NR has been attractive research field to improve these important properties. It is well known that the introduction of a small amount of compatibilizer can enhance mechanical properties of blends containing incompatible constituents. It has been reported that grafted copolymers can be effectively used as a compatibilizer for polymer blends (Wanvimon Arayapranee et al., 2004). For the production of thermoplastic elastomer, the blends of NR and polymers normally suffer from the phase separation resulting to poor mechanical properties; especially, the blend consists of dissimilar polarity of components. The graft copolymerization is one chemical modification methods to improve NR's properties via both solution and latex phases. To enhance the polarity of NR, methyl methacrylate (MMA) is applied for graft copolymerization of NR in the presence of thermal or redox initiators. However, the conventional graft copolymerization generally requires long reaction time (ca. 6-8 h) (Charoen Nakason et al., 2003).

Due to less energy consumption with faster heating rate, microwave irradiation has been used for various applications. The main advantage of microwave is related to the almost instantaneous 'in core' heating of materials in a homogeneous and selective manner. Microwave heating gives the rapid energy transfer into bulk of the reaction mixture and it can selectively and directly heat substances without thermal inertia and heat exchange with the media (Singh et al., 2006). Liu et al. (2005) studied the graft polymerization of ε-caprolactone onto chitosan under microwave irradiation. This reaction was induced via a protection-graft-deprotection procedure using phthaloylchitosan as a precursor and stannous octoate as a catalyst. The result indicated that 100% grafting efficiency (%GE) was achieved in short reaction time. Moreover, Kalia and Kaith (2008) studied the graft copolymerization of MMA onto flax fiber under the influence of microwave radiations. 24.6% grafting efficiency was found at 210 W of microwave power under optimum reaction conditions.

In this research, an attempt was made to prepare the graft copolymer of MMA onto NR latex initiated by redox initiator under microwave irradiation. The effects of the microwave power, exposure time, monomer and initiator concentrations on the grafting properties were statistically evaluated by using a two level factorial design and univariate experiments. The structure of graft natural rubber (GNR) was analyzed using Fouria Transform Infrared spectroscopy (FTIR) and Nuclear Magnetic Resonance spectroscopy (NMR). The morphology of GNR was also investigated using transmission electron microscope (TEM).

1.2 Objectives of the research work

The objectives of this research were stated as followed:

1. To prepare the graft copolymer of MMA onto NR latex induced by microwave irradiation.

2. To investigate the effects of the microwave power, exposure time, monomer and initiator concentrations on the grafting properties evaluated by using a two level factorial design and univariate experiments.

3. To characterize the structure of GNR using FTIR and ^{1}H-NMR spectroscopy. The morphology of the GNR was also investigated using transmission electron microscopy (TEM).

1.3 Scope of the research work

The details of experimental procedure for this research were presented as followed:

1. Survey the previous literatures and related research works.
2. Prepare the graft copolymer of MMA onto NR latex via conventional method compared to irradiation method generated by domestic microwave. (Preliminary study)
3. Characterize the structure of GNR by using FTIR and ^{1}H-NMR spectroscopy.
4. Design and construct the glass reactor equipped with adjustable power microwave systems: microwave chamber, waveguide, magnetron power supply, temperature control and cooling system.
5. Measure the dielectric constant of substances used in this research.
6. Prepare the graft copolymer of MMA onto NR latex initiated by cumene hydroperoxide (CHPO) and tetraethylene pentamine (TEPA) induced by adjustable power microwave systems.
7. Evaluate the effects of the microwave power, exposure time, monomer and initiator concentrations on the grafting properties by using a two level factorial design for statistic analysis and univariate experiments.
8. Characterize the structure of GNR by using FTIR and ^{1}H-NMR spectroscopy and analyzed the morphology of GNR by using TEM.
9. Determine the grafting properties of graft product by using the soxhlet extractor.
10. Summarize and conclude results.