CHAPTER I

INTRODUCTION

1.1 Introduction

Currently, disposal of waste rubber material is a global problem, and used tires constitute the largest volume of scrap rubber. Recycling of waste tires is essential due to economic and environmental reasons. Utilization of ground waste rubber has been reviewed recently [1]. Finely ground waste tire rubber (commonly called ground rubber tire, abbreviated as GRT) has been used as filler in rubbers [2-5] and in thermoplastics [6]. Baker and coworkers reported utilization of GRT in thermoplastic matrices [7-9]. Impact modification of polypropylene by blending it with waste rubber has also been reported [10, 11]. Utilization of GRT in polar polymer matrices like PVC has not been successful due to surface energy mismatch, leading to incompatibility. Surface modification of GRT is necessary to enhance compatibility. Chlorination has been reported to be a very effective way to modify the GRT surface and make it polar [12-15]. Naskar *et al.*[16] chlorinated the GRT surface using TCICA and characterized the modified GRT.

Kim *et al.*[17] reported that chlorinated crumb rubbers are compatible with nitrile rubber (NBR) and the chlorinated crumb/NBR blend shows greater physical properties than the unmodified crumb/NBR blend. Addition of nitrile rubber-based printing roller waste powder in rigid poly(vinyl chloride) has been reported to improve the impact resistance and flex properties of the plastic [18]. However, RTR is more polar than GRT because of RTR contains the double bond generated from the devulcanization process of GRT. From this reason, it is believed that RTR should be more compatible with PVC than GRT.

In order to study the utilization of both unmodified and modified GRT and RTR as filler in the rigid PVC compound, the physical properties, dynamic mechanical properties, swelling behavior, and morphology of chlorinated GRT and RTR-filled PVC are investigated for proving the toughness improvement.

1.2 Objective

The study focuses is on the improvement of the toughness of PVC by blending with either one of two types of tire rubber wastes; reclaimed tire rubber (RTR) and ground rubber tire (GRT). Chlorination of tire rubber wastes and addition of a compatibilizer were also investigated as methods to improve compatibility between PVC and the rubber.

1.3 Scope of the Research

1.3.1 Acquire a proper mixing method for PVC and used tire-rubber.

Two types of PVC included in the project are

- Soft PVC (S-PVC or Plasticized PVC).
- Rigid PVC (R-PVC or Unplasticized PVC).

Each type of PVC was mixed with GRT (a vulcanized rubber) and RTR (a devulcanized rubber).

1.3.2 Study the compatibility between tire rubber wastes and PVC in the blends.

Two types of waste rubber fillers used in this study are GRT and RTR. The surface of both rubbers were modified with trichloroisocyanuric acid (TCICA) as a chlorinating agent. Two compatibilizers tested in this study were chlorosulfonated polyethylene (CSPE) and nitrile butyl rubber (NBR). To investigate its behavior of blended PVC, swelling weights and physical properties such as impact strength, tensile strength, elongation, and hardness were analysed. In addition, thermal properties and morphology were also investigated by using differential scanning calorimetry (DSC), dynamic mechanical thermal analysis (DMTA), and scanning electron microscopy (SEM).