CHAPTER 1

INTRODUCTION

1.1 Scientific rationale

Polymeric foams generally consist of a minimum of two phases, i.e., a solid polymer matrix and a gaseous phase. There may be more than one solid phase present as in the case of polymer blend (generally heterogeneous). The gas phase in the foam is usually distributed in voids or pockets called cells. If these cells are interconnected, the material is termed open-cell. If the cells are discrete and the gas phase of each cell is independent of that of the other cells, they are termed closed cell. The nomenclature of polymeric foam is not yet standardized, classifications have been made according to the properties of the base polymer, the method of manufacture, the foam structure, or some combination of these.

Nowadays, there are many manufacturing techniques for polymeric foam processing. One of the most important processes is cross-linking/foaming process. This process is done by using a chemical blowing agent, which releases free gases at the beginning or during the cross-linking step. In order to obtain a large volume cell, the compounding polymer must have a good flow property. This is achieved by a good uniform mixing on the formulation and processing condition. It is also important that the blowing temperature and scorch temperature are well adjusted to each other. It has to be considered that cross-link must not start too late, otherwise the already blown compound may collapse. The formulation of polymeric foam is normally desired on the nature of polymer and the end-use properties. The processing conditions depend strongly on the formulation and foaming process. Polymeric foam has several advantages over equivalently unexpanded materials. Because a wide variety of polymers can be formed into foams having widely

varying structures, materials with certain desired properties can quite easily be tailor-made. These are lower density or light weight, good insulation properties, cushioning properties and high strength to weight ratio, leading to many applications, which directly depend on their properties and types of cellular structure, for example, thermal insulation, buoyancy, packaging, gaskets and etc[1].

Polyolefinic thermoplastic elastomers (TPEs) are increasingly getting more attention as a class of materials alternative to thermosetting rubbers. The most attractive feature of these materials is that they can be processed like thermoplastics while exhibiting the resilience and elasticity characteristic of elastomers. As indicated earlier, the key application area for polyolefinic TPEs is as replacement for conventional elastomers. Therefore, it is imperative that these materials be made capable of foaming to the same degree as afforded by conventional elastomers[2].

In this work, the foaming process of high-density polyethylene/natural rubber blends is investigated by studying the effect of foaming variables on the properties and cell structure of HDPE/NR foam. The foaming variables understudy include foaming time, blowing agent loading, ratio of HDPE/NR, cross-linking agent loading and ratio of HDPE/NR at a fixed cross-linking agent loading. The published information on foaming of these materials is scarce; however, some general features are well established.

1.2 Scope of the thesis

The scope of the thesis covers the factors controlling foaming process of the polymer blend of the HDPE/NR foam and their influences on foam structures and properties. The objective is to gain insight into the foaming in the production process and to establish a relationship between the structure and properties of good quality HDPE/NR foams.

The experimental work covers the followings:

1. Determination of suitable decomposition temperature of a blowing agent in the presence of various quantities of activator for the preparation of HDPE/NR foams by instrumental techniques, i.e. equipment set up for decomposition temperature measurement (EDTM) and thermogravimetric analysis (TGA).

2. Determination of the distribution of natural rubber phase in high-density polyethylene phase by Scanning Electron Microscopy (SEM).

3. Investigation of the factors affecting the cell structures and properties of HDPE/NR foams. The factors include :

- foaming time
- blowing agent loading
- ratio of HDPE/NR
- cross-linking agent loading and
- ratio of HDPE/NR at a fixed cross-linking agent loading

1.3 Content of the thesis

The content of this thesis comprises five chapters. Chapter 1 involves an introductory remark of the present research, which gives reasons and goals of the work. Details of the subsequent theoretical consideration and literature reviews are described in depth in Chapter 2 for those who want to understand the history and trends of the part investigated. Resulting from the literature, a novel research can be prepared. Chapter 3 involves the procedure of steps and conditions of HDPE/NR blends in foaming process and gives the details of the measurement of foam properties. The results and discussion of the work are described in Chapter 4, the effects of foaming variables on the foamed structure were reported inclusive of heating time, blowing agent loading, ratio of HDPE/NR, cross-linking agent loading

and ratio of HDPE/NR at fixed cross-linking agent loading. The conclusion and suggestion of this work are given in Chapter 5.