CHAPTER I

INTRODUCTION

1.1 GENERAL INTRODUCTION

The expansion of many industries within only a few decades induces the need for new materials which must be light, extensively available at relatively low cost and can be processed easily. At the same time, it must possess properties comparable with those of metals. The material that fits into such requirements is known nowaday as ***polymer***.

Epoxy is one type of thermoset polymer which can be used in many applications, such as for adhesives, construction, laminates, pipe, moulding and casting. Epoxy has three dimensional crosslinking network structure which leads it to some good properties, for example good chemical resistance, high electrical insulation, good adhesive strength and mechanical properties. However, epoxy is also hard, it exhibits brittle behaviour like glass. The brittleness of epoxy is detrimental because it leads to poor impact property. Numerous approaches have been proposed to improve this disadvantagous property of epoxy. One practical attempt is by adding a second phase into the epoxy resin, thus making the epoxy a "composite polymer". In this case, a rubbery material is believed to be a suitable phase.

It is anticipeted that by adding a softer, tougher phase such as rubber into the epoxy resin, the fracture energy or the energy required to break the epoxy specimen will be enhanced. The higher fracture energy means the rubber-mixed epoxy becomes more ductile and hence the application of epoxy resin can be broadened. However, other properties, which are quite important, have to be taken into consideration upon application of the epoxy as well. Examples of these properties include the modulus of elasticity, glass transition temperature, crosslinking density and the molecular weight between crosslinks. In fact, they can be related to each other too.

Since 1973, there have been many researchers who conducted work on the mixing of rubber with epoxy for toughness improvement.[3,21-23,27-32,67-69] Though not all, most of the work show an increase in the fracture energy when rubber was added at certain level. However, different resarchers tend to use different types of rubber and methods of molding of specimen. Thus, the properties investigated by each researchers tend to vary, sometimes quite significantly.[29-30,61,67] Most importantly, the mechanisms proposed to explain what had happened or how crack was induced and propagated tend to vary a lot. This is an area that is still opened for investigation and debates .

1.2 THE PURPOSE OF THE PRESENT STUDY

This research is aimed as an endevour to mix seperately solid and liquid rubber with epoxy resin. The objective is to enhance the toughness and to improve some mechanical properties of the epoxy resin. The solid rubber particles used is nitrile butadiene rubber (NBR). The NBR was applied as untreated and surface-treated with a titanate coupling agent. For liquid rubber, "Carboxyl terminated acrylonitrile-co-butadiene rubber (CTBN)" was used. CTBN with different concentration of acrylonitrile was applied in the present study. One is a CTBN which has 15% acrylonitrile content, and the other has 30% acrylonitrile content.

The mechanical properties of the rubber-mixed epoxy resin will be investigated. Samples will also be characterized to determine the compatibilization between the applied rubber and the epoxy matrix. The mechanical properties which will be studied in the present work are compression properties, tensile properties, fracture energy under double torsion, Izod impact and falling weight properties. Rubber-mixed epoxy resin will also be characterized for their density, thermal properties, dynamic mechanical properties. Microscopic observation of each phase and the interface will be performed by the use of a scanning electron microscope.