CHAPTER I

INTRODUCTION

Crosslinked polyethylene (XLPE) was discovered since early 1950s and have been increased attention due to the growth in telecommunication and data transfer. A three dimension network formed due to the crosslinking structure results in dramatic improvement of properties such as tensile strength, impact strength, chemical resistance and shrinkage. Therefore XLPE is suitable to use for production of heat shrinkable sleeves tubes or films which are components in making wire and cable. For the next decade the usages of XLPE in power cables will grow instantly due to the replacement of the chloropolymers, establishment and expansion of power generation and telecommunication infrastructure in many countries.

Crosslinked low density polyethylene (XLDPE) is well-known material used a component in making power cables. Crosslinked high density polyethylene (XHDPE) is appropriate for making hot-water and chemically aggressive medial pipe due to the improvement in impact property, creep and chemical resistance. Crosslinked linear low density polyethylene (XLLDPE), which has similar structure to HDPE with more side branches leading to more flexible and better impact resistance than HDPE, less widely used than XLDPE due to the higher impurity and melting temperature even though it has also better physical properties than XLDPE. Since XLDPE is of great commercial interest, it is vital to understand the kinetics of crosslinking reaction in particular the kinetic parameters are important for the control of final properties of the crosslinked polymers. The expected benefit of this research is to apply the information obtained for commercially development of the crosslinked LDPE and LLDPE.

Objectives

The purpose of the study is to fully understand of the kinetics of crosslinking reactions of LDPE and LLDPE using a peroxide compound as initiator in the absence and in the presence of an inhibitor.

1. To study the kinetics of peroxide crosslinking reactions of low density and linear low density polyethylene (LDPE and LLDPE) using the Rheometric and Differential Scanning Calorimetric techniques.

2. To study the effect of initiator and inhibitor concentrations on gel content, crystallinity, melting temperature (T_m) and crystallization temperature (T_c) of the crosslinked LDPE and LLDPE.

Scope of the Investigation

Scope of the study of the kinetics of peroxide crosslinking reactions of LDPE and LLDPE in the absence and in the presence of an inhibitor are as follows :

1. Literature survey of the relevant research works.

2. Review of the kinetic mechanism and derivation of kinetic expressions of such reactions.

3. Characterization of LDPE and LLDPE used in this study.

4. Evaluation of the kinetic parameters of the crosslinking reactions at various temperatures using Rheometric and Differential Scanning Calorimetric techniques. Dicumyl peroxide (DCP) as initiator and Irganox 1010 or tetrakis[methylene-3-(3′,5′-di-t-butyl-4′-hydroxyl)propanoate] as inhibitor were used.

5. Determination of the kinetic parameters including the reaction order of initiator, polymer and inhibitor, overall rate constant, overall activation energy and pre-exponential factor of crosslinking rate constant, and the efficiency of crosslinking.

6. Studying the effect of the amount of initiator and inhibitor on the percentage of gel content, melting temperature(T_m), crystallization temperature (T_c) and crystallinity of the crosslinked LDPE and LLDPE.