CHAPTER I

INTRODUCTION

1.1 Scientific Rationale

The advantages of ultra-high molecular weight (UHMW) PVC are good resilience and superior physical properties. These upgraded properties, combined with the usual advantages of PVC, permit these PVCs to enter markets previously excluded. The potential markets are insulation properties of wire and cable, replacements for elastomers in gasket and compounds used in automotives and their appliances that require high temperature properties and high strength.[1]

The conventional method of altering the molecular weight of PVC is to adjust the polymerization temperature. The lower the polymerization temperature the higher is the molecular weight.[2] This imposes the problems to UHMW PVC manufacturers. The problems encountered are difficulties in controlling the very low polymerization temperature and the risk of using highly reactive initiators which can be very dangerous in handling. In order to mitigate these problems, multiunsaturated comonomer was added during the polymerization reaction.[3,4,5] In this case, such a polymerization can be carried out at higher polymerization temperatures.

1.2 Objectives

1.2.1 To synthesize the ultra-high molecular weight PVC by addition of multiunsaturated comonomer.

1.2.2 To prepare the PVC dry blend from the UHMW PVC resin obtained from which properties are determined.

1.3 Scope of The Research

There are two parts of this research.

1.3.1 Synthesis of the UHMW PVC Resins by Addition of Multiunsaturated Comonomer, Diallyl ester.

The degree of polymerization ($\overline{DP}$) value is used as an index to classify the molecular weight of PVC. The target $\overline{DP}$ of this work is 2500 $\pm$ 50. There are six polymerization temperatures understudy which are 40, 43, 46, 49, 52 and 58°C. At 40°C, the reference UHMW PVC resin is produced without an addition of comonomer. At the other polymerization temperature, the added comonomer amount is varied until the $\overline{DP}$ value of UHMW PVC obtained is 2500 $\pm$ 50. A duplicate experiment was carried out for this thesis work. Then the physical properties of this UHMW PVC are determined. These are mean particle size, bulk density, cold plasticizer absorption and fisheye.

1.3.2 Determination of the Properties of UHMW PVC Dry Blend

The formulation for electrical insulation is selected for the present study. The properties determined are hardness, tensile strength, elongation, brittleness temperature, volume resistivity, heat deformation, and dynamic heat stability.

1.4 Benefits Expected from The Research

1.4.1 The polymerization of UHMW PVC resin can be carried out at higher polymerization temperatures by addition of multiunsaturated comonomer.

1.4.2 The experimental results obtained can be used as a guideline for further study of the synthesis of UHMW PVC resins with other molecular weight levels; or other types of comonomer could be used to synthesize the similar UHMW PVC resins.

1.5 Contents of The Thesis

The details of this thesis consist of

1.5.1 Theoretical considerations

Some technical information concerned with this work is described as suspension polymerization of vinyl chloride monomer (VCM), molecular weight control for VCM polymerization, and polymerization of UHMW PVC.

1.5.2 Experimental

Detailed experimental procedures are described along with the following corresponding results of UHMW PVC resins and their dry blends for insulation applications. The molecular weights of UHMW PVC obtained from different polymerization temperatures and comonomer amount are given. The properties of UHMW PVC with the same $\overline{DP}$ are compared with the reference UHMW PVC (no addition of the comonomer), and other UHMW PVCs with different comonomer amounts. The various factors which affect all the PVC resin properties are fully discussed.

1.5.3 Conclusions and suggestion

All the experimental results of both advantages and disadvantages of this polymerization method on UHMW PVC properties are shown. Moreover, some interesting suggestions for further study to obtain even more satisfactory results are listed.

1.5.4 Appendices

There are Appendices A, B, and C which show the details of VCM polymerization formulation at each polymerization temperature, the raw data of property results, and the relation between comonomer amount and reaction time at different polymerization temperature.