CHAPTER I
INTRODUCTION

Heterogeneously catalyzed olefin polymerization is widely used for producing many types of polymers used in everyday life e.g., polyethylene, polypropylene, polybutadiene rubber, etc. This polymerization reaction is highly exothermic. The removal of this heat to have a controllable reaction is one of the important design criteria used in designing polymerization reactors. One way to solve this problem is to use a diluent (or solvent e.g., hexane) to take up the heat of polymerization by a rise in temperature or by vaporization. If the catalyst and the polymer do not dissolve in the diluent, the process is called a slurry polymerization process.

The high density polyethylene (HDPE) is one type of polyethylene commonly produced by the slurry polymerization process using Ziegler-Natta catalyst which was discovered by Karl Ziegler in Germany and Giulio Natta in Italy in 1953 and 1954 respectivly. According to the broadest definition, the Ziegler-Natta catalyst is formed from a metal alkyl of base metal of group I to IV and a transition metal compound of group IV to VIII. These combinations are active only for certain monomers or under certain conditions. The Ziegler-Natta catalysts can be classified into 3 generations:

1. The first generation is the unsupported Ziegler-Natta catalyst e.g., $TiCl_3$-based catalysts which have only low activities.
2. The second generation is the supported Ziegler-Natta catalyst e.g., $MgCl_2$-supported catalyst/$Al(C_2H_5)_3$, the activities could be raised by 100 times. This catalyst is widely used for producing high density polyethylene(HDPE) in the commercial plants today.

3. The third generation is the soluble catalyst or metallocene catalyst which is the transition metal compound with aluminoxanes. This catalyst can give a higher activity and has been commercially used in recent years.

Although the slurry polymerization of ethylene with a $MgCl_2$-supported Ziegler-Natta catalyst has been studied by many researchers in the past, the low molecular weight polyethylene soluble in the diluent (e.g., hexane) which is the by-product of the process has not been studied very much. After the polymerization process, the slurry of high density polyethylene (HDPE) powder in hexane together with a small amount of low molecular weight polyethylene (1-2% by weight of HDPE produced, depending on the HDPE grade to be produced i.e., on the polymerization condition) are centrifuged at about 60 ^{o}C to separate the HDPE powder and the hexane containing the low molecular weight polyethylene (LMWPE). This hexane solution has to be purified before being recycled back to the process. In the hexane purification step, the low molecular weight polyethylene is separated out and collected. While this low molecular weight polyethylene can be sold as raw material to the candle making industry, its value is very low.

Moreover, the low molecular weight polyethylene can generate some problems. It can cause fouling problems in the equipment and affect the polymerization rate. If we can control or reduce the amount of low molecular weight polyethylene formed, the cost of purification of the hexane and fouling problems will be decreased and the efficiency of the monomer usage will increase. This thesis will study the relationship between the operating conditions of the slurry reactors and the amount of low molecular weight polyethylene formed.