CHAPTER I

INTRODUCTION

Plastic products are widely used in our daily life. They have important roles in agriculture, appliances, clothing, construction, electronics, furniture, packaging, transportation and numerous other areas because their properties surpass other materials. They can be hard, flexible, light, robust, cheap and chemically resistance. The quantity of plastic consumption has increased every year. [1]

Polyethylene, one of the general plastics, has widespread uses in film, bag and bottle applications. World consumption of polyethylene of during 1997 [2] was 37,950,000 metric tons which is the most among the commodity plastics. In Thailand, the demand for polyethylene is also increasing. The result from this is the enlargement of the waste plastics.

Because most of these wastes can not be decomposed by themselves under natural condition, the waste plastics have polluted our environment seriously. Therefore, it has become a key problem for us to solve the pollution caused by waste plastics, and to recover and re-utilize the waste plastics by processes of treatment and resource utilization. [3]

So far, various methods have been proposed for treating waste plastics. Generally, a catalyst will be used for catalyzing thermal cracking of the waste plastics into liquid hydrocarbons.

For instance, Takahashi and Tamimoto [4] studied the method for obtaining low boiling point hydrocarbon oil from the waste plastics, such as PE, PP, PVC or waste rubbers, by solid acid catalyst containing hydrochloric acid. The waste plastics were heated so as to be thermally decomposed at 250 - 450 °C to produce a vapor product containing gas and oil components. Later, the vapor product was brought into contact with a solid Lewis acid catalyst, aluminium trichloride ($AlCl_3$) and hydrochloric acid, at 180 - 250 °C to produce the low boiling point hydrocarbon oil, 30 - 40 %wt.

Zmuda [5] converted polyolefin wastes such as PE, PP and PS to liquid fuels by catalytic cracking. The catalyst for this reaction was in the form of aluminium oxide, aluminium silicate or aluminosilicates of alkali metals or alkali earth metal in an amount of 1 - 5 % by weight. The reaction temperature was between 400 - 600 °C. Amounts of 0.02 -0.04 m^3 / kg of air could be introduced into system while the reaction was operating. The yield of product was 98% of petro type or diesel oil type fuels.

Intrapreecha [6] studied the method of producting diesel fuel from high density polyethylene wax by hydroisomerization. This was operated at temperatures of 300 - 500 °C, hydrogen pressures of 300 - 500 psig and reaction times of 10 - 240 minutes, using 5%wt of 0.3%Pt and 0.5%F on alumina catalyst. The product was 90%wt of low speed diesel.

Yang [3] studied the method for treating waste plastics (PE, PP, PS) to produce hydrocarbon fractions, gasoline and diesel oil by a catalytic reaction. The catalyst comprised a silica carrier and active components such as K, W, Al, WO, Na, Ca, Fe, and O. The reaction was operated in a fixed-bed reactor, the temperature ranged from 280 °C to 480 °C and the pressure ranged 0.01 to 0.04 MPa for 8 to 10 hours. The obtained hydrocarbons comprised more than 30 percent of aromatics and cyclanes.

Leesuksan [7] converted polyethylene wastes, used bottles, to produce C_{10}-C_{16} hydrocarbons with gasoline properties by catalytic hydrocracking. The reaction was operated at 400 °C, 600 psig hydrogen pressure for 12 hours by using 40%wt of Pt(0.6%) / Sn(0.15%) / F(0.15%) on alumina catalyst. The yield of gasoline was 94%wt.

Yeyongchaiwat [8] studied the one-step catalytic process for cracking used polypropylene to fuel oil comprising C_8-C_{16} hydrocarbons with diesel properties corresponding to a good cetane index. The Ni(5%) / Sn(5%) / F(2%) on molecular sieve catalyst was used in this reaction at 350 °C, under 500 psig hydrogen pressure for 6 hours. The yield of liquid hydrocarbon was 86%wt.

Objectives and Scope of the Research

This research is developed from Leesuksan 's project by investigating a new catalyst which is cheaper and under a milder condition than the Pt catalyst in depolymerization of used PE into liquid hydrocarbons. Besides, the effect of the pore size of various molecular sieve types was studied by considering the molecular weight distribution of the oil products.

The goal of this research is :

1) To study the system of dual functional catalytic depolymerization of used PE to hydrocarbons with desired molecular weight.

2) To investigate the optimum condition and the best catalyst for depolymerization of used PE by varying catalyst type, catalyst concentration, reaction time, reaction temperature, hydrogen pressure and pore size of molecular sieve.

3) To characterize the oil products by Gas Chromatography.

4) To determine the physical properties of the oil products from optimum condition following the ASTM standard.