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ORIGINAL PAPER

Catalytic degradation of the mixed polyethylene and polypropylene into middle distillate products

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Abstract Mixture of polymers (HDPE/LDPE/PP) was pyrolyzed over a silico-alumina catalyst using a laboratory semi batch reactor operating isothermally at ambient pressure. The experiments discussed in this work show that the use of catalyst provides proper selectivity in the liquid product distributions and improves the yield of light hydrocarbon productions. The liquid samples were analyzed using GC/FID to find out their composition. The liquid collected at optimum condition (420 °C, 40 cat/pol ratio) was distilled at different temperatures to discretize light and heavy fractions. Octane number, color, Reid vapor pressure, specific gravity, and density are further analyses which done to determine extra physicochemical properties of the liquids at optimum reaction condition. Also, results compared with the physical properties of commercial gasoline which imply that the liquid somewhat matches with standard gasoline. By using Arrhenius's law, a kinetic model at optimum reaction conditions has been developed and activation energy determined. The reaction follows the first-order kinetic rate relationships. This model equation gives a suitable match with experimental results.

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Introduction

Recently, waste plastics' recycling is noticed all over the world due to their potential for use as resources. Since, the continuous increase in polymer production and consumption leads to accumulation of high amounts of polymer waste that can cause serious environmental problems, the conversion of these wastes into fuels can be considered as a promising recycling method. Chemical recycling was investigated, through which waste plastics were converted into fuel oil and valuable chemicals (Zhou et al. 2004; Kumar et al. 2011). The destruction of wastes by incineration is prevalent; however, generates pollutants with toxic emissions. Disposal of waste plastics by landfill is undesirable due to high costs and poor biodegradability. Waste polymer recycling methods have been developed. Tertiary recycling, in which waste plastic is converted into useful chemicals, is recognized as the most promising recycling method. The most commonly used conservative chemical methods for waste polymer recycling are pyrolysis and catalytic degradation. Thermal and catalytic degradation of waste plastics are two types of chemical recycling processes. The main problems of thermal degradation are heavy product distributions and high temperatures demand, typically more than 500 °C and even up to 900 °C (Kumar et al. 2011).

Appropriate catalysts control the product yield and components distribution, and also reduce significantly the reaction temperature compared to polymer degradation. Studies of the effects of catalysts on the catalytic degradation of polymer have been performed by some researchers (Akpanudoh et al. 2005; Azhar Uddin et al. 1998). It is

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