Two - Step Processing of PVC containing Polyethylene in Heavy Vacuum Gas Oil

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Initially a PVC (5 %) / LDPE (20 %) mixture in heavy vacuum gas oil (HVGO) was dechlorinated and then this mixture was hydrocracked in the presence and absence of catalyst. Experiments have shown that the dechlorination step and the temperature had great effect on the product distribution of hydrocracking (HC). It was observed that dechlorination step leeds to degrade PE besides dechlorination of PVC. and PE could be completely cracked with/without catalyst by hydrocracking, eventhough at 400 °C. The low amount of coke in liquid product from HC showed that the solid particles (double bound-containing polyenic chains) from dechlorination of PVC was cracked into liquid and gas hydrocarbons. It was shown that the catalyst has no considerable effect at 400 and 425 °C, but the gas yield was increased at 450 °C. The 75 % and 52 % of the liquid products at 450 °C were the hydrocarbons having boiling points ranging over 50-200 °C.

Introduction

Thermal decomposition has been proposed as a method for recover the chemical value of mixed waste plastics. During the thermal degradation at low temperatures, the mixed plastic waste is converted into a homogenous liquid form which may then be blended into refinery streams for the production of fuel. In case the waste contains PVC, a dechlorination takes place in parallel with the thermal degradation. The thermal degradation behavior of PVC alone or with other polymers has been described in

numerous publications [1], [2], [3], [4]. Dehalogenated and depolymerezed plastics can be used as feedstock in petrochemical process. In literature there is very little research on the conversion of plastics mixture containing PVC into fuels [5], [6], [7]. No study on the hydrocracking of dechlorinated polymer mixtures has been published so far.

In this study, dechlorination of polymer mixture in Heavy Vacuum Gas Oil was carried out at 350 °C. HVGO has multiple functions, mainly preventing the blockage of the gas line

and decreased energy requirement for the process. At second step, the homogenous mixture was cracked in presence of H_2 with/without catalyst to convert to fuel.

Materials and Methods

Materials

The HVGO,LDPE and catalyst in a study[#] were used in this study. PVC was supplied by ALPET-Izmir as a powder.

Methods

Dechlorination was carried out in a stirred tank reactor(V= 1L) under nitrogen atmosphere. The reactor was gradually heated to 350 °C and held at this temperature for an hour. The volatile hydrocarbons were condensed in traps. The HCL gas was absorbed in an aqueous solution of NaOH. After dehalogenation, the residue containing degradated PE,HVGO and coke like solid particles from PVC was hydrocracked. Hydrocracking experiments and product separation were carried out as in above mentioned study[#].

Result And Discussion

The product distribution of hydrocracking experiments of dechlorinated PVC/LDPE/HVGO mixture are given in Table-1. To compare the dechlorination effect on hydrocracking, HC experiments was also carried out with prepyrolyzed (at 350 °C) LDPE/HVGO mixture.

Evolved HCl at the dechlorination step was noted to cause partial craking in PE used; and this predegraded PE can be easily converted to liquid and gas hydrocarbons by HC in the presence and absence of the catalyst. It was observed that catalyst caused a decrease in gas yield, but an increase coke amounts at 450 °C. It was worth to mention that catalyst increased the amount of light hydrocarbons in liquid product at 425 °C. However this amount diminished at 450 °C (Fig.1). The temperature had a significant effect on the product distribution in the case of prepyrolysed HVGO / LDPE. The yield of gas and liquid products increased with the temperature. On the other hand, the catalyst had also considerable effect on the gas yield. In the presence of catalyst gas yield was much more than that of absence of catalyst, while the liquid yield was lesser at 450 °C

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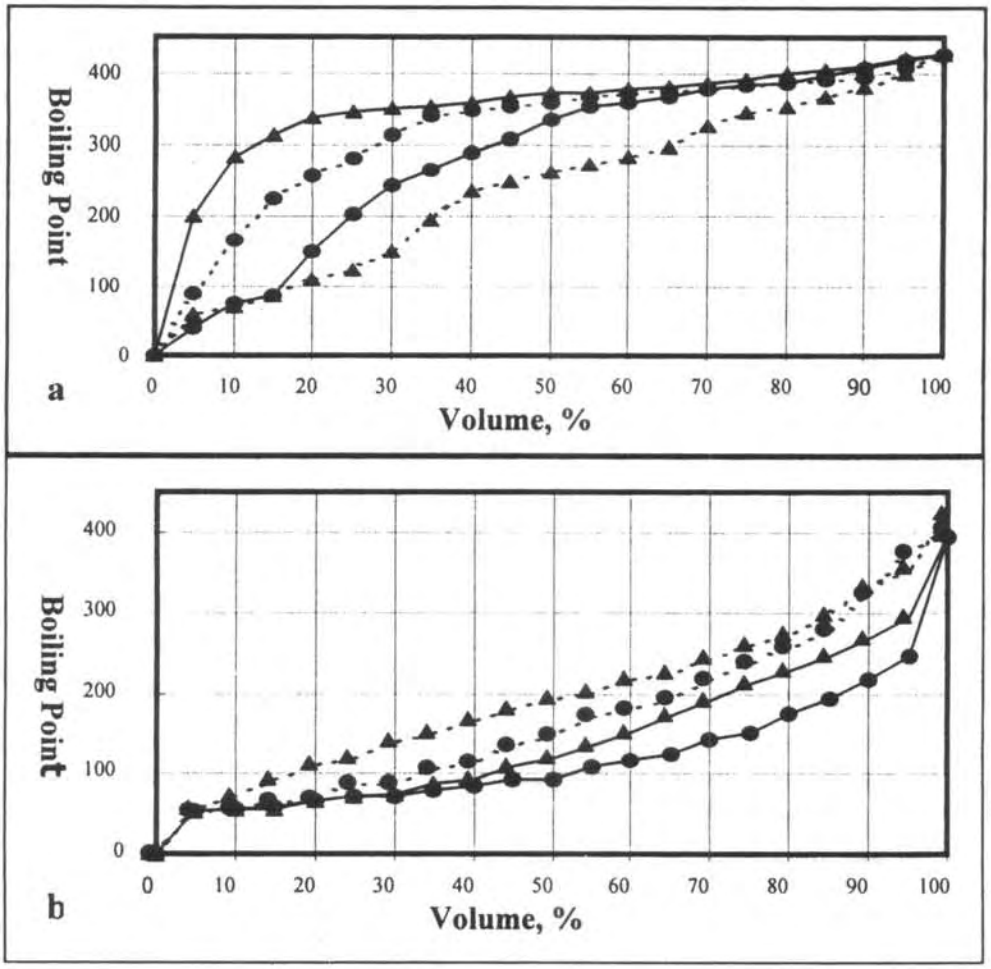
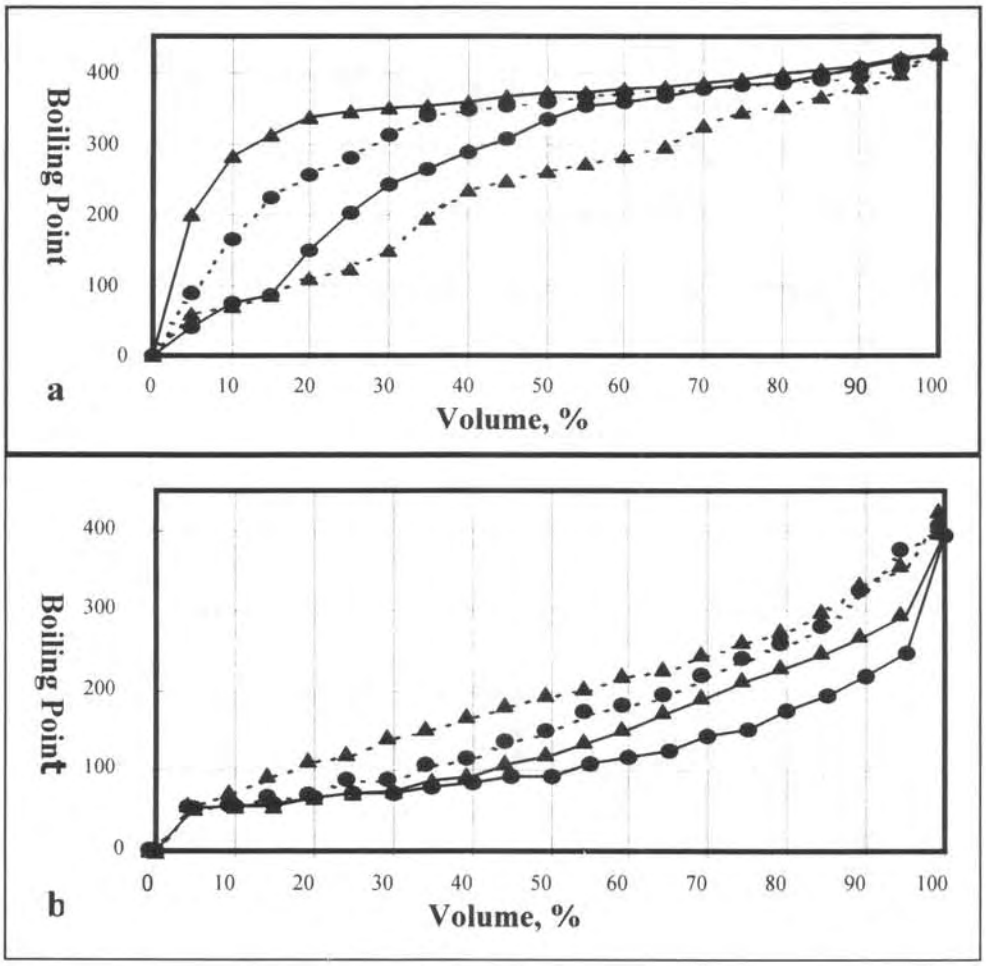


Simulated Distillation Curve of the Liquid Products from HC of HVGO / PE / PVC at 25 °C (a) and 450 °C (b) ; —●— HVGO / PE; ---●--- HVGO/PE+cat.; —▲— HVGO/PE/PVC; - ▲ - - HVGO/PE/PVC+cat



Simulated Distillation Curve of the Liquid Products from HC of HVGO / PE / PVC at 425 °C (a) and 450 °C (b) ; —●— HVGO / PE; ---●--- HVGO/PE+cat.; —▲— HVGO/PE/PVC; - - ▲ - - HVGO/PE/PVC+cat