Degradation of PET Using Ionic Liquid

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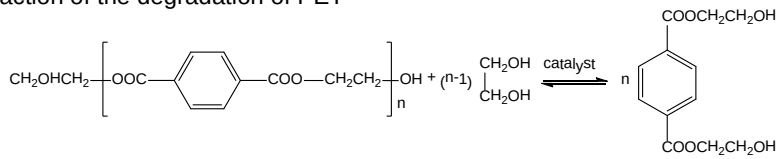
INTRODUCTION

The worldwide annual production of polyethylene terephthalate (PET) has reached 2,700 million tons currently. Due to the strong resistance to the microbes and atmosphere, the life cycle of PET can range from 16 to 48 years in nature environment. Based on environmental protection and economic benefits, the degradation of PET is critical. The current degradation methods of PET are mainly chemical degradation and biological degradation. This project aims to degrade PET with the method of alcoholysis (ethylene glycol) by a new kind of ionic liquid catalyst. The result will contain the comparison of the new catalyst with previous catalysts: the synthesis method, the amount of catalyst required, the degradation temperature, pressure and time, the conversion of PET and the selectivity of BHET.

METHOD

1. The synthesis of the catalyst:
   A +B +HNO_3 +water→catalyst（Zn,W-containing ionic liquid catalyst）
2. The reaction of the degradation of PET



In this reaction, ethylene glycol (EG) act as both the raw material and the product. It is found that the main product is bis-2,2,2-hydroxyethyl terephthalate (BHET) monomer, with little dimmer and trimer exist. The conversion of PET and the selectivity of BHET can be determined by the following equations:

$$Conversion\ of\ PET = \frac{inital\ weight\ of\ PET - undepolymerized\ PET}{inital\ weight\ of\ PET} \times 100\%$$

$$Selectivity\ of\ BHET = \frac{moles\ of\ BHET}{moles\ of\ depolymerized\ PET\ units} \times 100\%$$

The reaction conditions including the amount of catalyst, the degradation temperature, pressure and time will be optimized through experiment.

CURRENT RESULTS

The experimental data is not completed yet, but we have done most of the experiments. The current results are as follows: the optimum degradation time is 40 min, the optimum degradation temperature is185 ^{o}C, the optimum catalyst amount is 0.025g, with the convertion of PET is 100% and the selectivity of BHET is 84.34%.

CONCLUSION

The new ionic liquid catalyst can effectively degrade the waste PET into high pure monomer BHET under the relatively mild conditions compared with the previous ionic liquid catalysts.