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Enhanced catalytic glycolysis conditions for chemical recycling of glycol-modified poly(ethylene terephthalate)

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Abstract

Despite the significant influences of the rigid cyclic ring structure on the good thermal and mechanical characteristics of poly(1,4-cyclohexylenedimethylene terephthalate) (PCT), steric hindrance by the cyclohexylene group interferes with glycolysis, an important chemical recycling route for poly(ethylene terephthalate) (PET) derivatives. To confirm the effects of chemical structure on the reaction, bis(4-hydroxymethyl)cyclohexylmethyl terephthalate (BHCHT), a model compound for PCT, was synthesized and compared with bis(2-hydroxyethyl) terephthalate (BHET), a model compound for PET, in transesterification reactions under zinc catalytic conditions. The rate of transesterification of BHCHT was 1/3 of that of BHET, and this retarded reaction rate was dramatically increased by up to 4 times when a catalytic amount of alkoxy species was combined with the zinc catalyst. The conditions of alkoxide combined with the zinc catalyst were applied to the glycolysis of PCT; the glycolytic reaction rate was three times higher than that with the conventional zinc acetate and the glycolysis product was produced with 82% yield.

Keywords: PCT, PET, glycolysis, transesterification, chemical recycling