

CHEMICAL UPCYCLING OF PET WASTE FOR TEREPHTHALIC ACID RECOVERY: A SUSTAINABLE MATERIALS PROCESSING APPROACH

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ABSTRACT

Polyethylene terephthalate (PET) waste creates significant environmental problems because traditional mechanical recycling often leads to lower-quality materials. Chemical upcycling gives a different approach by enabling the recovery of materials down to their monomer level and promoting closed-loop recycling. This study demonstrates the chemical upcycling of post-consumer PET waste into terephthalic acid (TPA) using hydrolysis with sulfuric acid, followed by alkaline purification and acid precipitation. How the concentration of sulfuric acid (60-98%) and the reaction time (30-120 minutes) influenced TPA yield was systematically evaluated in a lab setting. Optimized results came from using 90% acid concentration for 90 minutes, resulting in a maximum of 4.32 grams of TPA from 10 grams of PET, which is about 50% of the theoretical yield. The recovered TPA appeared as a white crystalline solid, consistent with the physical properties of TPA. The results indicate that the process is straightforward, catalyst-free, and reproducible for material recovery. This study underscores the viability of chemical upcycling as an effective way to manage PET waste within a circular economy framework.

KEYWORDS: PET Waste, Chemical Upcycling, Terephthalic Acid, Sustainable Manufacturing, Materials Recovery

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