

Chemical Engineering Thesis Defense

Recycling of HDPE

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Abstract

High-Density polyethylene (HDPE) is the most used polymer on earth. Since it is used in such large quantities, it has become the most extensively produced polymer on the planet. Unfortunately, the rate of reusing or recycling HDPE is far behind the rate of production leading to plastic pollution. Most of this waste plastic ends up in landfills or incineration to recover energy. Plastic production consumes a lot of energy and is associated with CO₂ emissions. This method of disposing plastic only adds to the environmental pollution rather than improving it. Primary reasons for low recycling rate appear to be more political and financial. In the US, the rate of recycling was less than 10% whereas Japan showed a recycling rate of more than 80%. The other aspect of low recycling is financial. In order to make recycling a financially viable process, efforts have to be made to streamline the process of waste collection, segregation and technically feasible process. This study focusses on the technical aspect of the issue. Even though efforts have been made to recycle HDPE, none of the processes have been recycle HDPE with financial viability, recovering full value of plastic, minimum CO₂ emissions and minimum change in properties of the polymer. This study focusses on effective recycling of HDPE with minimum change in its properties. Dissolution has been used to dissolve the polymer selectively and then reprecipitating the polymer using a non-solvent to obtain the polymer grains. This is followed by mixing additives to the polymer grains to minimize degradation of the polymer during the extrusion process. The polymer is then extruded in an extruder beyond its melting temperature. This process is repeated for 5 cycles. After each cycle, the

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polymer is tested for its properties using the Tensile Testing, Fourier Transform Infrared Spectroscopy (FTIR), Differential Scanning Calorimetry (DSC), and Dynamic Mechanical Analysis (DMA). It was observed that the rheological properties of the polymer were maintained after the 5th recycle whereas the mechanical properties deteriorated after the 2nd recycle. Also, increase in carbonyl index was observed after 5th recycle.



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Zoom Link: <https://asu.zoom.us/j/3158889754>