Bio-Polymeric Study for Recycling and Replacing Polyethylene Terephthalate (Through Reprocessed Polyurethane Polyols and Algal Bioplastic Substitute)

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This project came up with two methods to improve the sustainability and growing concern with the increasing use of plastics. One was to come up with an entirely bio-based material (constructed from algae) to replace the consumption of plastic known as PET (polyethylene terephthalate). The other approach was to assist in utilizing recycled polyester to make a more environmentally-friendly polyurethane polymer. Biopolymer made from algae was successfully produced with the tensile strength and the stiffness increasing, with glycerin concentration decreasing as hypothesized. Maximums were seen with xylitol suggesting an optimal formulation point. Unexpectedly, the tensile strength for samples made out of xylitol exceeded that of glycerin by up to 113% suggesting the use of xylitol to be a better material. Recycled polyester was utilized to create polyurethane with faster reaction times (28% quicker) and curing times (51% quicker) than conventional foam. Higher compressive strengths were seen at higher loadings which correlated well with smaller cell size measurements. 1% increase in recycled loading increased compressive strength by 0.38psi. Furthermore, polyurethane made out of higher recycled polyester content resulted in a material more resistant statistically ($p<0.05$) to deformation at higher temperatures and less flammability than conventional foam. Results from the Thermal Gravimetric Analysis measurements (greater remaining char content) and fire-cone-calorimetry testing (lower peak heat release rate) at higher polyester loadings independently supported this conclusion. Two areas (algal biopolymer and recycled polyester polyurethane) were explored showing unexpected benefits in the search for some sustainable, alternate options to current plastic polymer usage.