Title: Advancing Solvent-Based Recycling of Complex Post-Consumer Plastics

Elizaveta Radkevich[1], Lily Callen[1], Charles Granger[1], Ezra bar-Ziv[2], Fei Long[2], George Huber[1]*

[1]University of Wisconsin-Madison, Madison, WI 53706

[2]Michigan Technological University, Houghton, MI 49931

*George Huber, gwhuber@wisc.edu

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Abstract:

Several advanced recycling technologies are being developed to address the limitations that mechanical recycling has with complex waste streams. Amongst those is Solvent Targeted Recovery and Precipitation (STRAP), a solvent-based recycling technique aiming to recycle complex plastic mixtures from mixed waste streams. STRAP can separate polymers from waste streams through selective dissolution. The target polymer is dissolved by a solvent capable of only dissolving the target polymer and not the other polymers present in the mixture. The dissolved solution is separated from the undissolved particles through filtration. The polymer is then precipitated out of solution through a temperature decrease. We have been successful in applying the process to various feedstocks including multi-layer plastic films, monolayer films with paper and adhesives, single use coffee cups, supersack containers, and municipal solid waste (MSW). These feedstocks have been characterized to determine polymer composition, polymer content, and impurities present. We have optimized the process conditions including solvent, temperature, dissolution time, and process sequence, if needed, to achieve the highest yield of purified polymer produced. In the case of monolayer polyethylene films, we have successfully removed paper labels, adhesives, and inks to produce a high-quality polyethylene (PE) comparable to virgin polyethylene. The STRAP PE cast film has total volatile organic content below 4 ppm and color similar to virgin PE. Techno-economic analysis and life-cycle assessment of the STRAP process with mono-layer PE films show economic viability on 56 kton/yr scale and lower global warming potential than virgin PE production. We have been able to produce a blend of polypropylene (PP) and PE from MSW with minimal ash and contaminants. This blend of PP and PE was blended with virgin PE to achieve comparable mechanical and rheological properties to purely virgin PE. Our current efforts are performed at lab scale, producing 1-5 kg per material. Next efforts will focus on the scaleup of this process, recycling these feedstocks at a 25 kg/hr pilot-scale unit.