WPI CHEMISTRY & BIOCHEMISTRY

Department of Chemistry and Biochemistry
Worcester Polytechnic Institute

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12:00 PM

Gateway Park 1002

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"Let's Make this Waste Work for Us: Versatile Strategies for Valorizing waste Plastics."

Of the 300 Mtons of plastic produced each year, only about 10% of it is recycled. Many plastic additives are carcinogenic, including bisphenol-A, perfluoro alkylated substances (PFAS), and phthalates. Plastic waste ends up in our environment, contributing to environmental pollution forms its own ecosystems, sometimes termed "garbage patches", spreading microplastics throughout our food chain. In total, plastic production and use contributes 3-7% of annual greenhouse gas emissions. All of these factors motivate a search for more circular use of plastics. The challenge is efficient and economical recycling of most plastics is not possible with current technologies. Thermal and hydrothermal technologies can solve many of the problems preventing economical recycling of plastics. For example, hydrothermal liquefaction (HTL) has potential to convert environmental plastic in remote locations, including the Great Pacific Garbage Patch (GPGP) (Belden et al., 2021). In a systems-level analysis, we show that the energy contained in the GPGP should be sufficient for indefinite collection and disposal sorties, with the potential for complete removal within 10 years. To turn off the sources of plastic, we envision riverine plastic collection sites, since rivers are the primary sources of ocean plastics. The composition of riverine plastic varies geographically, so we built a data-driven model to predict oil yields obtained by plastic mixtures of different compositions (Belden et al., 2022). This model predicts that removal of polyethylene terephthalate (PET) can lead to efficient thermal conversion of riverine plastics to oils. Turning off the riverine source terms of ocean plastics requires better municipal recycling facilities solutions. In one study, we showed that polystyrene in particular is suitable for a circular economy solution consisting of depolymerization to produce styrene followed be repolymerization (Reed et al., 2024). For mixed plastics, we developed models to predict economics and energy performance for municipal recycling facilities over a range of scales (Belden et al., to be submitted 2026). For cases when complete depolymerization is not desirable, we developed a new technology, termed aqueous chemi-mechanical recycling, that uses water as a green solvent to blend dissimilar plastics, remove colors, and reduce volatile organic compound content (Reed et al., 2026). Collectively, these studies point the way toward a sustainable plastic future.

Host: Dr. Rong Wang