



## New Recycling Method Could Make Polyurethane Sustainable (April 2020)

Innovation through synergy

**Centers for Chemical Innovation**

The NSF Center for Sustainable Polymers (CSP) connects scientists from the University of Minnesota, Cornell University, Northwestern University, the University of California, Berkeley, Washington University in St. Louis, the University of Chicago, and the University of South Dakota in a manner that promotes highly collaborative research. This environment allows partnership across various scientific disciplines, including polymer, organic, biological, inorganic, and theoretical chemistry. As such, CSP researchers have been able to approach challenging problems related to sustainability with a wide range of expertise.

Cross-linked polyurethane foam (PU) is used in many commercial applications including mattresses, insulation, and construction materials. Due to the permanent nature of its chemical cross-links, conventional PU does not flow by heating which precludes reprocessability. Instead, it must be downcycled into less useful materials. Given that PU represents 31% of the thermoset materials market and foam is less dense than other materials, this represents a sizeable waste stream that takes up large amounts of space when landfilled.



*Polyurethane foam waste is successfully reprocessed via a dissociative carbamate exchange mechanism activated at elevated temperature by a dibutyl tin dilaurate (DBTDL) catalyst with effective mixing via twin screw extrusion.*

To address the CSP's sustainability goals of reprocessing end-of-use materials, a team of researchers at Northwestern University comprising of Daylan Sheppard, Leslie Hamachi, David Fortman, and Prof. William Dichtel discovered that waste PU could be melt reprocessed by introducing a DBTDL catalyst via solvent swelling. However, methods that successfully reprocessed PU films were not efficient in removing air from PU foams. In order to address the challenge that PU foam presented, they teamed up with researchers from the University of Minnesota comprised of Kailong Jin, William Dean, and Prof. Christopher Ellison to develop a new method of reprocessing post-consumer PU foam waste using twin screw extrusion. This new method involves efficient mixing of catalyst-containing PU foam waste in order to ensure air is removed from foam during reprocessing. This collaboration benefitted from the Northwestern team's synthetic expertise and long history of studying urethane chemistry as well as the Minnesota team's engineering expertise in twin screw extrusion.

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Sheppard, D. T.; Jin, K.; Hamachi, L. S.; Dean, W.; Fortman, D. J.; Ellison, C. J.; Dichtel, W. R. Reprocessing Postconsumer Polyurethane Foam Using Carbamate Exchange Catalysis and Twin-Screw Extrusion. *ACS Cent. Sci.*, **2020**, *6*, 921–927.