Research News

Upcycling spongy plastic foam from shoes, mattresses and insulation

New method turns foam into higher-value rubber and hard plastics

Commonly used for insulation, polyurethane foam is notoriously difficult to recycle.

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May 5, 2020

Researchers have developed a new method for upcycling polyurethane foam, the spongy material found in mattresses, insulation, furniture cushions and shoes.

The process, developed by researchers at Northwestern University (/cgi-bin/good-bye?https://news.northwestern.edu/stories/2020/04/upcycling-spongy-polyurethane-foams-from-shoes-mattresses-and-insulation/) and the University of Minnesota, involves mixing postconsumer polyurethane foam waste with a chemical catalyst solution that allows the foam to be heated and become malleable. Next, the method uses a "twin-screw" extrusion process that removes air from the foam to create a new material.

This process allows foam waste to be processed into higher quality rubbers and hard plastics for use in shoe cushioning, watch wristbands, hard durable wheels (for shopping carts and skateboards) and in automotive applications such as bumpers.

"Polyurethane foam waste has historically been landfilled and burned or downcycled for use in carpeting," said Northwestern's William Dichtel, who co-led the research. "Our latest work removes air from polyurethane foams and remolds them into any shape. This could pave the way for industry to begin recycling polyurethane foam waste for many relevant applications."

The National Science Foundation <https://nsf.gov/awardsearch/showAward?AWD_ID=1413862&HistoricalAwards=false> -funded research was published in the journal *ACS Central Science* (/cgi-bin/good-bye?https://pubs.acs.org/doi/10.1021/acscentsci.0c00083).

Often made from toxic building blocks, polyurethane foam frequently ends up in landfills. While other types of plastics can be melted down and recycled, polyurethane foam's chemical bonds are so strong that it does not melt -- even in extreme heat. At best, people can shred it into synthetic fibers, which can then be downcycled into carpet and brushes.

Other upcycling efforts have compressed the foam to remove its air, but these efforts have resulted in cracked or unevenly blended materials. The new approach uses two intermeshing, co-rotating screws to simultaneously mix and remold the foam, improving mixing and air removal.

"This work from the Center for Sustainable Polymers is a great example of the outcomes NSF seeks from its support of the Centers for Chemical Innovation," says Ken Moloy, a program director in NSF's Division of Chemistry. "In this case, chemistry and engineering have been combined to find a potential solution to reprocess a common consumer polymer."

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