

Super Absorbent Polymer Recycling to Pressure Sensitive Adhesives

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OVERVIEW

Scalable process to produce pressure sensitive adhesives from superabsorbent polymers

- Diverts diapers and feminine hygiene products from landfills
- Produces commercial adhesives with reduced carbon emissions

BACKGROUND

Crosslinked sodium polyacrylate-based superabsorbent polymers (SAP) are used in a variety of common consumer products, including disposable personal hygiene products such as baby diapers, adult incontinence products, and feminine hygiene products. The global annual production of this superabsorbent material is estimated to be over two million metric tons, with disposable diapers claiming 74% of the market. Because SAPs are used predominately in disposable articles, a high percentage of SAPs are disposed of in landfills. Because mechanical recycling cannot be used with polymers that do not reversibly melt (e.g., crosslinked SAPs), most diaper recycling efforts have focused on the cellulosic components and ignored the SAPs.

INNOVATION

Researchers at the University of Michigan, in collaboration with a Fortune 500 consumer products company, have developed a practical method to upcycle sodium polyacrylate-based SAPs to pressure sensitive adhesives (PSAs). The open-loop recycling approach involves de-crosslinking the SAP, an optional chain-shortening step, and functionalization via esterification to produce the PSA. The resulting materials exhibit low-to-medium storage and loss moduli and

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are structurally nearly identical to commercially available pressure-sensitive adhesives. They are suitable for use as general-purpose adhesives for products including tapes, bandages, and sticky notes.

Furthermore, a life cycle analysis demonstrated that the adhesives synthesized via this approach outcompete the same materials derived from petroleum feedstocks on nearly every metric, including carbon dioxide emissions and cumulative energy demand. This potentially scalable route to recycling diapers and feminine hygiene products could keep two million metric tons of polymer waste from landfills each year and simultaneously reduce carbon emissions associated with conventional PSAs.