Polymer Breakdown

Reaction offers possible way to recycle nylon

Each year, thousands of tons of nylon end up in landfills. But small-scale experiments may offer big hope for efficient recycling of some types of the material.

Nylon-6, an artificial polymer used in carpets, clothing, and car parts, is made by chemically linking large numbers of molecules derived from a petroleum product called caprolactam. Current processes to break apart, or depolymerize, nylon-6 typically must use common laboratory equipment, temperatures above 330°C, the reaction was more efficient, but only 55 percent of the caprolactam was recovered because some of the substance decomposed in the heat.

At the intermediate temperature of 300°C—low by industrial standards—the yield of caprolactam approached 86 percent, says Kamimura. More important, he notes, at that temperature the ionic liquid didn’t become tainted with by-products of the reaction. The researchers were able to reuse their ionic liquid five times without significant drops in caprolactam yield.

The team’s approach is novel because it uses ionic liquids under conditions less harsh than those needed for other solvents, says Michael P. Harold, a chemical engineer at the University of Houston. Harold suggests, however, that several issues may stand in the way of making the process economically feasible. For instance, because ionic liquids are typically quite costly, expanding the process to an industrial scale would require the solvent to endure hundreds of depolymerization cycles.

“Ultimately, the economics [of the process] will dictate the success,” says Harold. “If the ionic liquid is very expensive and not sufficiently durable, the concept will not be viable.”

John D. Muzzy, a chemical engineer at the Georgia Institute of Technology in Atlanta, and his colleagues are developing a different sort of chemical reaction to unzip nylon-6. In the lab, they’ve used a liquid catalyst to melt the nylon and cleave its long molecules. The researchers haven’t yet published their findings, but Muzzy and his colleagues are developing a liquid catalyst to melt the nylon and cleave its long molecules. The researchers haven’t yet published their findings, but Muzzy and his colleagues are developing a liquid catalyst to melt the nylon and cleave its long molecules. The researchers have yet published their findings, but Muzzy and his team estimate that a single facility using their process could generate more than 4,600 metric tons of impure solution of caprolactam annually at a cost of about half the current market price. —S. PERKINS

Faker Crayfish

Males keep bluffing but don’t get caught

Many males of an Australian crayfish species consistently fake their way through macho confrontations, a new analysis of rivalries indicates, even though evolutionary theory says that such bluffing should be rare.

When two male slender crayfish (Cherax destructor) encounter each other, the one waving bigger claws typically sends the smaller-clawed creature fleeing, say Robbie Wilson of the University of Queensland in St. Lucia, Australia, and his colleagues. Yet the researchers’ measurements show that the biggest claws don’t necessarily deliver the strongest pinch.

That the oversized but feeble claws retain their menace represents “one of the first demonstrations of dishonest weaponry on a widespread scale,” says coauthor Michael J. Angilletta Jr. of Indiana State University in Terre Haute.

Slender crayfish, about palm size, stake out homes in streams, and males face off when they encounter each other. “They do this odd little dance,” Angilletta says. One, adopting a pose that reminds Angilletta of a knuckle-walking gorilla, plants his claws tip down in the sand, then lets the other male tap them. Then the poser and tapper switch roles. After several posing bouts, one male usually retreats. Only rarely does the encounter escalate into a wrestling match.

The researchers studied various confrontations among 32 males. Angilletta says that his coauthors—from Brazil and England as well as Australia—paired the males in a series of contests arranged to create “the crayfish World Cup.” A detailed analysis showed claw size to be a much stronger predictor of dominance than strength and body condition, the researchers report in an upcoming American Naturalist.

QUOTE

Ultimately, the economics [of the process] will dictate the success.”

MICHAEL P. HAROLD,
University of Houston

SMACKDOWN? Two male slender crayfish of Australia resort to actual wrestling only when they’re about the same size. Often, the smaller one simply flees.