Solutions sought for plastics problem

In 2018, countries committed to cutting down on plastic waste, and chemists developed more sustainable polymers

Plastic waste has been a long-standing problem, and this year the world continued to grapple with the growing mountains of discarded plastic products. Governments sought ways to curb plastic use and boost recycling efforts, companies invested in technology to recycle certain problematic plastics, and chemists created novel sustainable polymers.

China kicked off 2018 by restricting plastic waste imports with more than 0.5% contaminants, such as food residue or metals. This low threshold effectively meant that many recyclers in the US and elsewhere, which previously shipped their recyclable plastics to China for the labor-intensive sorting process, would have to find alternative solutions.

Also in January, the European Commission introduced its first Europe-wide plastics recycling plan, which aims to make all plastic packaging used in the region recyclable by 2030. The plan also includes the goal of recycling 55% of all that packaging material by 2030; currently, Europeans recycle 30% of their plastic waste. In May, the commission proposed a new law that bans or restricts the 10 single-use plastic products most often found on Europe's beaches and in its seas, including plastic cutlery and cotton swab sticks.

One particularly problematic polymer—polystyrene, which is common in food packaging and packing materials—currently isn't recycled on a large scale because of cost and food contamination.

On Jan. 1, 2018, the Chinese government severely restricted imports of plastic for recycling.

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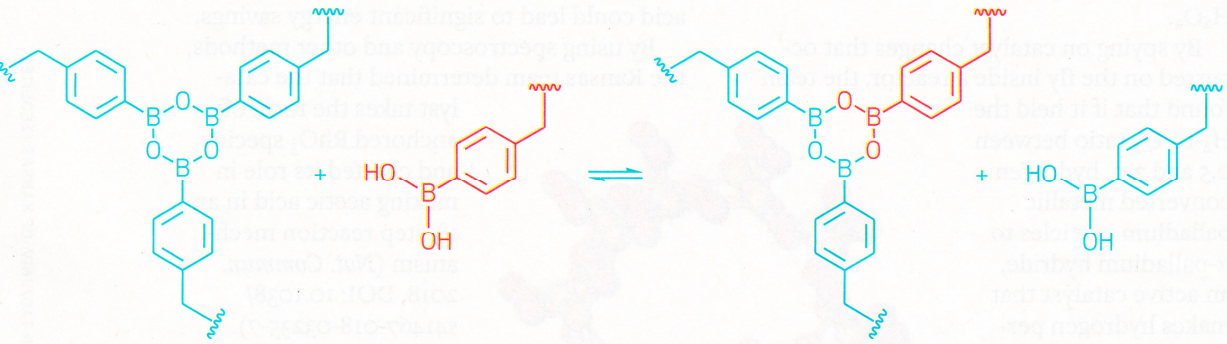
This year, large companies teamed up with start-ups, hoping to make polystyrene recycling practical and cost effective. Ineos Styrolution and Agilyx are looking at using pyrolysis to regenerate the styrene monomer, while Total and Polystyvert are exploring the process of dissolving polystyrene in a solvent and recrystallizing the polymer to rid it of contaminants.

Scientists also explored ways to solve the plastics problem with polymer innovations. Researchers led by Zhibin Guan at the University of California, Irvine, created a thermoset plastic that can be reshaped and recycled, which are features that most thermoset plastics, such as melamine and epoxy resin, lack. The thermoset that Guan's group developed features dynamic boron-oxygen networks. The polymer can be converted to its starting monomer, a diboronic acid, via heating in boiling water (*J. Am. Chem. Soc.* 2018, DOI: 10.1021/jacs.8b03257).

Recyclability was also a priority for Eugene Y.-X. Chen, of Colorado State University. Chen's group developed a recyclable polymer with mechanical strength and thermostability that are comparable to popular plastics' properties. The new polymer, made from γ-butyrolactone fused to a trans cyclohexane group, was thermally stable and crystalline, features that could make it competitive with commonly used plastics. By applying heat or a chemical treatment, the chemists could quantitatively recover its monomer in a pure state, ready for repolymerization (*Science* 2018, DOI: 10.1126/science.aar5498).



A thermoset polymer with boron-oxygen bonds has the ability to be reshaped and recycled, thanks to this chemical transformation.

"Solving the increasingly worsening worldwide plastics pollution problem takes a whole-society approach that will require the effort and cooperation of all relevant stakeholders, from plastics inventors to producers, retailers, consumers, and recyclers," Chen says. "As chemistry led to the creation of the plastics modern life depends on, it will undoubtedly contribute key solutions to the current plastics problem."—BETHANY HALFORD