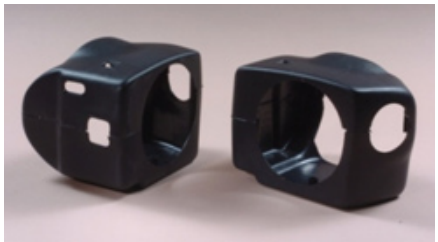
Recovering Plastics from Retired Vehicles

What will happen to your car at the end of its useful life? Will it be buried or burned? Most of it will likely be recycled. In fact, vehicles are among the most recycled consumer products. Much of your vehicle's steel and other metals will probably be recovered and turned into structural materials for new cars. Novel technologies developed by the U.S. Department of Energy's Argonne National Laboratory will soon enable industry to economically recover plastics from end-of-life vehicles (ELVs) for making new auto parts such as spare tire covers, steering column covers, and battery trays.

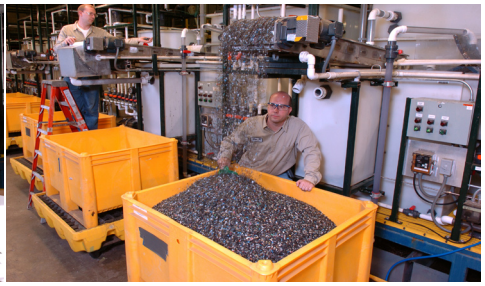
Background

For years vehicle manufacturers have been designing and building new cars and trucks with the goal that structural materials in ELVs will be recycled, reducing the flow of material into the solid-waste stream. At the same time, automakers must ensure that the design materials selected for their ability to be recycled do not impair the safety, reliability, and performance of the completed vehicle. In the United States between 12 and 15 million vehicles reach the end of their useful life each year. After dismantlers are through removing parts from ELVs for resale or remanufacturing, the vehicle hulks are shredded along with other metal-containing products, such as home appliances, electronic devices, and demolition debris. The shredders recover more than 95% of the metals in the shredded material and produce enough steel for 13 million new automobiles every year. This $10 billion, market-driven, North American vehicle recycling industry provides more than 100,000 jobs, benefiting the economy, reducing energy use for vehicle manufacture, and protecting the environment from contamination by metals. The remaining metals and nonmetallic materials, known as shredder residue, are shipped to landfills at a rate of 5 million tons a year in the United States alone.

Shredder residue contains polymers and residual metals that, if recovered, can be recycled profitably. As vehicles become smaller and lighter to improve fuel economy, the manufacturers will incorporate relatively higher percentages of lightweight, nonmetallic materials such as plastics, foam, and carbon fiber composites. To maintain its profits as



Automotive parts (steering column covers) made with recycled plastics recovered from end-of-life-vehicles.



Shredded plastic materials recovered from retired cars and trucks can be used to manufacture new vehicle parts and other plastic products.

Left: Items from shredder residue, recovered polyethylene and polypropylene, and a knee bolster manufactured from recovered plastics.

Right: Argonne's froth flotation pilot plant.

Benefits

- *Creates jobs and helps the national economy*
- *Valuable plastic recovered economically from residue produced by shredding obsolete vehicles, appliances, computers*
- *Recovered plastics useful for manufacturing dashboards, spare tire covers, battery trays*
- *40% of residue from retired vehicles saved from landfills and incinerators*
- *Fewer non-biodegradable plastics sent to landfills*
- *Saves manufacturers energy and money*
- *Recycling plastics and residual metals from shredder residue will save the equivalent of 24 million barrels of oil a year*

the share of metal in cars and trucks dwindles, the vehicle recycling industry needs technologies for nonmetallic scrap recovery.

Technology

The U.S. government and industry have partnered to devise economical methods for recovering valuable contents from shredder residue. One new technology, developed at Argonne National Laboratory, can separate many types of polymers from the residue with a purity of 95% at a yield never before attained in the recycling industry. Most retired vehicles begin their journey at a vehicle dismantling facility that recovers usable parts for resale. The remaining hulks go to a shredding facility for recovery of recyclable metals. Rather than being sent to a landfill, the shredder residue can now be fed to recovery facilities using the new Argonne technology, which combines mechanical and flotation separation processes to produce individual plastics that can be reused or recycled.

In the first step of the process, mechanical separation concentrates the plastics into a manageable fraction and conventional sink or float techniques separate the plastic concentrate based on differences in density. Individual plastics are then separated using froth flotation, a process for separating water-shedding (hydrophobic) materials from water-attracting (hydrophilic) materials.

The typical waste stream generated by shredders contains about 25% to 40% recoverable polymers, including polypropylene, polyethylene, rubber, foam, acrylonitrile butadiene styrene (ABS), and high-impact polystyrene (HIPS). Plastics such as ABS and HIPS are readily separable from other plastics but not from each other because they share the same density. Fortunately, Argonne's froth flotation technology adapted from the minerals processing industry can separate HIPS from ABS. Altered water chemistry enables an air bubble to attach to hydrophobic HIPS, lowering its apparent density relative to ABS. As a result, HIPS floats away from ABS, which sinks in the solution.

Commercialization

Argonne developed a 2-ton-per-hour pilot plant to determine optimal operating conditions and process economics. The national lab then evaluated potential business opportunities for specific recovery applications. As a result, Argonne is now working with a shredder to develop a 20-ton-per-hour pilot plant that performs both mechanical separation and froth flotation. Argonne also worked with the United States Council for Automotive Research's (USCAR's) Vehicle Recycling Partnership and the American Chemistry Council's Plastics Division under a cooperative research and development agreement structured by DOE to advance ELV recycling. Argonne is continuing to lead the way on plastics recycling through an onsite pilot recycling facility demonstrating this and other techniques for recycling these materials.

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