BY GREGORY FARNUM

METAL Removal

Plastic auto parts continue to supplant metal ones.

An average of 168 lbs. of plastic went into cars produced in 1977. By 1999, the level had risen almost 53 percent, to 257 lbs.

Experts agree that plastic parts will continue to displace metal ones in autos. And while no has predicted the development of a plastic engine block, use of plastics is inescapable nearly everywhere else, including under the hood.

A good example is today's transmissions. They're no longer just big hunks of metal. One-piece, stationary transmission parts with attached revolving rotors are being manufactured from glass-fiber-reinforced phenolic resins. The single-piece design replaces several separate metal components that would otherwise be needed, resulting in reduced assembly time.

Polyetherimide is now used extensively in transmissions for its superior dimensional, heat and creep performance. A single piece of polyetherimide can replace several steel washers. The material is also used in transmission sensors and valve-solenoid applications for the same reasons.

The transmission seal rings found in most vehicles today are made from fluoropolymers, which possess the twin advantages of being lightweight and having extremely low permeability. Plastic is being used, too, for oil screens and other components that must withstand prolonged exposure to hot transmission oil.

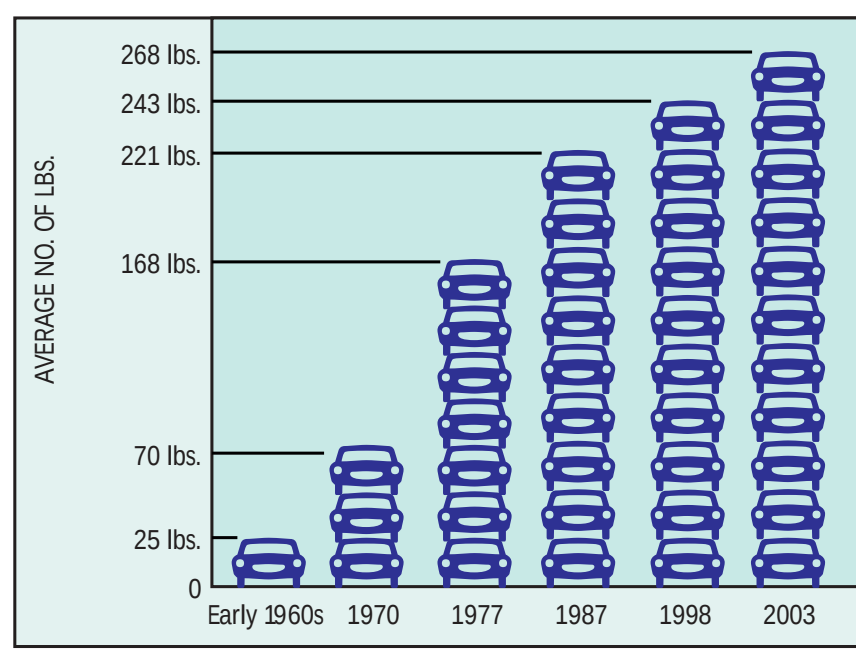
The dimensional flexibility of plastic gives designers greater freedom in the way they utilize available space. They can, for instance, design transmissions and transmission components that fit into relatively tight spaces. This is especially important for front-wheel-drive vehicles, in which multiple components compete for limited space.

The use of plastics in FWD transmissions also lowers the weight at the front of the vehicle, improving handling.

Under the Hood

The use of plastic engine components, such as rocker arms, is also growing. Along with plastic's light weight, the ability to integrate multiple components or features into a single part can save tooling time and costs, save assembly time and diminish noise, vibration and harshness. Automakers have strived in recent years to minimize NVH, primarily to increase driver satisfaction but also to extend the wear life of connecting components by reducing the stresses on them.

Plastic's ability to form integral—yet complex—shapes allows for the inclusion of air cleaners and even oil-fill baffles in the same molded unit. Automakers are also in the process of replacing mechanical throttle bodies with electronic ones. Plastic plays a key role in this effort by allowing them to integrate air-intake manifolds with these complex structures. The polyetherimide used provides the needed dimensional stability and thermal and chemical resistance,



The amount of plastic in autos continues to rise.

thereby improving performance.

Some engine-oil pans are being made of a similar plastic. Vinyl ester and nylon help designers create oil pans that integrate with windage trays, gaskets, strainers and sensor interfaces.

Looking forward, integrated plastic air-intake and fuel systems will take hold, according to the American Plastics Council. These will feature a fuel rail molded into the air-intake manifold, plus injectors and injector pads with an integrated throttle body, ducts and air cleaners. Another major development will be all-plastic radiators shaped in a variety of new configurations.

Plastic Meets Metal

The growing use of plastic in vehicles is receiving additional impetus from emerging "hybrid" molding technologies, said Herm Dillon, president of the market research firm Business Intelligence Group LLC, Columbia, N.J. "These use a combination of metal and plastic to produce a structural part. This is being examined heavily for front-end modules, which is the part that holds the radiator and a host of electrical and electronic parts. There are several variations of this technology."

One was developed by Bayer MaterialScience AG, Leverkusen, Germany. A stamped metal part is placed in a mold and then is injected with thermoplastic resin, as is done during a standard injection-molding process. The stamping can be exactly positioned in the mold to imbue the composite part with more strength and torsional stiffness than an all-metal part.

How widespread is hybrid technology? Bayer claims that by the end of 2003, some 11 million plastic/metal composite parts had been manufactured using its process and plastics. Additionally, more than 20 automotive parts employing the company's hybrid technology are scheduled to be introduced in the next 2 years.

Until now, hybrid technology has been almost completely limited to the manufacture of front-end modules. However, Bayer states that it is looking at more demanding applications for the technology, as well as more adventurous designs, such as parts that contain several pieces of metal instead of just one stamping.

Migrating Technology

Companies outside the plastics-processing world are also looking at hybrid technology. One of them is Thixomat Inc., Ann Arbor, Mich.

Its Thixomolding process is a patented technique for making magnesium-alloy parts on machines that resemble injection-molding machines. So far, it's chiefly been used to create small computer parts, such as housings for laptops.

Thixomat, which licenses the technology, claims the expanding array of suitable parts is changing for a couple of reasons. First, steel prices are rising, caused in part by increased demand from China's booming industries. Second, the price of magnesium has been falling because China has been mining so much of it. Now, magnesium, at about $2 per kilogram, costs less than half what it did in 1990. That is cheaper, on a per-volume basis, than aluminum.

Thixomat is investigating plastic/metal hybrid technology. Though processing magnesium and thermoplastics on the same machine is not considered feasible, a Thixomolded part could be transferred to a plastic-injection-molding machine for final processing.

Thixomat's efforts may or may not prove fruitful, but they help illustrate that the use of metal in automotive manufacturing is changing in a variety of ways. It's not simply a matter of tit-for-tat replacement of metal parts with plastic parts. Part design, and the use of metals for those parts, is changing in fundamental ways.

No one knows precisely where the changes will lead, but at least one of thing is clear: Manufacturers on all levels, whatever materials they work with, need to cast a fresh eye on the parts they produce. Can they be made better? Can they be made differently? Should they be replaced by a radically new type of part?

The time to have begun asking those questions was yesterday.

The following organizations contributed to this report:

American Plastics Council
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Bayer MaterialScience
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Business Intelligence Group LLC
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Gregory Farnum is a Detroit-based journalist specializing in industrial and scientific issues.