A Method for Lowering Component Costs By Direct Injection Molding of Recycle Plastic

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Abstract

The drive by automobile companies to lower their costs is, and will remain, a fact of life. Tier 1 suppliers are at the forefront of this directive. They are under pressure to supply their automotive component systems at the lowest possible cost. When you couple this demand with ever increasing raw material costs and the OEMs' requirement that they take on the overhead cost contributing function of designing the systems that they are manufacturing, the Tier 1s seem to be caught between a rock and a hard place.

Productivity improvement is of course one answer. However, it is easier said than done. Often productivity improvement involves purchasing capital equipment or making some other type of investment. Therefore, it may be some time before the cost benefits are realized.

An option available to immediately lower costs and to realize environmental benefits as well is to utilize low cost scrap plastics as the materials of construction.

The problem with using these low cost raw materials is their fluctuating processing characteristics and the variability of the mechanical properties. However, by characterizing and conditioning the scrap plastic and processing this material on modified molding equipment, quality parts can be manufactured with raw material savings often exceeding 50 percent.

This paper will discuss the scrap plastic preparation procedure, the machinery modifications and highlight the types of molded components that lend themselves to this manufacturing technique.

Introduction

Over the past 10 years, the focus of plastic recycling has changed. Back then, the focus was on educating and encouraging the public and industry to recycle. As the necessity and incentives to reduce the volume of waste materials entering our landfills sunk in to the populace, market forces became such that millions of pounds of plastic waste heading for the landfill now had value. The question then turned to one of how to collect this material and convert it into a marketable raw material.

We are now in a phase where multi-millions of pounds of plastics are being recovered from waste streams by a whole host of plastic recycling companies. However, this is still a small fraction of what is available.

Recovering the bulk of the waste plastic will depend a great deal on the refinement of new technology to reduce the cost of converting this spent material back into a valuable article.

The realities are such that for uniform waste streams like the PET soda bottle, PP battery cases and HDPE dairy jugs, there are commercially viable recycling companies that employ novel technological systems to separate, clean and market these different recovered polymers.

However, problems and obstacles remain. Most post-consumer waste plastics, including junked automobiles, contain different polymers that vary widely in their physical make-up. Even though it is possible to separate polymers by family type, there remains the issue of differences in molecular weight, fillers, additives, reinforcements, coatings, etc. These variables must be overcome or they will have a deleterious effect on the reclaimed material's mechanical properties and therefore its value.

A new breed of companies I call recycler/compounders has evolved which, through raw material characterization techniques and by utilizing blending and extrusion methodology, are producing commercial compounds that are economical and have predictable properties.

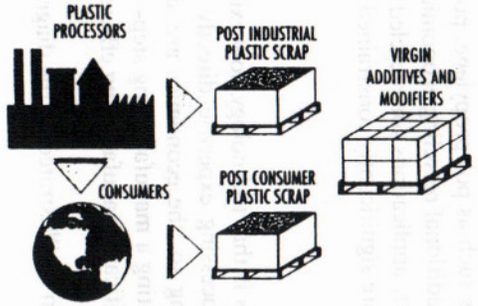
The drawback is that this manufacturing operation is relatively expensive. The economies dictate that the recycled materials are the more expensive engineering resins such as polycarbonate, nylon etc. When looking at the overall plastic recycling picture, the volumes and markets for these materials are limited.

When you focus in on the bulk of the thermoplastic materials used in automobiles and elsewhere, they are commodity materials such as polypropylene, polyethylene, and styrenics. The traditional recycling economics are such that for the most part, applications for recycled thermoplastics in automobiles are significantly constrained.

Technology

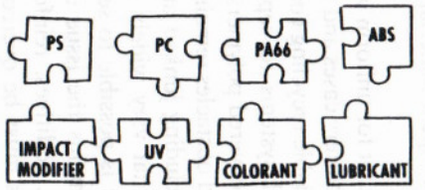
The good news is that technology now exists to combine scrap plastic processing expertise directly with injection molding. In doing so, the economics are significantly altered. By eliminating a manufacturing step—extrusion and pelletizing—significant manufacturing efficiencies are realized.

The process can be illustrated by the diagram on the following page:

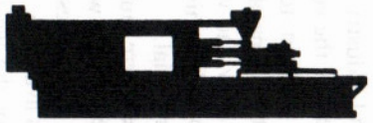


Raw Material Sources: By managing a wide base of post industrial and post consumer plastic scrap sources, AGS can assure continuity of supply. Sources include waste streams from the packaging, medical, optical, fiber, automotive, computer, and business equipment industry. In addition, AGS maximizes plastic scrap performance through the use of virgin additives and modifiers supplied by the chemical industry.

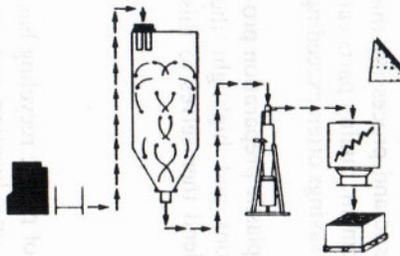
Incoming Raw Materials: All incoming raw materials are inspected and labeled with lot numbers and internal part numbers. Lot numbers initiate a lot traceability system. Internal part numbers define the minimum performance requirements that the raw material must meet for approval. Virgin additives and modifiers are received with supplier's certifications to established specifications. Unlike virgin materials, plastic scrap is not accompanied with performance certification data. As a result, AGS systematically qualifies all incoming plastic scrap materials to internally assigned part numbers.



Raw Material Formulations: AGS' raw material recycling expertise meshes plastic scrap sources with chemical technologies to produce formulations that will process and perform consistently from part to part. Formulations specify the raw material part numbers and the molecular weight proportions that will meet finished part requirements.

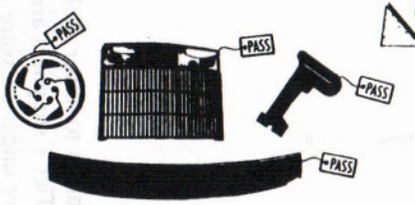


Injection Molding: As specified by the formulation, approved raw materials are released from inventory and blended in the prescribed amounts. Hygroscopic raw materials are dried to the appropriate moisture level and transferred to the injection molder. Specially designed injection molding equipment allows for precise shot to shot repeatability and compounds the raw materials within the barrel. Coupled with a strong quality program that emphasizes planning, process control, and continuous improvement, AGS produces high quality, recycled parts.



Processing Plastic Scrap: All plastic scrap is mechanically blended and then downloaded for evaluation. During this process, magnets, metal separators, and aspiration equipment remove contaminants such as ferrous metals, non-ferrous metals, fines, papers, wood, etc... The result is a clean, homogeneous blend from which representative samples are obtained for analysis.

Characterizing Plastic Scrap: Representative plastic scrap samples are molded and tested to determine visual, physical, thermal, rheological, chemical, environmental, and flammability properties. These test results are compared to internally assigned part number specifications. Based on these comparisons, plastic scrap is accepted, downgraded, or rejected.



Part Validation: A finished product validation program certifies that recycled parts will meet their end use requirements. Standard and custom tests simulate impact, heat aging, humidity, cold temperatures, chemical exposure, fatigue, and other applicable conditions. Appropriate samples of production parts are subjected to simulated end use conditions in order to certify conformance to expectations.

Packaging And Shipment: Reusable, recycled, and/or recyclable packaging is used to protect and facilitate transport of finished goods. Part validation results accompany every shipment.

By eliminating the extrusion manufacturing step, the recycling cycle is streamlined. Significant raw material processing costs are carved out of the process.

Naturally these materials have their limitations. The problems are primarily cosmetic. However, for components such as substrates for padded armrests and consoles, painted trim parts such as I.P. top covers, brackets, retainers and the rest, this process technology dramatically lowers raw material costs.

In today's market, raw material cost savings of 50 percent or more can be realized. For molded components where raw material costs comprise half of the finished price, the economics are self-evident.

To maximize the benefit of the raw material, modification of the processing equipment is required. The ability to handle powders, melt filter on-line, "control" color, thoroughly homogenize the melt, and so forth expands the application range.

Supply

As for the question of supply and availability, it must be remembered that sooner or later every pound and every article made from plastic becomes available for recycling. How deep you can go in the stream is dependent on economics.

By efficiently adding value to the recycled material, the economics are improved to a point where it is possible to exploit previously uneconomical streams of waste plastic. This new demand will only add to the already multi-millions of pounds currently recycled.

Lower costs and environmental benefits seem to me to be a win/win situation.

Biography

George Staniulis graduated in 1968 with a B.S. in Business Administration from Wayne State University. He has been in the plastics industry for 25 years, 22 of which have been spent with various companies engaged in plastics recycling as their primary business.

He has broad experience in identifying scrap sources and then modifying these waste streams by means of melt processing into value-added products.

The other three years were with a vacuum-forming company and a tooling manufacturer.

Mr. Staniulis has written numerous articles and presented technical papers on various aspects of plastics recycling for the Society of Plastics Engineers ANTEC and RETEC conferences. He has lectured extensively on this subject at meetings of The Society of American Chemical Engineers, Society of Automotive Engineers, government symposiums and other industry conferences.

His current position is president of AGS Technology Inc., a recycler and injection molder of thermoplastic scrap.