Food industry opportunities for savvy distributors

PLASTICS IN FOOD PROCESSING

by Jeff Warren

It has often been said that "America feeds the world." While this may be somewhat of an exaggeration, the statement definitely dramatizes the output of the United States' $1.3 trillion food industry. Supporting this mammoth production effort are the U.S. manufacturers of food processing equipment who annually build and sell over $25 billion in new machinery and another $10 billion in replacement parts and maintenance services.

For suppliers of engineering grade thermoplastic shapes, this market presents one of the largest single opportunities for the sale of their products. By gaining a solid understanding of the value that plastic stock shapes brings to food industry applications, plastic suppliers can be more effective at exploiting this continually growing market segment.

In this article, we will review the significant advantages provided by food grade thermoplastic shapes and outline some key aspects that can be used to displace the metals that are currently used in many food industry applications.

Thermoplastic stock shape advantages

Engineering grade thermoplastic stock shapes offer food industry engineers and maintenance personnel performance advantages that are not available from traditional food grade metals. Polymers like acetal, nylon, polybutylene terephthalate (PBT) and polyethylene terephthalate (PET) meet all of the requirements of food industry standards (see chart 1), provide excellent chemical resistance and, even running unlubricated, offer resistance to wear that exceeds that of virtually all metals. In applications involving rotating or reciprocating parts, the low weight of these plastics reduces the power required to drive the machinery and lowers the vibration and wear caused by non-symmetric or out-of-balance components.

UNIPET® PET from Nytef Plastics is used extensively in the food processing industry due to its inherent FDA compliance, dimensional stability and resistance to strong cleaning solutions.

Equipment components machined from thermoplastic stock shapes are ideally suited to the food industry because most food equipment manufacturers usually produce less than 100 copies per year of any given piece of processing machinery. Because machined plastic parts do not require expensive manufacturing tools, the cost per part for machined components stays relatively uniform and economical at volumes down to even a few pieces. Injection molded parts require expensive custom made part molds regardless of how many parts are made. Prices for these molds often exceed $10,000 and can make the cost of even small parts prohibitive as part volumes drop under a few hundred pieces.

In addition, unlike the high costs involved in making changes to injection molding tools, changes to the design of machined components can be rapidly incorporated into the part at minimal cost. Components machined from stock shapes can also be designed with dimensions and features that are larger than what is available from injection molders and the tolerances on machined parts can be held tighter than what is typically available from molding technologies.

Metals vs. thermoplastics

When you visit any food processing plant, the one aspect of the manufacturing equipment that is immediately obvious is the wide use of metals. No matter what type of food product is produced or the manufacturing processes that are employed, the machines doing the work have been fabricated primarily out of metals. While all of the visible metal may initially be discouraging to a plastics salesperson, it is very important not to get caught up by what you see on the machine's exterior.

Most of the applications for engineering plastics are *inside* the machines where friction, abrasion and cleaning chemicals act to degrade many commonly used metals. In these applications, engineering thermoplastics provide value and benefits that are not available from the traditional metal construction materials. To better understand this value, it is helpful to first review the limitations of the metals that are typically used in food machinery.

The metals most commonly used to manufacture food processing equipment are 304 and 316 stainless steel. These steels have a high content of nickel and chromium that allow them to resist corrosion and oxidation. 316 stainless steel also has 2-3 percent molybdenum added to it to provide added resistance to corrosion and pitting caused by exposure to common cleaners that contain chlorine and sulfuric acid.

While stainless steel alloys provide superb strength, dimensional stability and resistance to high temperatures and chemicals, they have very poor resistance to wear. If not properly lubricated, stainless steel surfaces will quickly wear down and gall when they are run in contact against other metals. Lubricants present quality problems in food processing equipment because they have the potential to contaminate and discolor the food products being manufactured. For this reason, food industry engineers strive to minimize, and, if possible, eliminate the use of lubricants in all food equipment applications.

Thermoplastic stock shape materials like nylon, acetal, PET and PBT offer excellent wear resistance even when they are run without lubrication. By replacing either of the two contact surfaces of a metal wear interface with one of these thermoplastic materials, the wear, galling and the need for lubrication are simultaneously eliminated from the application. As an additional benefit, these thermoplastic materials are six times lighter in weight than stainless steel. As previously mentioned, the lower weight of the plastic materials provides substantial benefits in terms of lower power requirements and lower vibration levels.

Aluminum is often used in food machinery because it is easily fabricated and offers excellent strength in combination with lighter weight. Processing equipment such as conveyors, pumps and filling machines are often designed so that they can be easily moved to a different area of the facility where they may be needed. Since aluminum is three times lighter in weight than stainless steel, its use can substantially lower the overall weight of mobile machinery and make it much easier for workers to manually relocate it.

The most significant shortcoming of aluminum is that it oxidizes in air and quickly corrodes when it comes in contact with many common cleaning solutions. For this reason, aluminum is not approved for applications that involve contact with food products. To be used as a food contact surface, a cast or machined aluminum part must first be coated with an FDA compliant coating that provides an impervious barrier to air and corrosives. These coatings are usually quite brittle and prone to chipping and can substantially increase the cost of the finished component. Thermoplastic polyester materials like PBT and PET are 50 percent lighter than aluminum, and since they are inherently chemically resistant to all of the chlorine and acid-based cleaners that are commonly used in the food industry, they do not require any protective coatings.

One additional limitation of aluminum is its very poor wear resistance (even worse than stainless steel). Even if it is kept continuously lubricated, aluminum will wear quickly away under relatively light loads. In applications where heavier stainless steel cannot be used, aluminum is often protected with PTFE impregnated layers of hard coat. As mentioned before, these coatings tend to be brittle and often chip or crack under light impact loads. Once the coating has been fractured, the aluminum component must be replaced or recoated. Again, this can be a very expensive repair. Engineering grade thermoplastic materials do not require lubricants or hard coatings to provide exceptional wear resistance.

Other metals such as bronze, brass and dairy metals are sometimes used for wear components in food processing equipment. Because these materials do not meet the requirements for food contact and require lubrication, the number of food equipment applications where they can be used are extremely limited. Even in non-food contact applications, engineering stock shape materials often provide lighter weight and longer life alternatives to these non-ferrous metals.

One benefit offered by engineering thermoplastics and not available from metals is the ability of plastic materials to provide extremely effective sealing characteristics. Even the hardest engineering plastic is 10 times more pliant than stainless steel or aluminum. This inherent elastic property of plastic allows it to provide exceptional performance when used in air or liquid sealing applications like valve seats and coupler seals. O-rings and seals that would normally be required in metal connections can often be eliminated when the connection is redesigned to be manufactured out of engineering grade plastics.

CHART I: FOOD INDUSTRY REGULATORY AGENCIES

Standard	Agency	Products Regulated
FDA CFR21	U.S. Food and Drug Administration	All materials used in contact with food products in the U.S.
USDA	U.S. Department of Agriculture	Meat and poultry processing facilities and equipment used in the U.S.
NSF Std. 51	NSF International (formerly the National Sanitation Foundation)	Plastic materials and components used in food processing equipment.
3-A Std. 20	3-A Sanitary Standards	Materials used as contact surfaces in the dairy products processing industry.
Ag Canada	Health Canada and Agriculture Canada	All materials used in contact with food products in Canada.

Manufacturing economics

Metals like stainless steel and aluminum are definitely the comfort zone of food industry engineers and maintenance personnel. The food industry has been using these materials for over 100 years and they are very familiar with the fabrication methods that are required to effectively utilize them. Unfortunately, this familiarity and focus on metals has often prevented these engineers from fully understanding the cost savings that can be realized by substituting thermoplastic stock shapes for more traditional metal components.

This factor is usually not immediately obvious because metals are typically sold by the pound and plastics are sold by the foot of rod or the square foot of plate. If you convert both materials to dollars per cubic inch, it becomes readily apparent that stainless steel is almost always more expensive than engineering stock shape materials like acetal, nylon, PBT and PET. Even aluminum, which by the pound is less expensive than many stock shape plastics, becomes significantly more expensive when the additive costs of FDA approved hard coat surfaces are included.

The other beneficial aspect of manufacturing with plastics that is commonly overlooked is the cost of machining. When machining thermoplastic stock shape materials like acetal, nylon, PBT and PET, material can be removed at rates that are up to 50 percent faster than the rates used with stainless steel and aluminum. Additionally, because stainless steel tends to work harden or temper, the faster that it is machined, the harder it is to cut. Plastics do not work harden and, unlike metals, they do not require cutting fluids for most machining operations. These factors add up to make the cost of machining plastic stock shapes 50-75 percent less than the cost for machining similar parts out of metals.

Summary

While metals have traditionally been the material of choice for the designers of food processing equipment, the performance benefits of engineering grade thermoplastic stock shapes are allowing them to be used in an increasing number of food equipment applications. The rapidly growing number of successful food processing applications have solidly proven that thermoplastic shapes offer exceptional cleanliness, wear resistance, and chemical resistance properties that are not available from most metals.

In addition, thermoplastic shapes offer increased manufacturing flexibility and material and fabrication costs that are significantly lower than comparable food grade metals. By effectively communicating these benefits to food industry equipment builders, suppliers of thermoplastic stock shapes can create new opportunities for their products and significantly increase their sales to this market. ■

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