THE Joslyn MANUFACTURING CO., INC

MATERIAL CONSIDERATIONS FOR THERMOFORMED PRODUCTS

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There is a myriad of factors when it comes to thermoformed plastic materials and their applications. It's important to understand the best source of polymer material for your plastics job—as it relates to environmental, external, and internal characteristics for the final product. Raw material selection is synonymous with product viability and sustained supply chain fluidity. Listed in this guide are specific materials and uses to help you choose the right plastic for your needs.

There are many environmental factors to consider when selecting thermoformed materials, such as impact strength—as it relates to use and environment—thermal conductivity and chemical composition, just to name a few. Chemical composition is a critical characteristic and creates two important categories for source material selection: **amorphous thermoplastics vs. semi-crystalline thermoplastics.**

CHEMICAL COMPOSITION

Amorphous thermoplastics, including polycarbonate, acrylic, PETG, ABS, and polysulfone, provide streamlined malleability in the thermoforming process and soften over a broad range of temperatures, all while bonding well with adhesives. Compared to semi-crystalline thermoplastics, there is a marked advantage in dimensional stability and impact resistance, but increased stress will produce fatigue resistance, and they are prone to stress cracking.[1]

Semi-crystalline thermoplastics, viewed as the industry standard for plastics, include polyethylene, polypropylene, nylon, and acetal. Semi-crystalline applications of these plastics prove beneficial in relation to weight bearing, wear and as structural components. There is better chemical resistance to amorphous thermoplastics, better aversion to electrical properties and decreased friction. Semi-crystalline plastics are difficult to thermoform and bond and display average impact resistance in comparison to amorphous thermoplastics.[2]

While there may be a slight inherent higher cost in processing these materials, they are generally cheaper materials per pound.

THERMOPLASTIC SOURCE MATERIALS BY COST

Amorphous	Semi-Crystalline
Higher Cost • Polycarbonate (PC) • Thermoplastic Polyurethane (TPU) • Acrylic (PMMA) • Polyvinyl Chloride (PVC)	**Higher Cost** • Nylon (PA) • Ultra High Molecular Weight Polyethylene (UHMW-PE)
Lower Cost • Polystyrene (PS) • Acrylonitrile Butadiene Styrene (ABS)	**Lower Cost** • High Density Polyethylene (HDPE) • Low Density Polyethylene (LDPE) • Polypropylene (PP)

[1] https://www.redwoodplastics.com/education-2/amorphous-vs-semi-crystalline-thermoplastics/

[2] https://www.redwoodplastics.com/education-2/amorphous-vs-semi-crystalline-thermoplastics/

To further analyze the comparison between amorphous and semi-crystalline thermoplastic polymers, we must review the strengths and weaknesses of the polymers as they relate to:

- Molecular shrinkage
- Chemical resistance
- Light refraction (UV rating/opacity)
- Melting grade

Amorphous Thermoplastics	Semi-Crystalline Thermoplastics
Strengths • Shrinkage • Warp • Tolerances • Opaque/transparent	**Strengths** • Mold flow ease • Chemical resistance • Wear resistance
Weaknesses • Mold flow ease • Chemical resistance • Wear resistance	**Weaknesses** • Shrinkage • Warp • Tolerances • Opaque/transparent

The specifics of intended use will dictate the best polymer selection. Light refraction as it relates to relative opacity will have a cause and effect on desired UV protection. There are levels of thermoforming UV protection that depend on the inherent opacity of the selected polymer along with its thickness and use of stabilizers.

Depending on the opacity of the polymer, light will damage the surface and weaken the product. Dark, thick products will protect against UV damage better than light-colored, thin products.

Impact strength of the polymer and intended use of the thermoformed product will form the basis for material selection. A weaker, low-cost polymer can be utilized in production if the product will undergo low strain. High-impact, light-sensitive, and high-strain jobs will require a higher graded material.

Joslyn can assist with suggestions in raw material strengths and how they correlate to real-world applications. Characteristics of the materials in the thermoforming process include components such as color, texture, and fire rating that depend on the end use of the thermoformed part. We can guide you through the selection of the polymer for the thermoformed part from these analytics for ongoing supply chain health.

If you have questions or would like to discuss specific project pricing, please contact the experts at Joslyn Manufacturing.