KAYSUN

INJECTION MOLDING & ENGINEERING SOLUTIONS

OVERMOLDING FUNDAMENTALS *for OEMs*

Overmolding is an injection molding process that provides OEMs across a range of industries with more choices for improved product design, performance, and aesthetics. Overmolding is a versatile solution that can be used in nearly any application, from adding a soft touch to consumer products to protecting medical devices in the field.

Benefits of Overmolding

Overmolding improves product performance, ergonomics, worker safety, and aesthetics. It also reduces overall manufacturing cost by seamlessly combining multiple materials into a single part or product — most typically a rigid, plastic base component (aka substrate) that is covered by a thin, pliable, rubber-like thermoplastic elastomer (TPE) exterior layer (some applications can also utilize rigid materials that are overmolded to rigid substrates).

TPE is an ideal material for creating a soft, comfortable, non-slip grip for products that are held by the end-user, such as a portable medical device. TPE also enhances product performance by reducing shock and vibration, dampening sound, providing electrical insulation, and improving chemical/UV resistance.

For certain types of specialty products, an exterior TPE surface functions as a barrier to certain environmental factors (e.g., moisture and oxygen, etc.) especially in industries where shelf life can be critical, such as medical/health care and food processing. TPE overmolding can also enhance shelf appeal and increase competitive advantage since it comes in a multitude of colors and tint options, and can be engineered to have different finishes including matte or gloss. Clear TPE surfaces can be overmolded onto patterned or customized substrates that may include a corporate message, logo, or other brand identification.

It's rare when an advanced technology improves product performance and customer satisfaction in so many ways, yet still reduces overall production costs. Overmolding eliminates the traditional injection molding process steps required for producing and assembling individual parts. Plus, the overmolded TPE layer forms such a strong bond with the hard plastic substrate that many value-added finishing operations such as priming, painting, or coating are simply unnecessary. The result? Increased product quality, reduced waste, and better throughput — all of which drive down costs.

THE OVERMOLDING PROCESS, EXPLAINED

Overmolding involves two separate molding operations and two separate tools. It combines a rigid substrate base with a pliable outer layer of plastic such as thermoplastic elastomer (TPE) or liquid silicone rubber (LSR). The substrate base is formed by injecting resin into a tool, where it cools and solidifies before being ejected and moved to an overmold cavity within a different tool.

In the overmold cavity a second molten material — known as the overmold — is injected around the substrate base. The two layers bond either mechanically or chemically to form the final product.

Overmolding requires experience, precision, and control, especially within initial product design, material selection, and tool design. Further, establishing process parameters and production design requires great care, as does monitoring in-tool conditions during the multi-shot process.

Material Selection

An injection molding partner with in-depth knowledge of material science is essential for efficient overmolding. The proper thermal interaction and compatibility between the substrate and TPE is critical for strong bonding action; even the slightest variances between the materials can compromise bond integrity and cause delamination or other defects.

TPEs represent a rapidly evolving segment of material science. These polymers have the characteristics of thermoset rubber but can also be processed via injection molding — making them ideal for products that require a rubber-like surface layer for softness, grip, or style. In fact, TPEs are being continuously engineered for characteristics such as chemical resistance, UV resistance, hardness, scratch resistance, clarity, and compliance with UL standards.

Advanced TPE grades expand the range of capabilities for bonding high-performing thermoplastic resins to hard plastic substrates and improving performance, appearance, and functionality. Kaysun's growing body of documented scientific data is providing more guidance regarding the classes of TPEs that work best with specific substrates under different pressure/temperature conditions.

Compatible substrates include:

- Polypropylene
- Copolyester
- Polystyrenes
- Polycarbonate (PC)
- Acrylonitrile butadiene styrene (ABS)
- Polycarbonate ABS (PC-ABS)
- Polymethyl methacrylate (PMMA)
- High-density polyethylene (HDPE)
- Standard and modified Nylon 6
- Polyphenylene oxide (PPO)
- Select other derivatives and blends

For cost, environmental, and supply chain stability reasons, many manufacturers are moving away from hydrocarbon-based resins toward bio-based or sustainable and renewable resources. R&D departments are developing new classes of TPEs derived from agricultural and other plant-based materials that present smaller carbon footprints. Heat-resistant TPEs are also being developed that can withstand high-temperature applications (up to about 300°F) in the electrical, automotive, medical, and defense industries.

The higher-bonding properties between TPEs and substrate base materials have given overmolding a manufacturability advantage over traditional injection molding, broadening the range of applications and design possibilities. However, overmolding engineers must stay current with advancing knowledge about how materials behave and interact under various production parameters in order to maximize efficiencies.

Other Variables

For many engineers and designers, the greatest benefit overmolding provides is product "touch" or "feel." The tactile quality of overmolded components depends on certain material properties, including friction coefficient, hardness, and thickness. For example, the thinner the TPE layer is, the harder it will feel even if the resin is very pliable. Why? Grip softness is largely determined by the thickness of the TPE layer, not material softness.

Perhaps the most important property in the overmolding process is the TPE melt temperature, which dictates how easily the TPE flows and its bondability. Melt temperatures must be determined for each substrate being considered, as well as the overall bond strength required for the part or product. These factors need to be carefully monitored and controlled during the process. Some operators, for instance, inaccurately assume that nozzle temperature is the same as melt temperature. This assumption often results in inferior bonding and product recall, since melt temperatures are generally lower than nozzle temperatures.

Defining "feel" is perhaps the most challenging part of the overmolding process. Identifying the best combination of material properties that will meet production specifications often requires multiple iterations in materials and design. At Kaysun, our deep experience in material science and production engineering keeps these adjustments to a minimum, reducing total costs and cycle time.

Prototyping Can Help Control Costs

Tooling for high-volume, multiple-cavity, multi-shot injection molding is a significant capital investment. Builds can take up to six months to complete and cost hundreds of thousands of dollars.

Although prototyping isn't required, it is highly recommended to make the most effective use of resources.

This optional process step provides an opportunity to collaborate with an experienced injection molder such as Kaysun for expert guidance on tooling design and materials selection during prototype iterations.

In turn, findings can be applied to final tooling next steps including performance validation and identifying realistic processes and schedules.

Prototyping helps determine key vent location, injection points, and other key tool features that ensure maximum product performance and manufacturability.

Tool design requires deep scientific knowledge and clear communication between designers, engineers, and production staff. In addition, frequent testing, adjusting, and retesting is necessary to meet the increasingly challenging production goals and timelines of manufacturers.

Prototyping in the earliest stages of product design and development is one of the most efficient ways to minimize any redesign and testing of production tools — always a costly process for any manufacturer.

Overmolding is an injection molding process that requires specialized equipment and high levels of engineering and technical skill beyond that of single-material injection molding. Existing and new TPE materials with expanded capabilities give Kaysun and our customers more versatility in product design, material combinations, and application possibilities. In turn, manufacturers are more competitive in the marketplace with products that meet consumer demand for stylishness, ergonomics, enhanced user safety, and comfort.

Overmolding engineers at Kaysun are experts in reducing the number of injection molding process steps in order to improve production efficiencies and eliminate downstream operations. Manufacturers partnering with Kaysun can leverage our extensive overmolding knowledge to increase throughput, improve quality, reduce waste, simplify validation, and improve the overall customer experience — all at lower production costs.

To learn more about how our engineering or overmolding capabilities can improve your next project, request a consultation today.

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