Tough Stuff:
LCP (Liquid Crystal Polymers)

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LCPs, or Liquid Crystal Polymers, are a unique class of thermoplastic resins, which are extremely non-reactive and inert. LCP is an expensive material that provides high performance for specialized, end-use applications, but it is not necessarily easy to work with. This paper will explore some of the potential pitfalls, and offer suggestions, solutions and best practices for working with the thermoplastic injection molding grades.

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Introduction

LCPs are particularly crystalline aromatic polyesters. Their applications are expanding and range from specialized electronic components, to automotive under hood components, to gun parts and medical device applications, replacing some metal parts. LCPs are high strength, high heat-tolerant, extremely chemical resistant, naturally flame-retardant resins, with great weather ability. But all of those great qualities don't mean a thing if you don't know how to work with the material, and the learning curve can be steep and expensive.

Background

LCPs are everywhere. A primary example most people recognize is the Aramid resin, also known as KEVLAR — used in bullet proof/ballistic garments and gloves. Other well-known trade names for LCP are Sumika, Vectra, Xydar and Zenite.

As a rule, LCP likes thinner wall sections than its polyester cousins would tolerate. Dimensionally you can achieve very tight tolerances with LCP and fantastic mold replication, lending to very complex geometries and ultra demanding components like electrical connectors that must have low dielectric constants.

LCP excels where stack up and center-to-center location tolerances are an absolute requirement for pin positions. LCP's stability in boiling water is also excellent, meaning that medical components can be autoclaved without issue. And, the broad chemical resistance translates into biocompatibility.

But, with all the advantages LCP provides, the downside to all that strength and versatility is that LCP is quite challenging to process.

Solution

Being shear dependent, LCP sets up very fast, with pressure drops and flow hesitations, so unlike other engineering resins runner and gate size/location can mean success or failure. The resin can set up before it reaches the cavity, so cold slugs can occur quite easily — you may see them in the wall section, sometimes creating a hole/void in the wall. Venting and part geometry demand special focus, as this cold flow melt edge will happen almost quicker than you can imagine. You can do a mold flow analysis, but frankly the complexity and possibilities are beyond most mold flow software programs, though that's a great place to start.

Most injection molders struggle with small cavitation (one- to two-cavity) and cold runners, let alone multi-cavity, hot runner systems. Although the latter are particularly well indicated, due to the high cost, many jobs that spec LCP require the use of "virgin only" materials (Medical, Military, high performance

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Industrial applications). Thus runner weight and material costs can add up, quickly putting the novice molder under water financially.

The good news is: there are a few molders in the world that are on the cutting edge of the processing knowledge window, who can deliver multi-cavity, hot runner manifold molds, at even faster cycles, and do it for less. These molders utilize certain proprietary techniques (mostly learned at that infamous school of hard knocks where the learning curve can sometimes be very expensive). The methods they have developed are not in "the book," — including the regular use of hot runner/manifold mold technology.

Conclusion

LCP is an expensive, high end polymer that provides high performance for specialized end use applications, but getting there requires an experienced molding practitioner, lest both molder and customer suffer potentially nightmarish consequences. Working with an experienced mold-maker and manufacturer will provide all of the advantages that LCP provides, without the potential downside.

For more information about LCP, its specialty uses, or the possible solutions provided by D&M Plastics, visit online at **www.DMPlastics.com.**

ABOUT THE AUTHORS

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An industry veteran with more than 35 years experience in product development and technical sales, Marc holds many U.S. and E.U. Patents, as well as FDA 510K Medical Device approvals. As Sales and Marketing Manager, Marc's success in technical sales, lean manufacturing operations and process development complements D&M's commitment to continuous improvement, and benefits all of D&M's clients.

Jim Woodburn, Engineering Manager
As Engineering Manager, Jim Woodburn specializes in creative solutions for injection molded parts and assemblies. His 33-year career in plastics includes three years at D&M, where he applies his extensive engineering and design experience to devise functionality and manufacturability solutions, ranging from color matching to masking features to many other innovative techniques for meeting unique design specifications.

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