

Eliminate Waste and Drive Higher Yields in Consumer Electronics Manufacturing

Hot runner injection molding methods with VICTREX™ PEEK Polymer

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Introduction

Consumers demand thinner, lighter and smarter devices as they spend 60% of their digital time on smartphones and tablets, up from 50% just a year ago¹. New wearable devices, such as smart watches and eyeglasses are expected to continue these trends. To differentiate their products in an increasingly connected world, leading mobile device brands are forced to strive for technologies that improve functionality and reliability while also reduce their production costs significantly.

To meet this challenge the mobile device companies are typically passing the challenge to their suppliers. The pressure is for consumer electronics manufacturers to innovate and find ways to scale up production and build devices more quickly and efficiently whilst maintaining quality. This calls for early involvement from suppliers and for a company's manufacturing and supply chain unit to look broadly for cost reduction opportunities. It is especially a challenge for manufacturers of mobile device such as smartphones, which have surpassed annual volume of one billion units in 2013 with double-digit year on year growth expected through 2018². The huge production volume means any forward looking solution to eliminate cost and drive higher yield will lead to significant cost efficiency, thus better profit margin and a definite competitive edge.

This paper explores one specific option, using VICTREX™ PEEK polymer and Husky's hot runner system, offering potential savings of up to 80% in scrap reduction, which could equate to millions of dollars' worth of savings.

Technology advancement in material and process

Cutting-edge technology advancements in material science are one option helping forward-looking electronics manufacturers address these challenges. The evolution of the bulky portable cell phone of the 1990s into the sleek smart phone of today illustrates how material advancement has made such changes possible.

As mobile devices go thinner, lighter and smarter, the challenge today is to identify a material that provides both reliability for long-hours of user indulgence as well as excellent processability and thermal stability to survive the extreme processing environment. One alternative positioned to meet these criteria is VICTREX™ PEEK high performance polymers. Coupled with the company's unmatched processing expertise, Victrex polymers can offer enhanced thermal stability for improved manufacturing processing, ultimately reducing waste and associated costs by eliminating secondary operations.

Hot runner processing advancements

One of the most significant processing advancements in thermoplastic injection molding is the development of “hot runner” or “runnerless” melt delivery systems which are often used for programs with volumes exceeding 200,000 units per year. This approach eliminates the cold runner and sprue by never allowing these flow paths to cool. Instead, the hot runner maintains the melt temperature as an extension of the machine nozzle all the way to the part cavity. In some cases, a small cold sprue or sub-gate is still used to gate into tight areas but, even with a “hot to cold” design, scrap levels are drastically reduced. While hot runner systems require investment in tooling and equipment, adopters of these methods realize benefits not previously possible:

- Reduced material cost – pay only for the material needed in the finished part
- Reduced environmental cost – reduce up to 80% scrap that typically ends up in landfills & lower energy use
- Reduced labor – hot runner valve gates eliminate post-mold trimming or machining
- Improved lean manufacturing – eliminate operations and hold less material in supply chain inventory



Husky Hot Runner
© Courtesy: Husky 2015

VICTREX™ PEEK polymer: Thermal stability is key

While hot runners seem like an obvious choice, many polymers are limited by their sensitivity to thermal degradation when exposed to heat for long periods of time. Thermal degradation dramatically affects both mechanical properties and cosmetic properties of the molded part, so engineers must give serious consideration to the thermal stability of a material when selecting hot runner processing.

Engineering plastics such as acrylonitrile butadiene styrene (ABS), polycarbonate (PC) and PC/ABS compounds have become the most commonly used polymers in consumer electronic products. For such resins, hot runner systems need to be optimized to avoid unacceptable changes in the color, cosmetic properties, or mechanical properties of these materials. Polymers such as polyamide (PA), polybutylene terephthalate (PBT), polyetherimide (PEI), and polysulfone (PSU) are being used more often to meet the increased capability demands of consumer electronics, but their higher processing temperatures can amplify thermal stability issues. VICTREX™ PEEK polymers offer a solution to both the properties and processing challenges of many consumer electronics parts with their high temperature performance, broad chemical resistance, and excellent thermal stability.

Today's high end mobile devices have highly engineered plastic-metal hybrid enclosures that are over-molded with wall sections below 1.0 mm, then precision machined and anodized for the premium look and feel that consumers want. These extreme manufacturing environments require robust materials that maintain their properties both during and after the molding process so the thermal stability and chemical resistance of PEEK polymers is a key differentiator in this space. Thermal stability becomes even more critical with the longer residence times of hot runner systems, therefore further investigation has been done to validate the retention of VICTREX™ PEEK polymer properties in the most demanding manufacturing conditions.



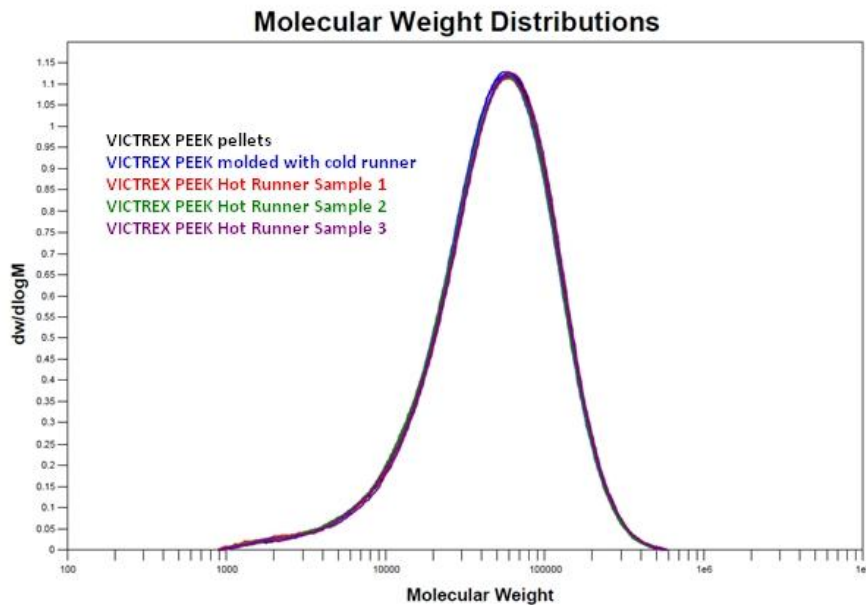
VICTREX™ PEEK Polymer
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Tests confirm benefits and material performance of VICTREX™ PEEK polymer

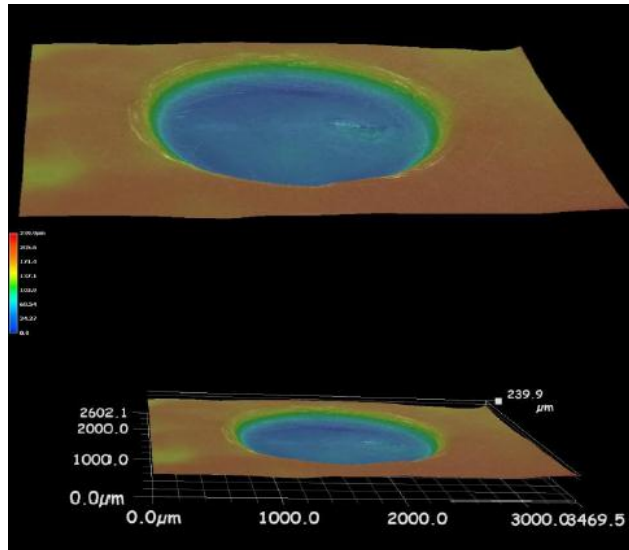
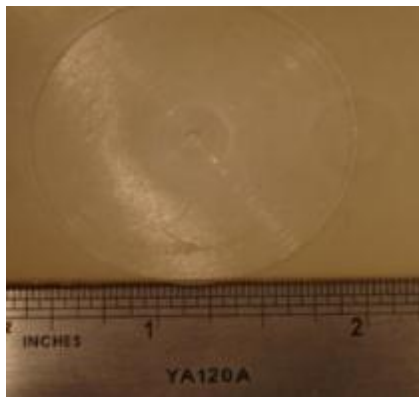
Tests in hot runner systems confirm that these time and money saving techniques can be used with Victrex materials with no degradation to the polymer. Valve gate and hot runner systems from Husky Injection Molding Systems, a leader in hot runner systems, are proven to produce parts with excellent gate vestiges and no reduction in material property. The valve gate design allows for production of parts with no secondary operations, even with tight tolerances and cosmetic requirements.

A range of VICTREX™ PEEK polymer grades were successfully processed using a Husky hot runner system with a Husky VX valve gate. The molded test part is a plaque measuring 100 mm x 40 mm x 0.8 mm. The molding trials used recommended processing conditions as well as increased melt temperatures and residence time to test the stability of the materials.

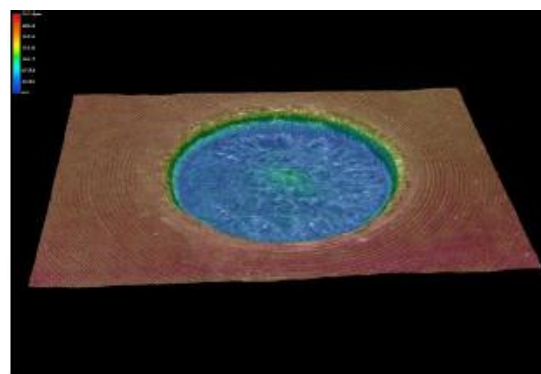
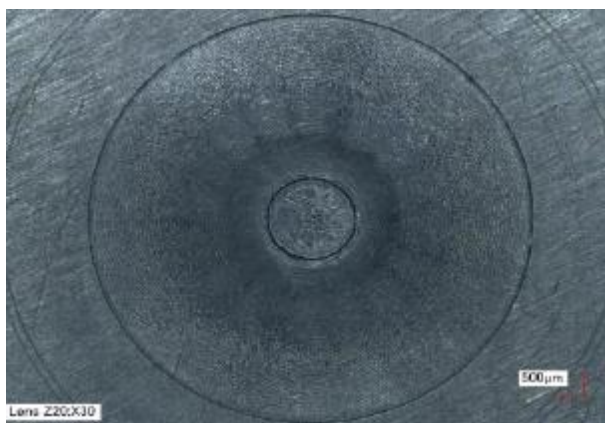
A drop in molecular weight could lead to embrittlement or other loss of mechanical properties. Testing by Gel Permeation Chromatography (GPC) shows essentially no change in the polymer's molecular weight after processing in the Husky system, even with processing temperatures of up to 400°C and extended residence time. Parts processed in the hot runner system showed the same molecular weight distribution as pellets before molding or parts molded in a cold runner system.



GPC Testing of VICTREX™ PEEK polymer before and after processing



Valve gate on VICTREX™ PEEK 150G material
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Valve gate on VICTREX™ PEEK 150CA30 (carbon fiber-filled) material
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Technological advancements that deliver up to 80% savings in scrap reduction

High-performance polymers are increasingly being sought out for more demanding applications in Consumer Electronics and other industries such as Automotive and Medical. We believe hot runners are being utilized more often for programs with volumes exceeding 200,000 units per year, which could reduce scrap by as much as 80% and potentially save millions of dollars in material costs.

Victrex Plc., an innovative solution provider responding to the needs of the mobile device market, and Husky Injection Molding Systems have demonstrated that VICTREX™ PEEK polymers can be successfully processed in Husky's valve-gate hot runner systems. Grades of unfilled, filled, and fiber-reinforced VICTREX™ PEEK polymers have shown excellent stability and an ample processing window. They exhibit no degradation or loss of properties in hot runner processing, maintaining high levels of performance in the finished parts. By eliminating cold runner scrap and avoiding defects due to degradation, significant manufacturing cost reductions are possible.

The Husky valve gate systems allow improved cosmetic appearance while eliminating secondary operations on parts with tight dimensional tolerances or strict cosmetic requirements. These technological advancements are helping to shape the future of the consumer electronics market.

About Victrex

Headquartered in the UK, Victrex is an innovative world leader in high performance polymer solutions such as VICTREX™ PEEK, VICOTE™ Coatings, APTIV™ film and VICTREX Pipes™ materials. These materials are used in a variety of markets and offer an exceptional combination of properties to help OEMs, designers and processors reach new levels of cost savings, quality, and performance. All Victrex material production comes under Victrex's ISO 9001:2008 quality registration. For its environmental management system at the UK manufacturing site Victrex is certified according to ISO 14001:2004. The certificate covers the manufacture of VICTREX™ PAEK polymer compounded pellets consisting of polymers and fillers, from production of pellets to dispatch. For more information please visit www.victrex.com

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About Husky

Husky Injection Molding Systems Ltd. is a leading supplier of injection molding equipment and services to the plastics industry. With one of the broadest product lines in the industry, Husky systems, machines, molds and hot runners are used to produce a wide range of products for the beverage packaging, closures, thinwall packaging, medical, and consumer electronics markets. For more information please visit www.husky.co

Reference

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