Liquid Crystal Polymers

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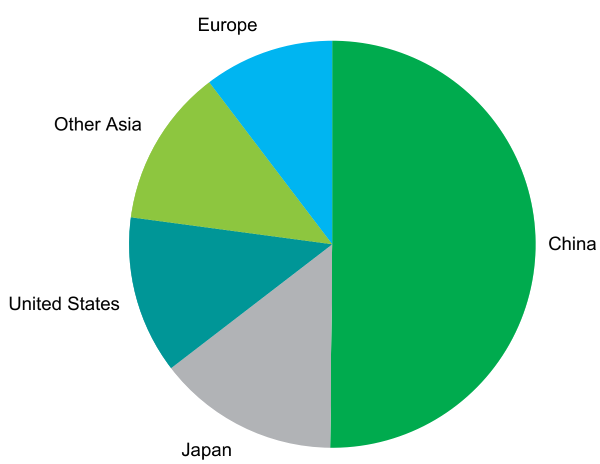
Abstract

The global electronics/electrical industry accounts for close to 80% of global demand for liquid crystal polymers (LCPs). The major component here for LCPs is in SMT connectors and other electronic device components. Growth is also attributed to the continued expansion of the electrical and electronics industry in electrical packaging. Today, there is increasing consumer and producer demand, as well as a strong outlook for applications in ultracompact electronic devices such as smartphones, laptops/notebooks, tablets, LEDs, and electrical device components such as motors, connectors, switches, bobbins, stators, chip carriers, coil forms, sockets, capacitor and protective housings, and printed circuit boards (PCBs).

LCPs can also be used in electronic components for robots, satellites, high-density circuit boards for missiles and weaponry, digital cameras, copiers and printers, high-end headphones, and virtual reality headsets. The remaining demand for LCPs is for industrial and automotive applications, as well as uses in medical, aerospace, military, and cookware/bakeware.

The following chart presents world consumption of liquid crystal polymers:

World consumption of liquid crystal polymers—2018



Source: IHS Markit.

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LCPs belong to the high-performance thermoplastics group. They are unique linear polymers that can align themselves parallel to one another to form a liquid crystal phase. This alignment is "self-reinforcing," resulting in outstanding properties associated with a high degree of orientation. In the melt phase and under shear, such as during injection molding, LCPs exhibit very low viscosity and high flow to completely fill small and intricate molds, making LCPs the

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favorite choice for making miniature and ultrathin parts down to 0.1 millimeter (mm) wall thickness with extremely short cycle times. LCPs compete with other high-performance thermoplastics and engineering resins, including polyphenylene sulfide (PPS), polyphthalamide (PPA), polycyclohexylenedimethylene terephthalate (PCT), and certain specialty nylons, but the best of the competing resins can only fill walls down to 0.25 mm at most, with longer cycle times during injection molding.

LCPs are classified as being either lyotropic (solution processable) or thermotropic (melt processable) polymers. This report focuses only on the thermotropic LCPs.

LCPs exhibit a highly ordered structure in both melt and solid states, and are manufactured from a variety of different monomers and encompass a wide range of materials. Moreover, LCPs can replace such materials as ceramics, metals, composites, and other plastics because of their outstanding strength at very extreme temperatures and resistance to almost all chemicals, weathering, radiation, and burning.

In addition to being wholly aromatic polyester/copolyester systems, thermotropic LCPs are characterized by straight, densely packed polymer chains that give the resulting product excellent unidirectional mechanical properties. They have good high-temperature performance (heat distortion temperatures range from 121°C to 355°C); excellent resistance to radiation, hydrolysis, weathering, and chemicals; inherent flame retardance and very low smoke emission; high dimensional stability with low moisture absorption and a very low coefficient of thermal expansion; and high impact resistance and stiffness. (On a pound-for-pound basis, LCPs are stronger than steel but only 15% as stiff.)

Asia dominates worldwide demand for LCPs; China is the largest consumer. Since the current global operating rate for LCPs is low, it is expected that there will not be any LCP neat resins capacity increases from 2018 to 2023. The global LCP market is expected to grow at an average annual rate of about 4%.

Contents

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