



High-temperature and engineering films in the marketplace

HIGH-TEMPERATURE
ENGINEERING
PLASTICS

by John Jarrett

High-temperature, engineering and specialty films have become an important part of the larger plastic film industry. High temperature films are high-performance films; they can handle tough applications that commodity films cannot. Consequently, they sell at premium prices over commodity films. Films made from PEEK, PES, PEI, PPSU, PSU, fluoropolymers, or specialty resins like PPS and TPX, are typically small in volume when compared to the market for commodity films like PE, PP and PVC, but the value of the high-temperature film market is very high.

The use of high-temperature and engineering films is driven similarly to the use of high-temperature and engineering stock shapes. Specific application needs are assessed based on physical, thermal, electrical and ignition properties, and the proper resin is chosen to support the application. As with stock shapes, high-

temperature thermoplastic films are used in lieu of thin metals and ceramics, and sometimes to upgrade from a lesser performing commodity film.

High-temperature and engineering films are typically cast or flat-die extruded around and through a series of specially heated and cooled chrome rolls. The aesthetic properties of high-temperature films can be controlled during the extrusion process, including surface finish. The term "film" can mean thicknesses from .001" through .030", depending on the language of the extruder. Most high-temperature films, however, are in the range of .001"-.010". The trend is moving toward thinner overall substrates as technology demands dictate lower weight and higher performance in the final part.

High temperature film applications

Applications for high temperature and engineering films are as varied as applications for rod, sheet, tube and slab. Electronic/electrical applications include flexible circuits and coil winding/transformer insulation. These applications require films with exceptional dielectric strength, heat resistance, and resistance to hydrolysis or steam. Recommended films include PEEK, PI, PEI, PPSU and PPS.

Chemical processing applications include pump diaphragms and rupture discs, loose-fitting chemical liners and flexible equipment covers. Films made from fluoropolymer resins are the best fit for these applications. These films exhibit superior chemical resistance to strong acids and strong or weak bases. These films may also need some degree of flexibility or ductility, and UV resistance. Recommended films include PVDF, ECTFE, ETFE, THV and HTE.

Industrial and consumer applications can include pressure sensitive tapes, labels and decals, and shims and gaskets. There are a variety of engineering and high-performance resins that can be converted to films from either neat resins or resins that are custom-tailored or com-

pounded for enhanced properties. Some examples include alloys of PET/PC, thermoplastic elastomers, and filled acetals and nylons.

Other specialty applications include aircraft insulation and interior films, and composite and adhesive films, which are generally supplied from PEEK, PEKK, PEI, PPS or PPSU films. Speaker cones and voice coils are typically serviced with PEI and PI films and specialty graphics films are supplied from films made from custom acrylic and polycarbonate resins and blends.



Ajedium Film Group LLC of Newark, DE, employs closed-loop production processing using an autoflex die and beta-transmission scanning equipment to produce in-tolerance, flat and stress-free high-performance films.



Ajedium Film Group extrudes films from high temperature resins with a melting point of 800°F or less.

Testing standards

ASTM and DIN standards are typical for the testing of films; similar to those of stock shapes. Mechanical properties, including tensile, flexural strength and modulus, are covered by ASTM D 882 and D 790. Tear strength is measured by ASTM D 1922 and D 1004. Films used as electrical insulation are typically subject to certification to Underwriters Lab (UL) 746B for relative thermal index. Ignition (flammability) characteristics are tested via UL 94 VTM (vertical test method) protocol. Since thin films cannot support themselves in the typical horizontal position of the test method, the UL vertical test method is often employed.

End users of high-temperature films require the technical expertise of companies whose sole focus is film manufac-

turing, and whose competencies and experiences with secondary operations like thermoforming, coating, adhesion and screen-printing are current with today's demanding technologies.

Manufacturing considerations

The critical requirements for thickness or gauge control necessitate the ability of the high-temperature film manufacturer to guarantee that the films are always uniform in thickness across the web width. This is possible with closed-loop automated production processes. One example of this is an auto-flex film die that works in conjunction with a beta-gauge scanning transmission system. An auto-flex die is a film die with a flexible lip in which each lip-adjusting bolt is paired with a cartridge heater. When a signal from the beta-ray gauge indicates that the film is out of specification at a given point in the web, the heater voltage at the relevant bolt area is raised or lowered, expanding or contracting the bolt, thereby decreasing or increasing the lip opening at that point in the film web. This happens very quickly, in a matter of seconds, and the entire process is displayed on a computer screen while the film is being manufactured for the operator to easily view.

High temperature films are generally extruded slowly, allowing for the production of films that are flat, and virtually stress and shrinkage free. This is critical when the film will be used in the manufacture of printed circuit boards or flexible circuits, or if the film is to be thermoformed with a deep draw. Speed and output rates are not the primary concern of the film manufacturer; quality is the top priority.

Conclusion

Films are usually forgotten when discussions of high-temperature and engineering plastics arise. However, films are nonetheless important to the high-temperature and engineering marketplace. The key to finding the best film for an application is finding the high-temperature film manufacturer whose knowledge and experience matches the critical needs of the application, and one who will respond to the innovative challenges represented by all high-technology applications requiring film. ■