Consider High-Performance Films to Solve Engineering Problems

High-quality, thin-gauge films made from high-performance plastics

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High-quality thin-gauge films made from high-performance plastics are relatively new tools in the design engineering arsenal that can solve a wide variety of problems.

Many engineers are familiar with the unique property benefits from high-performance plastics, such as polyphenylsulfone (PPSU), polyetheretherketone (PEEK) and various fluorinated polymers.

Some of those capabilities include:

- Sulfone polymers: Toughness and transparency with long-term thermal stability from -40C to 200C.
- Ketone polymers: Inherent flame resistance, exceptional strength and toughness, with broad chemical and wear resistance.
- Fluoropolymers: Repeating strong carbon-fluorine bonds that provide a high level of resistance to solvents, acids and bases.
- Polyimides: A combination of unique electrical, thermal, chemical and mechanical properties over a wide variety of environments.

What's relatively new is the increasing ability to make these polymers into highly repeatable, virtually gel-free thin films that can be used for very high-tech applications. The ability to make thinner sheets is important because it improves the economics of the high-performance resins.

"We had decided when we started Ajedium (in late 2002) that the hallmark of a great high-performance film is flatness, roll conformance and gauge consistency," says Kathie Cerchio, sales development manager for the high-performance film specialist. "So we decided to build a line that uses only auto gauge dies, in tandem with a closed-loop automated thickness control process." As a result, Ajedium produces films at ±5 percent or better thickness tolerance.

Control of molecular weight and impurities is also very important, says Shari Axelrad, global market manager for ultra polymers at Solvay Advanced Polymers in Alpharetta, GA.

A sister company, Solvay Solexis, bought Ajedium in 2008. "This will help to further adjust our resins and compounds for high quality films, improving our capability to serve the growing requirements of film producers," says Pierre Joris, CEO of Solvay Solexis. "Our market intelligence shows that films are one of the strongest growing applications for our resins."

PV Market Takes off

Solvay Solexis is the only producer in the world of a polymer called ECTFE (ethylene chlorotrifluoroethlyene), which is increasingly used as the top sheets in lieu of glass for flexible photovoltaic modules.

"You need very UV stable, chemically resistant, low permeability films for the top, or front, sheet," says Cerchio. A grade of Halar ECTFE film developed by Solvay Solexis and Ajedium is said to provide more than 90 percent transmission of light in the visible spectrum. The plastic film reduces weight versus glass, and permits construction of flexible modules. Improved properties allow production of thinner films, and a reduction in costs. The films are offered in 50 micron (2 mils) and 100
micron (4 mils) thickness.

Another interesting example of a new application for high-performance film is a plate in a new type of heat exchanger instead of titanium at a significant cost savings. Radel® R polyphenylsulfone film is thermoformed to produce plates used in an interchanger for heat-driven liquid-desiccant air conditioners developed by AIL Research of Princeton, NJ.

"We had to develop something that would withstand temperatures up to 350F and high chloride salt solutions yet not be too high priced," says Thomas Tonon, a senior research engineer at AIL. "Stainless steel would not work for us. We would have had to go to titanium and one sheet is more than $100. So we had to design our own." The comparable price for the PPSU sheet is about $2. About 40 sheets are required to make 20 plates.

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Heat-driven liquid-desiccant air conditioners have been developed by AIL Research in part with a grant from the National Renewable Energy Lab. The system uses desiccant solutions of halide salts, particularly lithium chloride and calcium chloride. As a result, PPSU is used. The system is said to improve building dehumidification with reduced energy input.

AIL Research is seeking partners for various forms of air conditioning that use the PPSU plate technology, including Liquid Desiccant Direct Expansion and air/liquid and liquid/liquid plastic film heat exchangers used for carbon dioxide scrubbing from power plant emissions.

Other emerging engineering applications for high-performance films include:

Aircraft - A new AvaSpire® modified PEEK is being tested as an insulation blanket used in aircraft fuselages. "One of the key advantages of Avaspire is that it has passed a new flammability test, called a radiant panel test, for these blankets," says Axelrad of Solvay Advanced Polymers. There is also potential to use Radel® R polyphenylsulfone film and KetaSpire® PEEK as adhesive films for composite aircraft structures, such as wings. These films are just 5-6 microns thick. They must provide great adhesion and durability at high autoclave temperatures.

Oil Country Goods. New grades of film are boosting temperature performance and chemical resistance for electrical equipment, such as motors. "In the oil and gas industry, the environments are getting harsher and harsher," says Cerchio. "That's an industry where the PEEK products have a big play because of their excellent chemical resistance."

Medical Implants - Some medical industry OEMs are using polyimide film sleeves to encapsulate batteries used in implantable devices. "I would call it a separator film that has to have a certain amount of strength and durability for the application," says Cerchio.

Resins - Several resin companies, such as DuPont and Bayer, sell film grades of their high-performance resins. Major independent domestic extruders of high-performance film include Ensinger/Penn Fibre, Bensalem, PA and Rowland Technologies, Wallingford, CT.