THE GREENING OF AN INDUSTRY

A growing market

MODERN PLASTICS WORLDWIDE

It is no stretch to say extruded applications may be one of the biggest growth markets for processors using bioplastics. MPW looks at offerings from some of the leading suppliers.

By Tony Deligio

Cereplast (Hawthorne, CA), which blends biopolymers like NatureWorks' polylactic acid (PLA) with other renewable resources, including corn, potato, tapioca, and wheat starch, offers 12 resin formulations, with CPTH01, CPTH02, CPTH03, and CPTH04 available for thermoforming. The company also has four injection molding, one extrusion coating, two blowmolding, two blown-film, and one profile extrusion grade.

While the company works with biobased resins like PLA and synthetic ones like BASF's Ecoflex, all its materials are biodegradable according to the ASTM 6400 standard, and feature at least 90% biobased content. Cereplast has six patents, three of which are starch related, two covering compounding of PLA plus copolyester, and one for nanomaterial dispersion in a biomaterial.

Cereplast began life as Nat-Ur, a molder of biobased resins, and was founded by Frederic Scheer, who has 15 years experience in biodegradable resins, including stints at Cargill and Novamont. In that time, Scheer determined bioresins' fatal flaw was poor performance and higher costs compared to standard materials. "What I've been trying to do at Cereplast is manufacture resin that presents similar physical and thermal properties as traditional petroleum-based resins but at the same time, comes with pricing that is competitive," Scheer says, "because the reality is we can make beautiful resins, but if they are 10 times the price of standard resin, they are going to stay in a museum, and nobody is going to be using them."

Scheer says from a processing perspective, the company has had the greatest level of success in thermoforming, with Cereplast resins running between 95%-99% the speed of a standard polypropylene. Extrusion coating runs roughly equivalent to polyethylene counterparts, but in injection molding and blowmolding, Scheer admits cycles are probably 20% slower.

The starch does affect coloring, changing it slightly from what would be expected in a polyolefin, for instance, and crystallinity has some variation, with some Cereplast resins surpassing a standard PLA in heat resistance. Scheer says the extrusion, extrusion coating, and blowmolding materials require drying.

Cereplast founder Frederic Scheer in his company's newly expanded distribution center. The company began shipping resin in the fourth quarter of 2006.

DuPont (Wilmington, DE) has partnered with BP for a 45,000-tons/yr plant in Loudon, TN, and they also have a 100-million lb/yr JV with Tate & Lyle in Loudon. Dupont launched its 100% bioderived 1,3 propane diol Cerenol product at NPE 2006. The technology can be used to make resins, dispersions, films, and coatings.

PLA stacks up in thermoforming

	PET	PLA	PP	OPS
Density (g/cm3)	1.33	1.23	0.9	1.05
Elasticity modulus (N/mm3)	2200	3500	1600	3000
Top load strength (N)	22	22	22	22
Weight (g)	19.9	12.2	16.9	15.2

French processor Vitembal tested 500-ml thermoformed clamshell packaging (as used at take-away salad bars) using four plastics—PLA, PET, PP, and OPS—and found PLA held its own in many respects. The standard was top load strength of 22 N.
As a result of PLA's lower density versus PET, and higher stiffness, equally performing PLA clamshells (with load strength as the standard) can be processed with significantly lower weights, thereby compensating for some of PLA's higher cost.

In April, Metabolix and JV partner ADM, launched Telles, which will market and manufacture its Mirel PHA material.

In terms of price, Cereplast materials cost from $0.58/lb to $1.45/lb, depending on the application. Customers include Innoware, Genpak, Alcoa, Solo, and Custom Plastic, among others.

Putting microbes to work

Taking a different molecular angle on bioresins, Metabolix (Cambridge, MA) has partnered with Archer Daniels Midland (Decatur, IL) to launch resin maker Telles, which derives PHA (polyhydroxyalkoanate), branded as Mirel, from microbes. Mirel will launch with five grades, according to Metabolix's Robert Findlen, with sheet (P4001) and thermoforming (P4002) grades, as well as ones for injection molding and paper coating.

The glass transition for the material ranges between -5°C and 0°C, with melting points between 150°C and 175°C and a specific gravity of 1.2. The company hopes to have FDA food-contact approval by the end of the year, and by late summer, it's expecting to offer cast- and blown-film grades. Findlen says standard processing equipment can be used, but drying is recommended. In its thermoforming grade, Findlen says the company has created parts with a 2-inch (4.5 cm) draw, but it should be able to go deeper with a new grade.

In films, Findlen says the products are comparable to linear low-density PE, with a softer feel compared to PLA-films, and thicknesses around 1 mm with the chance to go thinner on the basis of greater strength. The material does have a haze, similar to what would be seen in PP, and it offers some inherent barrier properties.

PLA pushes ahead

Polylactic acid (PLA) resin, which is typically derived from corn sugars, is primarily supplied by three firms: NatureWorks LLC (Minnetonka, MN), Mitsui Chemicals (Tokyo), which formed a partnership with NatureWorks in 2001, and Jamplast, a Missouri-based resin distributor. Spearheaded by NatureWorks, the material is gaining acceptance and has been on the market longer than Cereplast and Metabolix rivals.

Jamplast's PLA, suitable for extrusion and thermoforming, has a specific gravity of 1.3 and a melt flow rate of 10, according to online materials database IDES. Tensile strength at yield is 9000 psi, tensile strength at break is 8100 psi, and tensile elongation at break is 3%. It requires a drying temperature of 158°F for four hours, with a melt temperature of 380°F and a die temperature of 390°F.

Mitsui, which entered into an agreement with former NatureWorks owner Cargill Dow (Dow has since exited), on Sept. 26, 2001, offers two grades of its Lacea PLA material, stretched and unstretched. Lacea H-100J, stretched, is a transparent material suitable for blown film and injection molding. It has a density of 1.26 g/cc, tensile strength of 9860 psi, tensile elongation at yield of 4%, flexural modulus of 537,000, and flexural strength of 14,200 psi, according to IDES. For films, the material has water-vapor transmission of 10 g/100 in²/day, and haze of 93% at a thickness of 0.984 mil.

Lacea H-100J, unstretched, has a density of 1.26 g/cc, and tensile strength at yield of 10,200 psi, with elongation at break of 5%. Oxygen permeability is 150 cc/100 in²/day with water transmission of 1.9 g/100 in²/day.

NatureWorks, with 140,000-tonnes/yr capacity, offers eight PLA grades with two each for blowmolding, injection molding, and film extrusion, and one apiece for sheet extrusion and coextrusion. The 2002D grade, suitable for extrusion and thermoforming, has a specific gravity of 1.24, with a 6.0 melt flow rate. IDES reports that tensile strength at yield is 8700, tensile strength at break is 7700 psi, and elongation at break is 6%. A drying temperature of 195°F for two hours is recommended.

Cereplast™

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