Additives Annual 2010 by Michael Tolinski

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The plastics industry is expecting a lot from polymer additives these days, if the agenda at SPE’s 2010 CAD RETEC® conference in September was any indication. "Cost control, sustainability, [and] new materials are all of great interest," reported conference co-chairs Brian West of Techmer PM and Austin Reid of DuPont Titanium Technologies, in a joint statement. The annual conference of the Color and Appearance Division also attracted a variety of experts presenting on how colorants and additives affect processing, biomaterials, and optical characteristics, the co-chairs added.

Attention-Getting Colorants

But improved aesthetics was the main focus of the conference. Pigment and colorant suppliers are making brighter colors—while avoiding relying on heavy metals or halogens in their formulations. After all, consumers are attracted to "bright colors that set trends with differentiated products, without any harmful effect on their health or to the environment," notes Helen Hatcher of Rockwood Pigments (UK) Ltd. But this brightness is a challenge. “The intensity of yellow/orange is the issue, particularly in high-temperature, reactive, or technical polymers,” as she reported in her presentation scheduled for the 2010 CAD RETEC. Accordingly, Rockwood has released a stronger, redder "Bright Orange" grade of its Solaplex® pigments.

BASF has met the bright color challenge with a replacement for lead- and cadmium-based pigments: an orange pigment designated Sicopal® Orange K 2430. The pigment is inorganic (composed of mixed
oxides), allowing it to survive higher processing temperatures (>320°C) that degrade organic pigments.

"[The pigment] is so thermally stable that it can even be used in heat-resistant engineering plastics," says Hans W. Reiners, president of BASF's Performance Chemicals division. Moreover, the shades produced by the pigment cover a unique region along the red-orange color spectrum, allowing it to stand out more, says the company.

Also coloring polymers at the red end of the spectrum are new dyes. Lanxess is offering the halogen-free red dye Macrolex® Red A, with a color index of Solvent Red 135. "Many of our customers in the foodstuffs or the automotive industry, for instance, want to position themselves in the market with halogen-free products," says the company's Dominik Russe. The company says the organic dye is reportedly suitable for many polymers, offering higher solubility and a tinting strength that's roughly 3.5 times higher than halogen-based S.R. 135 dyes.

Ultramarine pigments are likewise getting brighter. Holliday Pigments offers its Premier fine grades with pigment particles that are reportedly small and fine enough to suit fiber and thin film applications. "The resulting composition (free from particles above 10 μm) ensures the mechanical strength of the host polymer is maximized in injection molding and extrusion," says Holiday's Matthew Nicholson. The company has recently targeted its Premier FRX and FVU ultramarines at applications in China’s rapidly expanding automotive market.

Meanwhile, material suppliers are supplying colored compounds with increasingly subtle shades – and names to match. Bayer MaterialScience LLC offers its PC and ABS grades and blends in shades of "Bluff" (a "velvety, pinkish-tan hue" for auto interiors), "Sharkskin" (silvery-gray), "Orinoco" (a "moody green"), and "Giggle" (an orange hue). "As in years past, we forecasted fashion and color trends to determine this season's go-to colors," says Michael George of the company's color and design center. (The names were coined by attendees at recent Industrial Designers Society of America conferences.)

Another industry interest is the coloring of the multiple bioresins now available. Teknor Color Co. has expanded its line of color concentrates for common biopolymers to include colorants for polyhydroxyl butyrate/valerate (PHBV), a subclass of the polyhydroxyalkanoate (PHA) biopolymer family. The concentrate reportedly can be classified as a biomaterial as per ASTM D6866, and meets aerobic composting requirements of ASTM D6400.

Holland Colours Americas Inc. is also expanding its line of colorants to include biopolymers. Its Holcobatch colorants use non-polymeric, non-petroleum-based carrier materials; the company says this will potentially allow them to be used in new biopolymers, beyond the PLA and sugar-derived PET in which they have been used.
**Special-Effects Aesthetics**

Consumers are also drawn to chrome-like reflective surfaces, but shiny finishes created via vacuum metalizing or painting also create high costs and VOCs. In response, Ampacet offers its UltraChrome additive masterbatch for creating scratch-resistant, “mirror-like” plastic surfaces. The masterbatch can be used with polyolefins and engineering resins in cosmetics packaging, housewares, consumer appliances, and automotive aftermarket products, says the company.

Chroma Corporation’s efforts similarly focus on using masterbatches to create the look of painted surfaces. One of the company’s newest concentrates creates a molded-in “frosted” look for colored PET bottles—at a savings of about 90% over spray-painting, says the company. “Consumer companies are hot on frosted-looking plastic packaging because they want to duplicate the fresh, clean, and premium appearance of sandblasted glass, with the safety of plastic that does not break when dropped,” says Chroma’s director of technology, Mir Ali. The frosted color is also more durable than paint, and reportedly works with injection/reheat blow molding, sheet extrusion, and thermoforming.

Chroma also compounds materials that create their own shine. Photo-luminescent plastic products have commonly used zinc sulfide as the key additive, but this material eventually can lose its glow-in-the-dark effectiveness after limited exposure to sunlight. Alternatively, the company says its new formulation uses non-radioactive strontium aluminate to create a longer-term effect for dashboards, marine buoys, signage, and other products.

For powered lighting, light-emitting diodes are becoming more popular, and Chroma and SABIC Innovative Plastics are producing materials that enhance LEDs’ effectiveness. Chroma’s light-diffusion masterbatches are said to eliminate hot spots caused by LEDs in illuminated dials, signage, and knobs. The polymer-based material, formulated for acrylic, polycarbonate, or other clear plastics, allows greater light transmission than traditional mineral-based light-diffusing additives, the company says.

SABIC’s new “Expression 2011” LED materials come in an expanded color palette and various light-modifying properties. The company’s colored Lexan PC grades and other, higher-temperature polymer grades can be formulated with various degrees of LED light scattering and diffusion. And they can be colored in opalescent pale blue tones, or in denser “Icy Mango,” “Emerald Forest,” and “Venetian Cherry” shades.
**UV Protection**

From packaging to agricultural film, additives that prevent polymer damage from ultraviolet light are becoming more application-specific. Holland Colours’ Holcomer UHT White is an additive for monolayer PET bottles used for packaging light-sensitive beverages. The additive’s high opacity reportedly blocks 100% of UV light, extending product shelf-life while maintaining the gloss of the PET.

For clear PET packaging, Ampacet offers its CrystalClear™ UV absorber (UVA), which reportedly does not create the unwelcome yellow tint in packaging. The company says it’s more effective than other UVAs at half the loading, resulting in a reduced net cost of about 40% per pound. Ampacet also offers a reduced-bloom UVA masterbatch specifically for thin-gauge polylefin film packaging. The UVA’s reduced surface blooming reportedly allows stronger seals and print/lamination adhesion.

For protecting relatively thick polylefin products, Songwon offer its SONGLIGHT® GR UV materials, which are synergistic blends of several additives. “These new products show superior cost/performance characteristics when compared to the industry standards,” says Songwon’s Klaus Keck, “and are particularly designed for polypropylene, especially for thick sections.”

Polypropylene used in stadium seating survived the UV exposure and other demands of last summer’s World Cup™ soccer tournament in South Africa. For this, Clariant Masterbatches credits its UV stabilizer and flame retardant “comibatch” custom masterbatches, which the company supplied in various colors. Clariant masterbatches were reportedly used for the various stadiums’ new seating, as well as their corrugated PP sheet advertising boards and telecommunications conduits.

TPO roofing membranes face particularly extreme UV weathering exposures, leading to specialized formulation packages. Roofing system manufacturer Carlisle SynTec has successfully tested TPO membranes that include an eight-component UVA/stabilizer package called OctaGuard XT™, in environments as different as Alaska and Las Vegas. An independent long-term study showed that the package helped the membranes survive not just heavy sun exposure, but also temperature extremes and severe hail, reports the company’s David French.

Agricultural films used for greenhouse likewise require heavy UV stabilization. For the recent K Show, BASF introduced an improved greenhouse film stabilizer designated Tinuvin® XT 200, which the company reportedly spent six years developing. BASF’s Victor Pacheco cites the world’s increasing population and dependence on more efficient greenhouse agriculture as the driving force for the development. “This economical additive ensures the efficacy of these films over a longer period of time, even in the presence of severe concentrations of agricultural chemicals like elemental sulfur,” says
Pacheco.

**PVC Plasticizers & Modifiers**

Answering the negative news about traditional PVC phthalate plasticizers, companies are formulating bio-based or eco-efficient alternatives. Dow Wire & Cable (a subsidiary unit of Dow Chemical) earlier this year launched DOW EQUILIBRIUM™ bio-based, phthalate-free plasticizers for wire insulation and jacketing. The company says the additive is made from nearly 100% renewable feedstock, allowing manufacturers in the many industries that use wire and cable to claim up to 40% reduced greenhouse gas footprints for the plasticizers in their products, Dow estimates.

The non-phthalate plasticizers in the market are now competing with each other. BASF is claiming victory in terms of the "eco-efficiency" of its Hexamoll® DINCH (1,2-Cyclohexanedicarboxylic acid diisononyl ester) plasticizer. The claim comes from a comparison with four other non-phthalate plasticizers in a study by an impartial German organization. "The eco-efficiency analysis shows that the product has the lowest environmental impact throughout its life cycle, so we are helping our customers to achieve sustainable development," says Dr. Albert Heuser, Petrochemicals Division president.

Improved plasticizer performance is the focus of International Specialty Products Inc. ISP has introduced its Flexidone™ PVC additives, which are based on alkyl pyrrolidone chemistry and offers improved solvency and reduced volatility at high temperatures, compared with conventional plasticizers. "Classic low-temperature plasticizers, such as adipates, are limited in their ability to deliver flexible end-product performance," says ISP’s Hasan Kaytan. Conversely, Flexidone products "can deliver cold flex performance at temperatures down to minus-70°C."

For improved siding, fencing, decking, and other rigid profile PVC applications, Arkema Inc. has introduced an acrylic impact modifier. The new Durastrength® 3000 modifier is said to have excellent processability in comparison with non-acrylic PVC impact modifiers.

**PLA-Toughening Modifiers**

Companies like Arkema are also targeting PLA, a bioresin that requires a lot of modification to become more useful. "While PLA is a wonderful biopolymer, its properties can benefit from specialized additives, especially in challenging applications," says Peggy Sharp of Arkema. The company’s Biostrength® 280
clear impact modifier is targeted at PLA food-contact applications, adding toughness, ductility, and durability to extruded and thermoformed packaging. In addition, a Biostrength 900 metal release additive reportedly makes PLA processing more consistent, enhances its flow properties, and widens its processing window.

PolyOne Corp. likewise offers a clear impact modifier for PLA, designated OnCap™ BIO Impact T. The modifier retains PLA’s transparency, which the company says is compromised by other modifiers. It also increases tear resistance, enabling higher production throughput and reducing scrap, without limiting the PLA compound’s food-contact use or biodegradability, when used at prescribed loadings.

Masterbatches from Teknor Apex Co. address all of PLA’s main problems: poor impact strength, metal release, and melt strength. The company’s Terraloy™ 9000-series masterbatches use PLA carrier resins to optimize their ease of use. Testing reported by the company showed that at loadings up to 10% in PLA, different 9000-series masterbatches improved Gardner impact strength by ten times or more, increased film pull-force over a range of draw-down ratios, and functioned well as a mold release or provided film/sheet release in extrusion. The pelletized masterbatches "disperse more effectively and uniformly in PLA than additives that come in powder form, work well in a wide range of processing equipment, and do not affect the clarity of neat PLA polymer," sums up Teknor’s Edwin Tam.

**Biodegradability Accelerants**

The biodegradability of PLA makes it attractive for packaging, as with other biopolymers—though they may require some help degrading. Teknor Apex has developed a thermoplastic starch (TPS) for blending with biodegradable copolyester (polybutylene adipate-co-terephthalate, or PBAT). The starch reportedly speeds up PBAT’s degradation rate; Terraloy™ 2000 series blends containing up to 40% starch reportedly have passed the ASTM D6400 standard for plastics in aerobic composting facilities. This is said to make them compostable candidates for replacing polystyrene and polyolefins in shrink wrap, containers, bags, cutlery, flower pots, and similar products. The TPS is melt-mixed with the host polymer, helping to retain properties of the copolyester.

Companies have also sought ways of making standard polyolefins truly biodegradable. For example, Chroma Corp. now offers an "FDA sanctioned" and RoHS-compliant masterbatch that is designed to lower the molecular weight of the polymer, speeding oxidative degradation initiated by sunlight, heat, or oxygen. It reportedly can be integrated with conventional processes and high-speed molding. The specific masterbatch loading level (typically 1-4%) dictates the shelf-life of the PE or PP products it’s
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used in, says the company.

**Additives Aid Recycling**

Other additives introduced this year enable the use of more recycled resin in products. Americhem Inc. introduced a post-consumer recyclate (PCR) "renewal" additive that adds clarity and reduces the yellow discoloration associated with recycled resin content. Even at loading of 0.1-0.5%, the company says it helps control color variation in clear bottles made with PCR. “Based on testing we have completed with this product, bottle converters could use up to 50 to 75% PCR and still achieve results that are visually close to bottles made from virgin PET resin,” says Chris Miller, Americhem R&D technology manager.

Meanwhile, Polyvel, Inc. has introduced viscosity-modifying additives that aid the incorporation of recycled PET. The CT-series modifiers reportedly increase recycled PET’s intrinsic viscosity, improving melt, tensile, and weld strength. Various grades are offered for strapping and sheet extrusion applications, and even for non-PET condensation polymers such as nylon and PLA.

Elastomeric impact modifiers can also aid the use of recycled material. ExxonMobil Chemical’s Vistamaxx™ propylene-based elastomers reportedly are being used by companies to enhance the quality of recycled polyolefins. It not only improves the impact strength of mixtures of reclaimed polyolefins from different sources, it’s said to enhance mixing and improve processability, “smoothing out” the process at relatively low loadings of 5-10%.

SMA (styrene maleic anhydride) resins are being used to improve other recycled resins such as nyons. It promotes reactive chain-extension in reclaimed nylon, improving its melt and mechanical properties. “These innovations are particularly useful for recovering polyamide 6,6 from used carpeting that has, up until now, been post-consumer waste dumped in landfills,” reports Jeremy Austin of Cray Valley, LLC. When used at 0.5-1.0% loading, Cray Valley’s 3000P SMA effectively increases molecular weight and chain branching, thus improving the material’s processing and properties, he adds.

Polyscope Polymers BV similarly proposes its Xiran® SMA additives as means for improving the recyclability, paintability, and high-temperature performance of ABS and PMMA. Low-grade ABS scrap, for instance, can be transformed by the additive into high-heat ABS, at low cost, claims the company. The SMA also reportedly improves the compatibility of ABS or PMMA with elastomers and reinforcements, and with other polymers with which they are normally immiscible.
Clarifying & Blending Agents

Clarifying agents have become tools not just for enhancing transparency, but for improving other properties and processing. Milliken is reporting trials with its Millad® NX8000 clarifier in PP that have demonstrated that the additive can reduce cycle times and lower processing temperatures by 40-60°C (to around 200°C). This the company claims cuts process energy consumption by 15-20%. The company is also releasing a grade for extrusion-blow molding (NX8500E). And it has collaborated with Total Petrochemicals to produce a clearer thermoforming grade of mPP for packaging. "Increased clarity, together with metallocene PP’s other desirable properties, makes this new grade a better solution than traditional materials for a range of thermoforming applications,” says Milliken’s Mike Musgrave.

Nova Chemicals is improving thermoformed packaging by introducing a polymer blend into standard resin. The company’s UPES® resin, a reactor blend of polyethylene and polystyrene, is reportedly being used in thermoformed polyolefin containers, improving their stack-strength and wall-thickness consistency. The company says the “bi-functional” hybrid material also widens processing windows and improves melt strength, adhesion, stiffness, and other properties when used in various resins.

Flame Retardants

Flame retardants (FRs) are following the pattern of other plastics additives, in that there are new and improved options that do not contain questionable or undesirable ingredients, such as halogens. JJITechnologies reports that its JJAZZ® non-halogen amino-phosphate FR for polyolefins has passed ASTM E84 burn characteristic testing with a “Class B” flame rating. Resin samples formulated with the FR were said to meet the smoke-density and flame-spread limits of the standard. Company applications manager Nick Zaksek explains that the "near-instantaneous char formation of JJAZZ dissipates and deflects the flame away from the fuel source.”

Alternatives are being sought specifically to replace decabromo diphenyl ether (decaBDE), the halogen FR commonly used in plastics for electronics and construction. PMC Polymer Products’ Endura® masterbatches are said to provide FR properties similar to decaBDE masterbatches, at similar loading rates. The company also supplies decaBDE-free “ignition resistant” HIPS compounds.

Mineral-based FRs are another non-halogen alternative. A fine-particle grade of aluminum trihydrate (ATH), produced in the USA, is now offered by Monson Companies, via partner Nabaltec. The precipitated Apyral® 40CD ATH has a specific surface area of 3.5 m2/g and low oil absorption. Nabaltec also reports
that in mPE FR cable compounds, the ATH provides about a 10% increase in tensile strength and elongation at break, compared with a standard 4 m2/g ATH compound. In an PE/EVA wire-insulation compound, it also reduced diehead pressure by about 10% and melt temperature by about 15°C.

**Anti-Fog & Anti-Static**

Tough surface property challenges are being addressed, such as anti-fogging on the outer layers of laminated multi-layer PE films. Danisco has developed the GRINDSTED® PGE 308 anti-fog additive for adding to thin metallocene LLDPE sealing layers in laminate films; the company claims the additive is not adversely affected by the lamination process. The company’s Bjarne Nielsen says that customer trials have been successful and the company "is now recommending the use of the innovative, bio-based anti-fog for all coextruded and laminated PE film solutions."

Anti-static properties can be critical characteristics, especially in new medical products. SABIC Innovative Plastics has launched a new line of anti-static compounds for inhalation devices. Three new transparent LNP Stat-Loy® materials reportedly are permanently static-resistant. They help drive the "design flexibility to create very efficient inhalation devices that can optimize patient dosages for improved safety, while simultaneously slashing manufacturing system costs," says David DeVito, LNP product manager for SABIC.

**Dispersible Nanotubes**

Carbon nanotubes (CNTs) also add static-dissipating and other practical properties to a polymer, as long as they’re dispersed effectively. At least a few companies this year announced new grades of multi-wall CNTs with improved dispersability. For example, an expanded selection of CNTs from Southwest NanoTechnologies, Inc. is being offered by Sigma-Aldrich® Materials Science. Southwest’s SMW multi-wall CNTs reportedly can add electrostatic discharge protection to a polymer without sacrificing its mechanical properties, and without the costs and dispersion difficulties of single-wall CNTs.

Bayer MaterialScience also sees importance in making CNTs more practical to use, explains the company’s Dr. Heiko Hocke. "Multi-wall carbon nanotubes, with their very large length-to-diameter ratios, display very high tensile strength and exceptional electrical and thermal conductivity." So Bayer introduced Baytubes® C 70 P, the agglomerates of which reportedly require less time to disperse in low-viscosity liquids than previous CNT grades. This improves the overall economics of using the CNTs in
polymers, the company says.

**Antimicrobials Fight Infection & Odor**

Also of interest are the antimicrobial properties that can be added to plastics using additives. In hospitals and medical situations, microbe growth constitutes a threat on multiple surfaces; thus PolyOne launched its WithStand™ additive concentrate for Class I, II, and III medical devices and medical packaging.

Polyvel has also introduced a series of masterbatches for controlling bacterial growth. The VA series products contain silver, trichlosan, or proprietary agents that kill various micro-organisms such as E. coli and salmonella, the company says. The VA products also control odors caused by bacteria, while the company’s ZO series of masterbatches control odors produced from the processing of wood-polymer composites, recycled materials, or other sources.

**Processing Aids**

Last here but certainly not least, plastics process aids are indispensable tools for productivity. Fluoropolymer-based melt-processing aids effectively coat and lubricate the walls of process equipment, reducing torque and improving output. But at ANTEC 2010, AXEL Plastics presented a non-fluoropolymer process additive for polycarbonate that likewise operates through this “wall effect”—at very low (0.05%) addition levels, and without causing hydrolysis of the PC.

Mold release agents can add to the bottom line in injection molding, especially when they can be incorporated into the plastic. Thus RTP Company has developed masterbatches that add a synthetic perfluoropolyether oil (PFPE) into neat resins to ease part release. The company has commonly used PFPE to enhance the wear and abrasion resistance of its specialty compounds, but here it’s offered as an alternative to external spray releases for freeing sticking parts. Other advantages of the PFPE masterbatch include improvements in melt flow, throughput, surface finish, and mar- and scratch-protection, the company cites.