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MAKING THE MOST OF CARBON BLACK

THE LATEST DEVELOPMENTS IN MIXERS

COMPOUNDING NEWS FROM K 2013
Carbon blacks are important colorants and conductive additives. Thermoplastic applications that are pigment-ed with carbon black include automotive parts, agricultural film, food packaging, industrial components, pipes, and wire and cable. Other applications use special conductive carbon blacks to provide electrical conductivity and prevent the risk of electrostatic discharge (ESD). These applications include electronics and electronics packaging, clean-room equipment, automotive fuel systems, semi-conductive cable, and industrial parts used in locations with explosion risks.

**Expanding options**

Changes in ownership in 2010 and 2011 – including Aditya Birla’s acquisition of Columbian Chemicals and Evonik’s sale of its carbon black business which has become Orion Engineered Carbons – have been followed by capacity expansions from several suppliers. These investments have been driven by continuing growth in many applications, including tyres and batteries, as well as thermoplastics. Asia continues to be a growth area, and suppliers report growth in other regions as well.

**Timcal** is on track to complete the expansion of its Willebroek plant in Belgium by the end of 2013. The plant specializes in conductive and highly conductive carbon black for the polymer and battery markets, both of which are applications with good growth potential.

The polymer market shows steady growth, but how quickly the battery market grows will depend on the sales of electric and hybrid vehicles that use lithium-ion batteries, comments Christine Van Bellingen, product manager for carbon black and graphite for polymers at Timcal.

**Cabot**, which supplies carbon black and carbon-black masterbatches, has been expanding capacity in China to support growing plastics demand from the automotive, infrastructure and agricultural markets. Cabot expanded masterbatch capacity at its Tianjin plant by 45,000 tonnes in 2011, while in March of this year it opened a new plastics application development laboratory in Shanghai. The company also opened a new carbon black plant in Xingtai, China, in 2013, although grades produced there are primarily for tyres.

Another company investing in China is local producer **Asia Carbon Industries**. It converted three production
lines to specialty carbon black production in 2013. The new grades can be used as pigments, conductive additives and UV stabilizers in plastics, coatings, inks, electrical parts or batteries. **Orion Engineered Carbons** introduced three pigment grades to the South American market in May 2013 to meet rapid demand growth in this region. The grades (PPR G, PBR 60 and PBR 300) are produced locally at the company’s plant in Paulinia, Brazil for injection-moulded parts, sheets and films made from PE, PVC, and other thermoplastics.

"Many customers have started to differentiate themselves by producing not only commodities but also specialties. The demand for high-value products is increasing in South America," says Henry Brooks, vice-president of pigments for the Americas at Orion. Applications for specialty carbon black pigments in the region include automotive and OEM parts, consumer goods such as machine tools and appliances, and infrastructure projects. For example, UV-resistant black plastic pipe is in increasing demand in the oil and gas industry and for pipe and film in drip irrigation systems, adds Brooks.

**Perfecting pigments**
Carbon black users are continuously seeking the most cost-effective solutions to balance price and performance of both properties and processability. "Carbon black is more than just structure and particle size - surface chemistry, purity levels, and other attributes all need to be balanced to find that right level of performance, whether its colour, UV, or conductivity. But there is also ease-of-dispersion, moisture absorption, and other parameters that improve processability," says George Haines, global segment leader for plastics at Cabot. Critical carbon black parameters such as morphology and surface chemistry can be adjusted to meet particular application needs.

Weatherability, including UV-light resistance, is a crucial property for plastics exposed to the elements, and colour performance is important for many applications. High-jet pigments in a range of bluish undertones help deliver a luxurious look, for example, says Brooks at Orion. Dispersion and tone are both important for engineering resin applications, agrees Prakash Patel, senior technical director at **Ampacet**, which is active in providing carbon-black concentrates for engineering resins, such as PET, polyamides and polycarbonates.

Dispersion of carbon black pigments can be a challenge because of the small particle size of carbon black compared to other pigments, but suppliers are working on improved processability. New surface-modified carbon black pigments are easier to disperse, says Brooks. Better dispersion can improve both processing times and final product properties.

FDA-compliant carbon black grades for food-contact applications are in high demand. Food packaging is a growing market due to the continuing trend towards convenience packaging, such as pre-packaged foods in black trays and restaurant take-out food clamshells, says Patel.

In order to meet FDA requirements, carbon black grades must have low levels of polycyclic aromatic hydrocarbons (PAH), not exceeding 0.5 ppm, and benzo(a)pyrene (BaP) not exceeding 5.0 ppb; the maximum concentration of carbon black allowed in food-contact articles is 2.5%. PAHs can be removed from the carbon black surface by an extraction process, explains Orion, which offers several grades that meet FDA requirements.

At K 2013, **Birla Carbon** introduced Raven P7 Ultra, a "next-generation" carbon black for pipes, jacketing and geomembranes that has very low moisture pick-up (MPU). The latter is affected by relative humidity as well as carbon black properties including surface area and sulphur and ash levels. The new carbon black has a
Carbon black | additives feature

tailored morphology, a particle size less than 25 nm, and high cleanliness.

Birla claims that Raven P7 Ultra is the industry’s lowest MPU product for pipe applications. It also reports that the carbon black grade has excellent organoleptic properties and is compliant with EU No. 10/2011, which makes it suitable for indirect food applications.

In addition, Raven P7 Ultra is said to offer excellent UV protection, a smooth surface finish, longer screen life and easy processing. It also meets the coefficient of absorption requirements for telecom cable jacketing.

Orion’s new Printex Zeta A is designed for low compound moisture absorption, particularly for pressure pipes used in water and gas supply, where carbon black adds UV stability. Dispersibility and a balanced average primary particle size and specific surface area of the carbon black are important for UV protection, notes the company. In drinking water pipes, low impurities, such as sulphur, improve organoleptics.

Aemerge is a new company based in Indiana, USA, which is producing carbon black pigment from an unusual source – recycled wooden pallets. Aemerge uses carbonization to transform organic waste, such as biomass, used tyres and industrial waste, into carbon-based products including carbon black pigment, activated carbon, and a soil improver.

The pigment product, named OrganicBlack, is made only from recycled wooden pallets. Organic Black can be used as an extender to supplement the use of traditional carbon black. Third-party laboratory tests have compared a masterbatch containing equal proportions of OrganicBlack and a conventional N762 carbon black pigment with one a masterbatch containing just the conventional black. They found that tensile properties remain unchanged after a 500 hour UV-light weathering test. Higher amounts of OrganicBlack can cause a slight shift from blue to brown undertones as the percentage is increased.

Adam Seger, head of sales and marketing at Aemerge, says: “OrganicBlack is priced 30% less than traditional N Series carbon blacks used in plastic applications. Given the continued market concerns about supply and price for oil-based blacks, we believe we offer price stability and access to a secure supply source that can supplement conventional carbon black pigments to save costs in commodity pigmentation applications, with the added benefit of being a renewable raw material.”

OrganicBlack has a bulk density of 20-22 lb/ft³

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Birla says that its new Raven P7 Ultra is the industry’s lowest MPU product for pipe applications (320–350 kg/m³), and users report that it handles well in its powder form, says Seger. Although it has a larger particle size, dispersion has been shown to be acceptable for commodity applications. Aemerge is seeking FDA approval and certification under organic product programs for OrganicBlack; it is listed as a USDA bio-preferred product and has also passed the EPA 313 analyses for the presence of metals. “The pending FDA food-contact notification is generating a lot of interest,” says Seger. “We expect commercial, North American sales to begin as early as January 2014. We have a secure supply of feedstock and expect to scale production up quickly over the next year.”

Conducting progress
Suppliers see a continuing increase in demand for conductive carbon blacks. For example, demand from the electronic packaging industry remains strong, says Van Bellingen at Timcal. Carbon-black filled polycarbonate (PC) and polystyrene (PS) are used in these applications at loading levels in the range of 10–20%. PC is particularly sensitive to traces of basic elements, such as sodium and magnesium, so carbon blacks with low impurity levels are required. Interest is also increasing in polyolefin foams, which offer lightweighting. Extra-conductive blacks may be preferred for the lowest foam densities, but high-quality, easily dispersible conductive carbon blacks are also used. “The impact of compounding and foam processing must be taken into account during the conductive-foam design,” notes Van Bellingen.

Another important application is conductive plastic fuel systems, which continue to grow in use as a replacement for metal-based fuel system components. Industrial applications, in which parts are subject to regulations protecting against electrostatic discharge in industrial environments (e.g., ATEX), are also growing, says Haines of Cabot. “Other uses of conductive carbon black are being evaluated. We believe this is an area of continued differentiation and innovation,” he adds.

At K2013, Cabot introduced the Vulcan XCMAX family of super-conductive, specialty carbon blacks to provide high conductivity at low carbon-black loadings in plastics. Target applications include: wire and cable; antistatic flooring and safety systems; automotive fuel tanks and inlets; coatings; and electrical and electronics products. Cabot says that the new products provide a range of performance properties beyond its existing line of XC specialty conductive blacks. The morphology of the Vulcan XCMAX builds on Cabot’s proprietary furnace-black process technology to provide high conductivity, cleanliness and consistency.

Cabot also offers pre-compounded Cabelec conductive compounds with XC and XCMAX carbon blacks. It announced at K 2013 that it is expanding its range of Cabelec conductive concentrates, which contain high loadings of carbon black to enable converters to better tailor formulations. The line now includes polystyrene, polypropylene, and polyethylene-based concentrates. Cabot is also investing in graphenes, which can achieve electrical conductivity at very low loadings; graphenes, however, are at a different price-performance point than carbon black.

Understanding the many factors influencing conductivity is an asset in end-product design, says Timcal’s Van Bellingen. Conductivity is primarily affected by carbon-black structure, namely aggregated primary particles in a branched structure that enhances electrical conductivity. A higher structure will exhibit greater conductivity. Structure can be affected by shear during compounding or injection moulding, but carbon blacks can be designed to be more shear resistant.

Timcal’s Ensaco 2606, for example, has a higher structure stability, which provides flexibility in the product design because the structure can withstand
The type and level of carbon black required to achieve conductivity is a key variable. A common strategy is to use extra-conductive carbon blacks to reduce carbon black loadings and help to maintain virgin resin properties. However, research at Timcal using HDPE has shown that a high-quality, easily dispersible conductive carbon black (Timcal’s Ensaco 250G) retains the same physical and flow properties as an extra-conductive carbon black (Ensaco 350G) at equivalent conductivity, even though the extra-conductive carbon black is used at a lower level (for the full report, see Compounding World, November 2012 – http://bit.ly/timcal).

In addition to carbon black loading, dispersibility and low impurity levels are crucial for maintaining properties. This knowledge gives formulators an option for designing the most cost-effective product, says Van Bellingen. Extra-conductive carbon blacks would be desirable for applications that also require further weight savings, easy welding, or very low sloughing. Outside of these applications, there is increasing use of high purity, easily dispersible conductive carbon blacks, which meet property requirements but avoid the cost and dispersion issues of extra-conductive blacks, adds Van Bellingen.

Orion is also targeting electrically conductive applications with its new XPB 538, which has a high specific surface area comparable to that of the company’s extra-conductive black Printex XE 2-B. This delivers electrical conductivity at low carbon black loadings. XPB 538 has high purity levels, which are needed for applications such as toys or platinum cross-linked silicones.

Orion has also introduced another conductive black, XPB 545, with high jetness and gloss for antistatic-coating formulations and conductive compounds. XPB 545 has low levels of heavy metals and achieves a balanced performance of conductivity, dispersibility, and cleanliness that allows it to offer effective performance at lower concentrations, says the company.

Orion’s new Printex HV offers the cleanliness, dispersibility, and conductivity required for the semi-conductive layer in high-voltage (HV) cables. Low ionic, particulate, or sulphur impurities prolong cable service life.

Click on the links for more information:
- www.aemerge.com
- www.ampacet.com
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- www.cabot-corp.com
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Orion has launched new conductive grades aimed at applications such as cable jacketing.