Avient extends reSound reach

Avient, which combines the former PolyOne and Clariant Masterbatches businesses, has launched a number of additions to its reSound R line of post-consumer (PCR) and post-industrial recycled (PIR) plastics targeting the North American and Asian markets.

Injection-mouldable reSound R VX TPEs are being offered in 25% PCR and 40% PIR grades in North America, with the former using recycled ocean plastics from Oceanworks. Both can be overmoulded onto PP and are envisaged to find application in personal care products, lawn and garden tools, outdoor goods, office supplies, footwear and houseware durables.

ReSound R ND compounds comprise 100% PCR-content PA6 and PA66 grades with varying levels of glass fibre and mineral reinforcements. These are targeted at applications in the consumer, automotive and powersports markets in North America.

For the Asian market, Avient has introduced reSound R PC polycarbonates with 25-75% recycled content and 10-30% glass filler. Several grades are available, which are said to match virgin PC in terms of tensile elongation, tensile strength, notched Izod impact, flexural modulus and flexural strength.

Avient said it is evaluating potential to make the reSound R PC and reSound R ND products globally available, but adds this will depend on regional sourcing capabilities.

Kraton seeks Biaxam approval

Speciality polymers maker Kraton Polymers said it is seeking regulatory approval for its Biaxam sulphonated polymer technology from the US EPA and other regulatory agencies for use as a durable, long-lasting disinfectant.

Studies have shown that Biaxam rapidly inactivates up to 99.99% of SARS-CoV-2 and certain microbes, the company said. Potential applications include coatings on personal protective equipment, such as face shields, and high-contact surfaces including door handles, elevator buttons, public transportation surfaces and mobile phone cases.

The company said the technology is patent-pending and will be commercially available shortly, depending on EPA approval. Kraton President and CEO Kevin M Fogarty said: “We are currently conducting discussions with a number of possible development partners to explore potential applications in the US and other regions worldwide.”

Nabaltec starts up in US

Nabaltec’s plant at Chattanooga, Tennessee, US, is now in operation. The Naprotec facility will produce ground alumina trihydrate (ATH) products, including surface modified ground, fine precipitated, and performance enhanced grades. Capacity is more than 30,000 tonnes/yr.

The facility is the German company’s second production site in the US and underlines its intention to expand its position as a leading supplier of eco-friendly flame retardant fillers in the North American region, according to Nabaltec CEO Johannes Heckmann.

Hexpol launches into cable

Hexpol has announced the development of a new portfolio of compounds to address the growing wire and cable market.

Products include silicone rubbers, CPE, EPDM, NBR+PVC, CR rubber compounds, pigment and additive masterbatch; thermoplastic, EVA, TPE and TPV technologies. Grades are available for bedding, insulation and sheathing applications.

Typical properties include halogen-free flame retardancy, low smoke and low toxicity. The materials are also RoHS, SVHC and REACH-compliant.

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Over recent years, the focus of many sustainability initiatives has been on developing plastics parts that perform their design function while using less material. Today, though, the increased focus on plastic waste and the aim to create a more circular economy is placing greater emphasis on end-of-life options for plastic items. A key element in making “circularity” a reality will be ensuring plastics can be effectively recycled into materials that offer good levels of performance. Additive technologies are likely to play a significant role.

A number of non-profit organisations are addressing the problem of plastics waste and the need for better recycling at a political level. The UK Plastics Pact, founded in 2018, is an initiative from the Ellen MacArthur Foundation’s Plastics Pact network that aims to transform “the way the UK makes, uses and disposes of plastic.” In August this year, the US Plastics Pact was launched with 60 members ranging from consumer goods to chemical companies and associations such as the Association of Plastics Recyclers (APR). These non-profit groups have set ambitious goals for the next few years for recycling and the use of recycled plastic.

Improving rPET
The polyethylene terephthalate (PET) recycle stream is already well established. Meeting brand owner requirements for circularity, however, means the industry is striving to use more recycled PET (rPET) bottle waste back into bottles and other packaging applications rather than use in rPET fibre. To this end, a range of new additives and masterbatches are coming to the market to improve rPET colour, odour, and appearance, as well as to enable better recyclability.

Avient (formerly PolyOne) has launched a low-haze, non-polyamide-based oxygen scavenger
for rigid PET packaging – ColorMatrix Amosorb 4020G. The company says the new grade offers up to 50% lower haze and also reduces yellowing by 50% during the mechanical recycling process compared to earlier grades of Amosorb oxygen scavenger. The company says that, with the increasing use of rPET in rigid containers, brand owners must be sure their oxygen scavenger system is maintaining efficacy. Its tests showed that the 4020G additive had negligible effects on efficacy for the rPET grades tested compared to competitive materials, which it says lost almost all oxygen scavenging ability with rPET content as low as 20%.

Another concern for rPET is the increased levels of acetaldehyde (AA) created during the recycling process, which can lead to off-taste in bottled contents. Avient’s ColorMatrix AAzure Acetaldehyde Control Additive is a process aid for PET and rPET preforms that can also reduce AA by up to 80% in the preform. As a process aid, the additive helps overcome the risk of blowouts, so higher levels of rPET can be used. The additive is commercially available in major global markets and meets direct food contact regulatory requirements, the company says.

Avient’s ColorMatrix Smartheat RHC was introduced in September last year to improve the quality of PET bottles contained recycled resin. The liquid dispersion processing aid is intended for use by rPET producers and manufacturers of preforms for injection stretch blow moulding and is claimed to improve rPET processing and product quality. The company says the additive helps improve thermal stability and reduce yellowing and provides a more effective alternative to the addition of toners or colorants to mask yellowing caused by heat exposure. The company suggests that a wider uptake of the additive in the rPET chain would eventually improve overall quality of the recycle stream.

A new addition to Avient’s ColorMatrix Lactra light blocking additive technology family for PET dairy packaging is also said to be compatible with PET recycling streams (there have been concerns that mineral modifiers may have a negative effect on the rPET stream for fibre). The new additive contains less than 1wt% titanium dioxide (TiO₂) and less than 4wt% inorganic content; it is also available as a TiO₂-free version. According to the company, tests show that the Lactra additives are suitable for closed-loop bottle-to-bottle recycling. The low levels of TiO₂ in the products also helps packaging products comply with new European TiO₂ restrictions (EU Waste Framework Directive 2008/98/EC), it says.

A new impact modifier masterbatch from Sukano allows use of virgin or rPET in monomaterial, recyclable packages for cold, flash-frozen, and room-temperature food trays, replacing specialised copolyester resins or other hard-to-recycle film structures. The company offers several other masterbatches to improve rPET, including anti-yellowing, melt enhancing, and NIR-detectable colours and blacks (the latter have been tested using the French COTREP protocol and found suitable for recycling).

Targeting HDPE

After PET, HDPE is the second most widely sorted PCR stream in most material recycling facilities (MRFs). Some of the primary challenges with recycling HDPE are retaining its physical and rheological properties, says Paul Albee, Consultant for Addisperse (AFI Global). A lack of understanding in the recycled compound industry regarding formulation technology, which can help solve these problems, is a further challenge.

Addisperse introduced its NC203C stabiliser, which is based on reactive chemistry, to rebuild molecular weight and boost physical properties in reprocessed and recycled HDPE compounds. The additive also improves process stability during extrusion and increases “melt uniformity and hot strength, dramatically improving foaming,” says Albee. For example, in a PCR HDPE milk bottle resin the addition of 2% NC203C allows foam density to be reduced from 0.89 to 0.61 gm/cc.
while reducing cell size and improving process stability, he reports. The NC203C additive also increases the strength and tensile properties of foamed or unfoamed extruded parts.

Addisperse is currently developing custom blowing agent concentrates containing NC203. A new nucleating agent concentrate is also in development based on a halloysite mineral filler. It is intended to allow shorter cycle times for injection moulding of recycled HDPE compounds and recycled polypropylene (PP).

**Riverdale Global’s +Restore Additive** is being used to improve properties of PP and HDPE PCR. Tests using regrind have shown that virgin-like properties can be obtained with 100% recycled PP or HDPE and a low level of the liquid additive (typically 0.1 to 0.5%). “Because the additive has an affinity for the base polymer, it acts as a lubricant, enhancing melt flow. In addition, the +Restore molecule has a functional group that readily reacts with pigments, fibres, or fillers in the resin, while a different segment of the same molecule is designed to couple with the polymer; as a result, it forms a strong bond between resin and filler without compromising flexibility,” said Jared Arbeter, Technical Sales Manager at Riverdale Global.

**Britec Solutions** has developed BTec REA360 Regrind Enhancing Additive, which the US additives company says improves physical properties, reduces odour and enhances processing performance of regrind and recycled resins. The additive (available in liquid and pellet forms) can be used by processors such as injection moulders and blow moulders with process scrap, and by recyclers that process mixed-melt grades and industrial feedstocks. “Data supports that physical properties of regrinds and recycled resins are replaced to levels similar to that of virgin grades in both polypropylene and polyethylene at very low use rates of 0.1 to 0.5%,” says the company.

Britec illustrates the benefits of the additive with the example of an unnamed recycler in Texas reprocessing HDPE PCR waste, which consisted of mixed colours and mixed MFI’s along with 2% carbon black. It says: “Testing concluded that with addition of 0.03% BTec REA360 to their regrind feedstock, critical physical properties were improved dramatically. The Izod impact strength showed a vast improvement of 37% and the flexural modulus was improved by more than 30%. Melt flow was enhanced and stabilised, contributing to more than 18% increase in production output.”

**Völker Spezialprodukte** bases its plastics additives on montan waxes and develops grades to deliver specific solutions for producers of virgin and recycled plastic compounds. The company’s Cevo range of additives has been developed to solve processing and application-related issues in many processing areas, with Cevo-process B-3680 and Cevo-process B-3690 said to be particularly effective dispersion additives for recycling of PCR HDPE/LDPE.

“Post-consumer HDPE/LDPE waste in most cases contains unwanted polymer particles and mineral – or other – contaminations that prove to be disruptive in the production of recyclates and that reduce the quality,” the company says. “Their proper dispersion as well as the dispersion of fillers – for example, carbon black – is mandatory in order to produce adequate recycling qualities, for example for injection moulding.”

The company says that tests have shown that carbon black can be “excellently dispersed” when Cevo-process B-3680 or Cevo-process B-3690 is added at 0.5% loading in virgin HDPE and at 2.0% in recycled HDPEs. “This was proven by a classical filter pressure test: the results show that the increase in pressure is significantly reduced. This proves the dispersing effect of these additives in the post-consumer compound,” says the company.
**Boosting PP**

While PP is a widely used polymer, it is not so widely recycled. However, initiatives are underway to change that. In July 2020, The Recycling Partnership in the US launched the Polypropylene Recycling Coalition, which aims to improve PP recovery and recycling in the country. The Coalition says PP holds a higher volume in the US recycling stream than HDPE and it hopes to improve capture and use of this. **Milliken**, which offers several PP additives for virgin and recycled PP, joined the Coalition in September.

“We are actively participating in initiatives that support broader use of polypropylene—especially recycled content—in packaging and other industries. Our additives already help enhance the quality and performance of recycled polypropylene, and membership in the coalition will add a new dimension to our multi-pronged approach to circularity,” said Allen Jacoby, Senior Vice president, Plastics Additive, Milliken & Company. Milliken’s DeltaMax Performance Modifiers are being used to improve impact resistance and melt flow properties in recycled PP.

Separately, Milliken’s Millad NX 8000 clarifier for PP received APR’s Critical Guidance Recognition, which recognises it as recycling-friendly, in July 2020. The company is building a manufacturing facility in South Carolina that it says will increase its clarifier capacity by 50% to meet fast-growing demand.

The VMO additive line from **Struktol** is designed for modifying melt flow of polypropylene. Available as a masterbatch that can be easily incorporated into the polymer or compound, the VMO products include a neutraliser to reduce odour in the final compound. “This VMO series can be very useful for manufacturers that want to reduce the amount of virgin or recycled PP of differing MFIs they keep on
hand. Having one type of PP resin of low MFI would allow for any number of higher MFI possibilities,” the company says.

Struktol says the VMO series products have been designed to allow for some PE present in the PP, in some cases upwards of 35%, adding that PE contamination is a common issue that PP recyclers encounter.

The grades in the series - VMO 058, VMO 108, VMO 208, VMO 308 and VMO 408 - range in activity from low to high. Struktol says the range of activities is helpful for recyclers as it allows for high percentage dosing in cases where weighing or dosing small quantities could be problematic.

**Compatibiliser update**
Compatibilisers are key for effective recycling as, after sorting, a recyclate feedstream may still be contaminated with materials that are incompatible with the main polymer. These incompatibilities can cause problems, such as delamination or poor physical properties, when the recycled plastic is processed into a new part. Compatibilising additives improve interfacial adhesion between, for example, a mineral filler and the polymer matrix, or between two incompatible polymers, resulting in a polymer blend with more uniform and better strength properties. Compatibilisers can also be used to improve recyclate from mixed plastics streams, such as where it is difficult to mechanically separate polymers.

**Ampacet’s ReVive compatibiliser masterbatch** contains a blend of additives designed to enable film manufacturers to re-use in-house scrap generated from edge trim of multilayer films as well as recyclate from post-consumer barrier films (these films contain multiple materials, such as PA, EVOH, and PE, and would not typically be recycled). The additive technology, however, allows the material to be recycled and reprocessed in the PE layer of film construction, explains Doreen Becker, Sustainability Manager at Ampacet. The company says independent tests have demonstrated improved optical properties using ReVive compared to PE/PA recycle without the additive. The masterbatch is part of the company’s R3 Sustainable Solutions portfolio.

Building on its long experience in styrenic block copolymers as compatibilisers and modifiers, **Kraton** has launched its CirKular+ portfolio of additives for use in PCR and post-industrial recyclate. Three products in the compatibilisation series and two products in the performance enhancement series are already commercially available, with samples currently being tested in potential applications, says Yuliya Streen, Global Marketing Manager at Kraton Corporation.

The new additives are designed to improve processing and properties of mixed-material recyclate streams. For example, the C2000 and C3000 additives can enhance properties such as stress cracking and impact strength in polyolefin PCR streams in which, particularly in the US, PP and HDPE are frequently commingled. The C1000 and C1010 compatibiliser additives are useful in polyolefin blends contaminated with PET, as well as for improving processability and properties of the mixed PCR stream (resin codes 3-7). The additives are also said to improve processability of recycled PET carpet fibres, which may contain PET, PA, PP, and fillers.

“The CirKular additives allow mechanical recycling of mixed PCR, which can increase circularity by reducing the amount of material going to incineration or chemical recycling,” says Streen. “We understand that the balance of performance and value is critical in recyclate because it competes with the low cost of virgin resin,” she adds.

Kraton’s C1010 is available in a grade that contains 50% post-industrial recycled block copolymers; this grade is a more affordable option but does not have the FDA clearance that the other grades offer. As compatibilisers, the additives are typically used at approximately 3-5wt% in the formulation but in some cases only 1-2% is needed to improve homogeneity of the blend, according to Streen.

**Kenrich Petrochemicals’** neoalkoxy titanate additives achieve compatibilisation through a different method to the more commonly employed silanes, maleic anhydride modified polymers, or block copolymers, claims President Salvatore J

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**CirKular+ additives from Kraton can enhance the performance of mixed PCR blends of HDPE and PP with PET**

*Source: Kraton*
Monte. He says the additive allows in-situ organo-metallic polymer catalysis that also couples and compatibilises interfaces.

The catalysis effect increases polymer flow and creates new co-polymers, rather than just alloys, Monte says. These copolymers have better mechanical strength than polymer blends, which allows use of higher levels of PCR.

The Ken-React additive is available in a master-batch pellet or powder form. Monte says that when compounding with the concentrate, melt temperatures should be maintained at about 10% lower than normal to regain the shear energy needed for reactive compounding. The additive can compatibilise any post-consumer recycle mixture, even with the typically wide mix of fillers, carbon black, and other contaminants.

“Any organic materials remaining after washing, such as oils, are compatibilised through proton coordination. And any calcium carbonate in the mixture is coupled to the polymer, which improves properties,” says Monte. The additive is said to work with any mix of polymers, including polyolefins, PA, and PET, which means it can be used to compatibilise a mixed PCR stream.

Imerys offers an extensive portfolio of mineral additives for plastics compounds and, for the recycling sector, has developed ImerLink, which is described as an engineered mineral specifically designed to compatibilise recycled blends of PE and PP. However, the company says that its talc products can also added to recycled plastic compounds (as well as virgin compounds) to restore mechanical performance. “As talc is chemically inert, thermally stable and is not affected by multi-pass extrusion, it can be recycled indefinitely without losing its initial properties,” says the company.

Adding talcs to recycled PP increases composite stiffness, according to Imerys, which says that ultra-fine talcs can be used at lower incorporation rates and provide the added advantage of increasing impact and scratch resistance. The company says it has a full range of talc grades with different fineness, enabling recycled plastics producers to select a grade that provides the optimum cost/performance ratio for their requirements.

Maximising value
One of the challenges in extracting maximum value from most post-consumer recyclate (PCR) is in the process of separating the mixed incoming stream—which will typically contain PET, HDPE, PP, PE, and other materials—into purer streams that can be processed and re-used. Many material recovery facilities (MRFs) are set up to sort out PET and
HDPE using automated near infrared (NIR) detectors. In the past, MRFs had difficulty sorting out PET and HDPE containing carbon black as it prevented NIR identification; now a range of new, black and dark coloured pigments that are transparent to NIR allow these containers to be recycled using existing NIR optical sorters.

A recent masterbatch line from Ampacet, called Silky Bliss because it provides a delustering effect, includes both darker and lighter colours that are transparent to NIR. Ampacet has also launched its AfterLife line of recycle-friendly colour masterbatches with a range of dark shades, including purple and dark blue, that are also NIR transparent. Its NIR-transparent black masterbatches – Rec-NIR-Black 1900302-EA and 4900147-E for rigid polyolefins – recently received the French COTREP certification for use in PP and HDPE. The company has also successfully completed third-party testing in the US with several grades of Rec-NIR Black using APR’s standards.

“We are aware of the pain points of our customers, and we’re offering solutions to make recycling more viable for them,” says Becker, who says sorting is just one issue they face. “Mechanical recycling compromises properties, can cause off odour, and causes optical issues, such as visible contaminants, haze, yellowing, and colour variation.”

In addition to odour scavenging masterbatches and off-the-shelf colour-correcting masterbatches for post-consumer recycling (such as the company’s masterbatches for green or blue-tinted PET), Becker says Ampacet offers colour-correcting masterbatches customised for each batch of PCR so companies can retain the colour integrity of their brand in formulations with PCR.

### Alternative options

An alternative way to sort recyclate is to embed a tracer into polymers that can later be detected in a recyclate sorting facility. Polysecure, for example, uses fluorescent markers and a specially-designed machine for tracer-based sorting.

Fluorescent marking is also used in Nextek’s NextLoopp system, which aims to produce food-grade recycled PP from post-consumer packaging using markers in labels to improve sorting. The PRISM [Plastic Packaging Recycling using Intelligent Separation technologies for Materials] technology employs a high-speed sorting system with UV light source to read the printed code.

The “Holy Grail” project, a collaborative venture promoted by P&G and supported by the European brands association AIM, use a digital marking technology from Digimarc to allow individual items of packaging to be identified and sorted by high speed vision cameras. The latest version of the technology was demonstrated last year by sorting technology specialist Tomra at its recycling plant at Mühlheim-Kärlich in Germany. The intention is now to move to an industrial pilot to prove the viability and business case for digital watermarking as a tool for larger scale sorting of packaging for higher-quality recycling.

In February 2020, BASF expanded its reciChain pilot project that uses blockchain technology and a digital tracer embedded in the polymer to track recycled material through the value chain. The pilot began in Brazil, and was expanded to British Columbia, Canada.