

**A**s the move away from non-recyclable and less sustainable packaging gathers pace, one polymer in particular stands out from the crowd. When it comes to recyclability, PET is emerging as a true plastics packaging champion.

As well as giving converters the opportunity to reduce their environmental impacts and emissions, PET and polyesters in general continue to grow their market share on account of them being so versatile, lightweight, safe, and transparent.

“Currently, PET is the fastest-growing polymer in masterbatches,” explains Matt Barr, vice chairman at Chroma Color. “This is due to its lower cost, and that it offers a great sustainability story. PET also gives processors the ability to produce a thin-walled product, reducing the overall packaging cost. In addition, processors can use it to manufacture multilayer packages to better protect products.”

But for all the sustainability appeal of PET, and to a similar extent PP, the increase in demand for post-consumer recycled (PCR) feed-stock means sourcing quality raw materials can be far from straightforward.

If the raw material falls short on quality, processors can find it difficult to achieve the desired aesthetics and colour consistency required from commercial PCR resins. To address this, makers of colourants, additives and masterbatches are prioritising the development of purer, safer, and more robust products, in an ongoing drive to bring recycled plastics up to a similar quality as their virgin counterparts.

Corporate sustainability goals, along with pressure from consumer and environmental groups, are driving increased demand for resins with higher PCR content – especially within commercial packaging applications. Consequently, Barr at Chroma Color expects plastics processors to expand their focus on colour solutions for PCR resins throughout 2021 and beyond.

“Each resin family requires unique colour or additive formulation adjustments to ensure the development of an acceptable finished package on shelf,” he explains. “Chroma Color has an extensive and successful track-record of providing additive concentrates, including processing aids, impact modifiers, UV and other stabilisers, which help to revive PCR resin aesthetics while maintaining physical properties.”

Having made multi-million dollar capital investments in each of its six US plants over the past five years, Chroma Color recently launched a next-generation version of its UltraPET colourants range, which is specifically designed to be used with recycled PET. Barr says the pellet range enables brand owners to achieve their sustainability goals by using higher levels of PCR content.

# In pursuit of purity

Makers of colourants, additives and masterbatches are developing ever more innovative products and technologies to overcome a shortage of quality raw materials in the recycled PET market. **Noli Dinkovski** reports

“We recently had a producer of high-quality thermoformed trays ask us for help in overcoming the difficulties inherent in PCR base materials,” Barr says. “Our solution was to provide UltraPET highly-loaded colour concentrate at a usage rate of just 0.7-1 per cent.”

Colourants supplier BASF Colors & Effects says its biggest challenge is to create packaging that fulfils the new ‘circularity by design’ principles, while at the same time achieving an attractive, high-quality package. Circularity by design requires that a package is repurposed in order to withstand processing multiple times, while maintaining its integrity.

Marc Dumont, the company’s head of global industry management pigments for plastics, suggests there is an opportunity to meet these sustainability ambitions by providing safer and more resilient colourants.

“Our pure colourants, like Irgazin Red K 3840 UP, can meet safety demands by starting with a higher purity profile that mitigates the appearance of non-intentionally added substances during reprocessing,” Dumont says. “Along the same lines, our robust, stable colourants like non-warping preparation Eupolen PE Blue 69-1501 directly improve

structural integrity, which is a prerequisite for mechanical recycling.”

According to Dumont, the multiple processing steps needed to break down the polymers and additives in mechanical recycling is an “unpredictable canvas” on which to start building up a new product. That’s why, he argues, it’s even more critical to start with good-quality, reliable colourants with recycled plastics.

“Furthermore, a big challenge is to maintain the mechanics of the polymer,” he says. “When not dispersed correctly, pigments are known to negatively influence mechanical properties – even with virgin polymers. Our preparations help mitigate the negative impact to mechanics, since they will easily disperse into a variety of polymer substrates and withstand more processing overall.”

Elsewhere, through its subsidiary MyReplast Industries, Italian firm NextChem has developed upcycling technology that combines mechanical recycling with chemical processing.

Covering both PE and PP, each MyReplast compounded granulate is formulated to fulfil specific customer requirements and quality standards. They are available in fully-formulated colours, in standard black, and in different



*Left and above: The unpredictability of building new products from recycled polymers makes the use of purer and more robust colourants even more critical, says BASF Colors & Effects*

*Below: LyondellBasell's new Advanced Solutions masterbatch range is tailored towards recycled solutions, renewal of resin content, and design for recycling*

shades of grey as a basis for further colouring with masterbatches.

For NextChem, the key to consistent quality and purity is the efficient and effective selection and separation of plastics waste by combining state-of-the-art polymer and colour identification techniques. It says the finishing touch, the actual 'upcycling', is achieved through the recombination of selected plastics waste streams and chemical modification with compatibilisers, stabilisers and colourants in a formulative compounding step.

The company claims "extraordinary" batch-to-batch consistency can be achieved through rigorous control of each process step, and that a compounding line offers options for intervention when it comes to adjusting the final composition of the polymer blend.

"Although big steps forward have already been made, several challenges still need to be addressed – in which additive packages and masterbatches are expected to play a fundamental role," says a spokeswoman for NextChem. "The main challenges that mechanical recycling faces today are the inclusion of con-

taminants, odour and emissions requirements, aesthetic requirements such as colour and transparency, and compliance with food-contact requirements."

Perhaps the biggest hurdle for the wider acceptance of mechanically-recycled post-consumer plastics, at least from a consumer point of view, NextChem suggests, is the aesthetics – especially in the packaging industry, where branding is at the basis of any market strategy.

Neutral or transparent end-products can only be achieved using neutral and transparent feedstock, the

company insists. Even in post-industrial waste, only a minor share of the plastics are neutral, white, bright or transparent, and these sought-after treasures already come at a high price, NextChem adds.

The company claims the future of mechanically-recycled plastics products, therefore, will not be a brightly-coloured one.

"To fully exploit the available post-consumer plastics waste available, also the multi-colour part of the plastic waste needs to be used," the spokeswoman says. "Customers and brand owners will have to get used to less radiant and bright colours, and more opaque pastel tones."

While this view may be at odds with a number of colourant and masterbatch makers, NextChem also believes it offers a great opportunity for them to distinguish new, more sustainable mechanically-recycled products through targeted rebranding. ▶







“For producers of colour masterbatches this presents a challenge but also a new opportunity as, depending on the colour selection of the multi-colour plastics waste being recycled, masterbatches need to be designed for colouring grey-tone or other base-tone colours, rather than starting from a pristine neutral or white base material,” says the spokeswoman.

In fact, this trend has already begun, she adds. “MyReplast Industries is seeing a strong appetite for light to mid-grey polymer PE and PP products of good quality, to be used for further colouring at the press with full-colour masterbatches designed to meet specific colours based on exactly that base-tone.”

Clariant is another company eyeing what it considers to be the enormous potential in sustainably-sourced products and PCR polymers. The Swiss chemicals firm concurs that the main issue for the packaging designer and the masterbatch producer is to create the desired bright and vibrant colour when using PCRs. However, Philippe Lazzerme, head of marketing for plastics at Clariant Pigments, believes the challenge is not in creating new pigments – with the exception of black – “as chemistry is chemistry”. Instead, he says the real issue goes back to finding and establishing a new, more sustainable raw material source.

“The reactions and processing equipment used to make ester wax, like our Licocare RBW Vita waxes, from a polyol and aliphatic acids, are already established,” Lazzerme says. “But it comes from a sustainable source. In the case of Licocare, the raw materials are extracted from discarded rice bran hulls. As a bonus, the new, sustainable source actually makes a cleaner product that is less yellow and more thermally-stable to colour shifts.”

As sustainability commitments gain momentum, Lazzerme understands that some brand

*Circularity is becoming ever more important in masterbatch making*

*Photo credit: The Shepherd Color Company*

owners might refrain from using colour, thinking that their packaging will be easier to recycle. But once again, he is adamant that if the right pigments are selected, recyclability will not be affected.

“The makers of masterbatches, compounders, and original equipment manufacturers are asking for products that help with recycling – namely polymer and filler compatibilisers, stabilisers to protect the integrity of the final products from the extra heat histories, and viscosity-modifiers to make recycled plastics flow as well as, or even better than, conventional compounds or polymers,” says Lazzerme. “This is a key focus of our R&D.”

With the use of PCR polymers growing, Clariant suggests it is becoming ever-more important to make sure that the colourants used are safe and do not release any harmful substances during, or after, the recycling process.

Safety is also high on the agenda for additives maker Palsgaard. The Danish firm says masterbatch makers are looking to replace products with a questionable safety profile while maintaining the same, or better, efficiency. Here, the company has a clear advantage in

that many of its additives are also used in food.

Palsgaard’s Einar range of polymer additives is predominantly used in polyolefins, PE and PP, where they serve as anti-static and anti-fog additives in films and injection moulded products. Global industry director Ulrik Aunskjær says the company’s development focus is offering “safe chemistry” to the industry. Within additives, that includes presenting an alternative to amines.

“Additives are being scrutinised and re-evaluated based on both recyclability and food safety,” says Aunskjær. “Screening and approving new additives is a time-consuming and resource-heavy exercise, which is why any new additive needs to meet the requirements of tomorrow – it is not enough to fulfil the bare minimum of today.”

As well as being made from edible vegetable oils, Aunskjær claims Palsgaard’s additives are added at very low concentrations due to their high efficiency, which – along with the decomposition into non-dangerous substances – makes them perfectly suitable for packaging that is meant to be recycled.

Masterbatch maker LyondellBasell is another company focused on the handling of recycle. Last year, it launched its Advanced Solutions masterbatch range that is tailored towards recycled solutions, renewal of resin content, and design for recycling.

Shaloo Baweja, marketing manager for masterbatch at LyondellBasell, says processing with recycle can be improved by adding a compatibiliser to allow a higher content of different polymers to be blended together. Meanwhile, thermal stabilisers and polymer processing assist in better controlling the rheology when using recycle.

“The aesthetics of the end product can also be improved with the reduction of yellowing by

## NIR-detectable pigments make progress

One major advance in the recyclability of plastics in recent years has been the development of infrared (IR)-optimised pigments. These give aesthetically-pleasing 'black' colours, but are still detectable by automated recycling sorting machines.

By working together, detection devices including near-IR (NIR) spectrometers, vision systems, laser object detection and metal sensors, can recognise virtually any and all materials in the average materials recovery facility's incoming mixed stream.

Mark Ryan, marketing manager at The Shepherd Color Company, says that while a jet black is often desired for first-use packaging, when it comes to colouring post-consumer recycled material, the colouring strength of pigment to overcome inherent and variable colour becomes the primary driver. This can lead to two versions of the IR black pigments, optimised for the

specific application.

"Considering the amount of black plastics used in food packaging, and the increase in food delivery and take-out, the use of our [Arctic branded] IR Blacks can have a significant impact on the sustainability of plastics," says Ryan. "Shepherd Color pigments, due to their inorganic nature, are highly heat-stable and non-migrating, so that they give consistent colour, even after multiple extrusions."

A subsidiary of Akro-Plastic, AF-Color is another masterbatch maker that has recently developed NIR black pigments. AF-Color IRD is carbon-free and meets the requirement of the 2019 German Packaging Act, which sets requirements around the compatibility of packaging with automated waste separation.

"We offer every kind of masterbatch – black, coloured as well as additive concentrates," says AF-Color sales director Dirk Schöning. "We will be happy to test the detectability of the material combination you want –

every colour can be supplied without carbon black."

Masterbatch maker Sukano believes the development of NIR-detectable black pigments has been a major step forward for the packaging sector, adding that it has been at the forefront of this effort with its NIR-Black detectable masterbatch.

Sukano also claims to have gone the extra mile, in ensuring colourants other than black can be detected under NIR light at sorting centres. It says that, through its analytical labs and colourist expertise, it has broadened the NIR-detectability concept so that any coloured product can be designed to meet this requirement.

"We recently took another step forward by confirming the recyclability of light-barrier white opaque PET bottles – and, most importantly, offering an alternative end-of-life that goes back into its original application," says Alessandra Funcia, head of sales and marketing at Sukano.

adding thermal stabiliser and blue colour toner," says Baweja. "Odour absorbers can be added to reduce the odour associated with using recycle. In addition, the reduction of gels and agglomerates by adding thermal stabilisers and compatibilisers can improve the aesthetics and quality of the end product. Recyclers can also add these masterbatches to the compounding process, which improves the quality of the recycle they sell into the market."

When selecting a masterbatch supplier, Baweja believes it's important to seek a company that can guide in product selection as well as fulfilling quality requirements. "LyondellBasell provides premium quality control and product stewardship support," she claims. "We tailor our products to meet the performance needs of our customers."

Further advice comes from Ken Malin, director of global sales and marketing at Polyvel. He stresses the importance of understanding the way in which additive masterbatches can add functionality to end products, allowing for differentiation from the competition.

Polyvel provides a variety of additives for packaging, including anti-fogs for PP and PE, physical property-enhancers for polylactic acid, and impact-modifiers for injection moulded or extruded parts. It also supplies everything from clarifiers, internal lubricants, plasticisers, and

process aids to anti-blocks, anti-statics, stabilisers, and nucleators.

"For recycled packaging, we offer melt-flow modifiers that allow reproducers to increase the value of their products," says Malin. "The latest product is VF-P08, a highly efficient anti-fog for hot fog applications, and VF-P05 for cold fog applications."

While it's evident that the demand for recycled packaging represents a major challenge for makers and users of colourants, additives and masterbatches, what is also clear is that the products and technologies available on the market today can offer solutions for every conceivable problem – as Malin suggests: "We've been producing additive masterbatches for more than 35 years and, while there are always challenges, none are insurmountable." **P**

### More information from:

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