Pushing pigments to perform

IMAGE: LANXESS

Pigment makers are producing brighter and more stable pigments that can withstand higher processing temperatures and multiple processing cycles, as well as meeting sustainability goals. Jennifer Markarian reports

Recent acquisitions in the pigment sector have created broader product offerings for pigment users and promise to see the pace of innovation accelerate. In June of this year, for example, Germany-based Heubach Group announced an agreement – in partnership with private investment firm SK Capital Partners – to acquire Clariant's Pigments Business. The deal is expected to close in the first half of 2022 and the combined business will operate under the Heubach name.

Family-owned **Heubach**, which has been producing pigments for more than 200 years, said the businesses share "a complementary product portfolio and a regionally compatible asset footprint" and pledged to continue to prioritise product development.

In the same month another long-pending pigments deal was completed as Sun Chemical, a member of the DIC group, finalised its acquisition of BASF's global pigments business, BASF Colors & Effects. That was originally announced back in 2019 but had been held up by the regulatory process. The newly combined businesses will offer a broader portfolio in effect pigments, inorganic pigments, organic pigments, specialty dyes, and pigment preparations.

"This acquisition enables us to combine the technological capabilities of both companies to increase new value creation as expected from the leading company in the pigment business, including in the increasingly critical area of sustainability," says Christof Kujat, Head of Global Technical Industry Management Plastics Germany, Sun Chemical.

Meanwhile, pigments supplier DCL Corporation acquired Sun Chemical's Bushy Park manufacturing facility located in South Carolina in the US on July 31, 2021. The deal includes the specialty pigment families of perylenes and quinacridones. These provide high chromaticity, high durability, high heat stability and transparency for applications includ-

Main image: Extended use periods, higher processing temperatures, multiple processing cycles, and regulatory changes are some of the factors driving pigment development

Right: Clariant's PV Fast pigments are produced from renewable raw materials and some are suitable for compostable applications

ing automotive, industrial coatings and engineered plastics markets, the company says. The sale of the Bushy Park business addresses competition concerns raised by regulators over supply of these pigment types.

Sustainable interest

Beyond this recent spate of M&A activity, the pigment market is seeing increasing interest in sustainable products and applications. **Sun Chemical**'s Kujat says many polymer processors are looking at bio-based and compostable formulations as part of a move to more sustainable solutions. Compostable products can be challenging as all ingredients, including colorants, must comply with standards for composition, disintegration, biodegradation and ecotoxicity. Within the European Union, EN 13432:2000 is the standard for compostable and biodegradable packaging. It is connected to the European Directive on Packaging and Packaging Waste (94/62/EC) and all plastic packaging and materials going into such packaging can be certified to meet the standard.

"We have a product range that covers the full colour space aimed at colouring compostable plastics. These pigments must meet regulatory requirements for low heavy metals and low NIAS [non-intentionally added substances]. Although end-use colorant compositions are typically found at low percentages in final formulations, high purity is required by many brand owners. Even low levels of detected NIAS can be problematic in the final article," says Kujat.

In addition to the current offering of EN 13432 certified pigments, Kujat says the company is working on an optimised blue pigment preparation to allow higher dosage and more freedom in colour matching for compostable and biodegradable plastics. He says that the colorant under development will allow a much higher dosage than standard phthalocyanines and is based on an EN 13432 certified pigment.

The **Clariant Pigments** business has also been active in developing pigments that can go into compostable applications. The company said earlier this summer that nine of the products in its PV Fast and Graphtol pigment ranges fully comply with EN 13432 standards (when not used above the maximum concentration in the final plastic product) and are certified by TÜV Austria with the OK compost industrial label. The organic pigments that are now certified offer bright colours – including yellow, orange, red, pink, blue and green – for biodegradable plastics suitable for industrial composting.

Having organic pigments certified for EN 13432

IMAGE: CLARIANT

is a key development. Some common organic colorants that can produce bright colours are not biodegradable and some contain heavy metals, according to Tony Bruce, Performance Chemicals Sales Manager at **Cornelius**, a UK-headquartered European chemical supplier with a product range that includes pigments for plastics. "Bright colour packaging is precisely an area that is starting to be penetrated by compostable plastics," he says.

Inorganic pigments for compostable or biodegradable polymers must also be chosen carefully. **Ferro** – which announced in May this year it was to be acquired by American Securities portfolio company Prince International Corporation for around $2.1bn – says that some of its food contact grade pigments, including ultramarine and iron oxide pigments, fulfill the requirements of EN 13432.

Heavy metals

According to Stefano Bartolucci, global market segment manager for plastics in the Inorganic Pigments (IPG) business unit at **Lanxess**: "Due to regulated heavy-metal levels, certain pigment classes cannot be used for colouring biodegradable plastics made from renewable or fossil resources. This is the case with, for example, nickel, chrome or copper-based pigments."

Lanxess says that its Colortherm brand of iron oxide pigments are, however, almost completely free from heavy metals. The company's lab service can measure heavy metal content to help customers determine maximum pigment concentration allowed in biodegradable or compostable polymers. "The limits for biodegradable plastics can be reliably maintained, even with a high pigment content," says Bartolucci.

Regulations covering health and safety and sustainability, particularly in the EU, continue to

IMAGE: LANXESS

Above: Analysis of a Colortherm iron oxide pigment in the Lanxess laboratory

evolve. "The application of pigments in plastics will, like every other branch of chemistry, be affected by the legal and regulatory changes connected with the EU chemicals strategy for a more sustainable and toxic-free environment," says Bartolucci. That strategy was approved in March 2021. He also highlights planned amendments concerning European food contact and toy regulations as other regulatory examples likely to have an impact on inorganic pigments, although he says he is confident that the company's inorganic pigments will continue to be able to be used safely.

Pigment requirements are not quite so demanding in the area of bio-based polymer compounds – which is another trending area in sustainable solutions – as they do not need to meet composting standards and are typically not processed at such high temperatures as conventional fossil-based polymers. Users can select from a wider range of pigments but food packaging or other food-contact uses require approval by the relevant authority.

Thermal stability

The higher processing temperatures of engineering plastics makes colouring a more challenging task, with heat stability a decisive factor, according to Bartolucci. "In the case of organic pigments, high processing temperatures often lead to accelerated decomposition, but inorganic alternatives can be subject to colour variations at temperatures above 180°C," he explains.

Bartolucci says Lanxess has recently expanded its Colortherm Yellow inorganic pigment range for heat-resistant, high-performance plastics. Manufactured using the company's proprietary Laux produc-

IMAGE: SHEPHERD COLOR

Above: New from Shepherd Color, Oxide Green 30C659 offers very good IR reflective properties

tion process, which results in increased heat stability, the new Colortherm Yellow 5 pigment is based on iron oxide and Colortherm Yellow 26 is based on zinc ferrites. Both are designed for cost-effective colouring in the 220-260°C temperature range.

The new grades are intended to fill the temperature performance gap between regular pigments and the company's higher performance Colortherm Yellow 20 and Colortherm Yellow 30, which are based on iron oxide and zinc ferrite and are heat stable to 300°C. "With equally high colour strength at the same colour space, they offer plastics manufacturers and processors an excellent compromise," says Bartolucci.

He adds that this Colortherm Yellow range covers the colour spectrum of light, saturated yellow shades as well as orange tones. The colour strength of the zinc ferrites – Colortherm Yellow 26 and Colortherm Yellow 30 – is up to 20% higher than comparable products due to their manufacturing process, claims Bartolucci. With higher colour strength, a corresponding lower level of pigment addition is required to colour the plastic.

Oxide Green 30C659 is a new dark green colour pigment from **Shepherd Color** that is said to offer excellent infrared reflective properties and to be suitable for use in a range of plastics applications, particularly thin films and fibres. Part of the company's Dynamix ED pigment line, Oxide Green 30C659 is specially processed to provide a tight particle size distribution and is treated to greatly improve wetting and dispersibility, according to Mark Ryan, Marketing Manager at the company.

"In thin films [these characteristics] reduce the chances of outsized or undispersed particles causing defects or streakers," Ryan says. "In fibres the overall improved dispersion reduces filter-pack values and leads to less defects."

Another recent addition to the Dynamix ED line is Yellow 30C133, which is a PY184 bismuth vanadate yellow that complements the company's NTP Yellow and RTZ Orange pigments. Ryan says this pigment range offers "a complete coverage of the yellow colour space with high-performance pigments with high-heat stability, excellent dispersion properties, and bright chromatic colours."

Ferro recently introduced its 6000 Series, a high dispersibility (low Filter Test Value) range of red iron oxides designed for film, fibre and other demanding applications, according to Global Marketing Manager for Plastics at Ferro, Daniel Lladó. He says that the company is also currently working on encapsulation and surface modification technologies to enhance pigment properties such as processability, heat and weather-fastness, as well as resistance to chemicals.

Pandemic effects

Over the past 18 months, the Covid pandemic has seen a huge increase in the use of sanitising solutions on surfaces, presenting pigment users with a new potential challenge of colour fading. **Sun Chemical** says it has seen an increase in requests to test colour stability, leading to the decision to carry out a study of several organic pigments by directly exposing them to sanitising solutions. Global Plastics Technical Lab Manager Michael Willis says: "This study provided a comparison of colour stability for chips versus dry pigment exposure to four sanitising solutions. The results were impressive, showing little to minimal catastrophic failure of colour, especially in the high-performance pigment category."

Mechanical recycling plays a key role in reducing plastics waste. However, it generates multiple challenges, one of which is the need for robust colorants that are able to withstand the multiple heat cycles that post-consumer recycle (PCR) may be subjected to.

Multiple processing steps with high temperatures may potentially lead to material degradation, explains Sun Chemical's Kujat. "If PCR contains chemical substances of concern, like degraded impurities, it is limited in its ability to replace virgin polymer. Therefore, lower quality PCR could hinder the industry in its target to achieve high recycled content in products. That's why we see a trend in starting with purer, safer, and more robust colorants for plastics to ensure further recycles," he says.

Sun Chemical offers a portfolio of pigments that are suitable for mechanical recycling of polyolefins, including HDPE, Kujat says. These include the Eupolen and Microlen product ranges (formerly BASF brands) that are claimed to offer very good dispersion, low warping and improved pigment

IMAGE: FERRO

Right: The high tinting strength of ultramarine pigments can be effective in enhancing aesthetics in PCR

purity. The Sunfast grades PB15:3 249-7900 and PG7 264-7700 are also said to be well suited for use with PCR, offering high tinting strength and easy dispersion.

Likely moves to prolonged lifetime and reuse of plastics are also seen as opportunities for pigments that provide high heat fastness and weatherability at **Ferro**, according to Lladó. And, with the increased use of PCR, pigments will also be needed that can deliver more homogenous colours.

Lladó says that Ferro's ultramarine pigments can enhance the bluish under-shade of black or greys and avoid yellowness in whites or creamy shades, which is useful in homogenising the colour variation that might arise from different sources or batches of PCR. He says the company's Nubiperf SRD ultramarine blue provides a high tinting strength with enhanced red undertones and is very effective in improving the aesthetics of recycled material.

Sorting out NIR

Another key aspect of recycling is the ability of black-pigmented materials to be sorted by resin type using near-infrared (NIR) scanners as conventional carbon-black pigmented plastics absorb infrared waves rather than reflect them. NIR or IR-reflecting or "NIR visible" black pigments have been introduced over the past few years as an alternative. In the US, the key driver for use of NIR-visible pigments is that black parts that cannot be sorted become a lower-value material stream. That is also a key driver in Europe, but the need for sortability is also embedded in the plastics packaging waste directive.

Below: With an NIR reflectance of 20%, Bayferrox 303T Black allows waste sorting using NIR detection equipment

Sun Chemical's Kujat says that, European regulations are increasingly covering more industries and extending to environmental impact during manufacturing as well as at end-of-life. The need to redesign pigments used in packaging for NIR sortability is one result of this. The company's Sicopal Black K 0098 FK (a former BASF brand) is an inorganic black pigment intended for recycling with NIR detection. "We recently extended from 2% use level for conditions of use A-H to include condition J, opening the door for microwaveable and oven ready food packaging," he says.

IMAGE: LANXESS

Lanxess's Bartolucci says the company's Bayferrox 303 T black pigment has an NIR reflectance of 20%, which enables efficient resin identification and sorting using NIR detectors.

Demand for NIR sortable pigments is also seen as a developing trend at **Shepherd Color**. "We are seeing a lot of interest in this technology because of the increased focus on recyclability and sustainability," says Ryan. The company offers Black 10P925 for deep black colour in virgin material and Black 10P950 for PCR, which needs higher colouring strength. "What we have been working on is the use of other pigments with these IR Black pigments to optimise the dark masstone colour," he says.

Meanwhile **Ferro**'s NIR reflecting pigments include Pigment Brown 29 (24-3950FCP) and Pigment Black 33 (Nubifer NB-803K FCP), which have both been approved by FDA as food-contact materials since June 2020, according to Lladó. He says current work in this area aims to improve performance of the pigments, such as through the addition of ultramarine blue (UMB) to increase jettness and add bluish shades (UMB is transparent to NIR and will not interfere with sorting).

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- **www.sunchemical.com**
- **www.clariant.com**
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