Automotive Coatings: CREATING EXCITEMENT WITH EFFECT PIGMENTS

By Cynthia Challenger, CoatingsTech Contributor

Regardless of the end-use application, special effect pigments provide a differentiated appearance. This is certainly true in the automotive industry, where they are used in coatings applied to both the interior and exterior of vehicles. Shifts in customer color and appearance preferences drive the use and development of effect pigments, as do developments in coatings technology and application processes. High sparkle finishes and faithfully chromatic colors on car bodies and mirror-like finishes on interior components are increasing in popularity and driving the use of glass flakes, colored aluminum, and aluminum pigments with a much finer particle size. Pigments also need to provide the same appearance in coatings with thinner and/or fewer layers while exhibiting increased durability.

Creating a Unique Look

Coatings formulators work directly with pigment suppliers to develop and commercialize new specialty effect pigments to generate exciting color spaces that accentuate the bodylines of new vehicles. Effect pigments are the fastest growing segment of the high performance pigment market, and in 2015 were present in 70% and 65% of automotive colors for new builds in the Americas and Europe.

Effect pigments are the fastest growing segment of the high performance pigment market, and in 2015 were present in 70% and 65% of automotive colors for new builds in the Americas and Europe.

While neutral colors such as white, black, and silvers still dominate most of the automotive color palettes, deep, rich, highly chromatic blues, greens, oranges, and reds have begun to find their place in the automotive world as well,” says Jason Kahla, manager
of technical service & product application with Sihlersine Manufacturing. “Special effect pigments that provide brilliance and pop” can help to create a look that stands out among the sea of color monotony and appeal to those consumers who wish to stand apart from the crowd.”

“With a shift away from achromatic colors to a more sophisticated, balanced palette. For some applications, designers are seeking to create a value-added appearance by increasing the brilliance and reflectivity of metallic finishes while maintaining a smooth, non-sparkling appearance, according to Michael T. Venturini, global marketing manager, Coatings, Sun Chemical Performance Pigments.

To achieve the desired appearance, most pigment flakes must be oriented in a specific manner within the coating. Their particle size also impacts the way they interact with light, larger parti-
cles provide more sparkle and brilliance, but the dimensions are limited to avoid impacts or gloss and other appearance properties. The industry is pushing the limits in this area, accord-
ing to Paul Czorniak, technical manager with the Color Excellence Group of BASF Coatings, and is seeking as much colorfastness as the color can allow yet still providing a smooth and glossy look. The rheology of effect pigments, particularly in high solids, solvent-based systems, also influences their final appearance properties. On the other hand, there is a desire for smoother glass-like finishes, which has led to greater use of finer parti-
cle sizes to help deliver a quality liquid appear-
ance in many colors, according to Bronin. However, smoother finishes that give strong travel (bright face and dark side-tone) are difficult to achieve with an external ball application (preferred for its greater transfer efficiency), which tends to make flakes stand up and give a more granular appearance, according to John Book, product line manager with Vals.

“Small particle sizes and size distributions also have a negative impact on color capability and metallic orientation, so such advances are far from simple,” asserts Frank Malmon, manager of pigment and color technol-
gy for the Color Development group of PPG Automotive OEM Coatings.

The shape of the vehicle has a significant impact on which effect pigments are used. For instance, flat/flat effect pigments that give coatings brightness will be dictated by the type of coating and coating application systems. For external applications, the compact appli-
cation processes (primerless coating systems, three-coat basecoat-inter-
grated processes) are used today on exterior car bodies. This involves the appli-
cation of only a basecoat and topcoat over the e-coat. “Effect pigments in these systems must provide hiding power and exhibit high chemical, moisture, and UV-resistance properties in order to protect the e-coat,” he says. In addition, coating formulations now have higher pigment concentrations in smaller volumes, and the coating layers are either thinner or the flash times eliminated. “Both scenarios have a negative impact on coating appearance and require extensive reformulation of coatings to meet end-use expectations,” notes Thomas A. Cook, global manager for color and process technologies with PPG Automotive OEM Coatings.

The trend towards thinner coatings has driven the development of new low-aspect-ratio effect pigment particles that provide brilliant colors in high-chroma hues with good hiding and gloss. Generally, the use of smaller particle sizes will provide a smoother appearance with good gloss. However, to achieve the most chromatic color effects and good chip behavior, manufacturers must consistently deliver highly optimized particle size distributions, comments Mike Crosby, market segment manager for BASF’s Global Automotive Automotive OEM Pigments Business Unit. New lightweights substrates have surface-roughness and adhesion issues that also require coating reformulation, according to Bill Eberle, director of tech-
nology acquisitions for PPG Automotive OEM Coatings. On a positive note, Brown points out that ultra-smooth primers have helped to achieve a better glass-like appearance by creating a smoother base on which to paint. Such integrated processes are just one response by the automotive industry to improve sustainability, reduce the use of hazardous materials and its carbon...
of technical service & product application with Sherline Manufacturing. “Special effect pigments that provide brilliance and ‘pop’ can help to create a look that stands out amongst the sea of color monotony, and appeal to those consumers who wish to stand apart from the crowd,” he adds. Alles Brown, advanced development and mastering manager in the Color and Material Design group of Ford Motor Company, agrees that, while there will always be niche colors for special applications, overall there seems to be a balancing of colors to round out a complete selection, with a shift away from achromatic colors to a more sophisticated, balanced palette. For some applications, designers are looking to create a value-added appearance by increasing the brilliance and reflectivity of metallic finishes while maintaining a smooth, non-sparkling appearance, according to Michael T. Venturini, global marketing manager, Coatings, Sun Chemical Performance Pigments.

To achieve the desired appearance, most paint flakes must be oriented in a specific manner within the coating. Their particle size also impacts the way they interact with light; larger particles provide more sparkle and iridescence, but the dimensions are limited to avoid impact or glass and other appearance properties. The industry is pushing the limits in this area, according to Paul Czerniak, technical manager with the Color Excellence Group of BASF Coatings, and is seeking as much colorfastness in the color as the color can allow yet still providing a smooth and glossy look. The rheology of effect pigments, particularly in high solids, solvent-based systems, also influences their final appearance properties. On the other hand, there is a desire for smoother, glass-like finishes, which has led to greater use of finer particle sizes to help deliver a quality, liquid appearance in many colors, according to Brown. However, smoother finishes that give strong travel (bright face and dark side-tone) are difficult to achieve with the use of smaller electrons, which tend to make flakes stand up and give a more granular appearance, according to John Bink, product line manager with Vals. Smaller particle sizes and size distributions also have a negative impact on color capability and metallic orientation, so such advances are far from simple,” asserts Frank Malmont, manager of pigment and color technology for the Color Development group of PPG Automotive OEM Coatings.

The shape of the vehicle has a significant impact on the effect pigments used. For instance, fine, bright effect pigments that give coatings brightness with higher travel are preferred for vehicles that have a more interesting, free-forming style, while for trucks, which are more slab-sided, coatings with more opaque effects are frequently used, according to Jerry Koeringmarck, who was manager of technical color design for PPG Automotive Coatings in North America. “For many of the new car designs targeting a younger consumer base, there is a push towards highly chromatic colors that employ colored aluminum pigments, mica pigments, glass flakes, and interference pigments,” says Koeringmarck. He also notes a shift in the wheel coatings market, where black is becoming more popular at the expense of traditional silvers for car interior trim parts, chrome-like coatings are used to create a value-added look and add lustrous properties to simple plastic and other components. Auto parts and accessory manufacturers (AAP) also tend to be dominated by silvers, and many of these coatings contain pigments manufactured using physical vapor deposition (PVD) processes. In addition, many interior coatings are intended to provide attractive lustrous properties. Because they are often single-layer systems, the effect pigments must have high resistance to body oils, perspiration, lotions, cosmetics, and other chemicals, according to5. Kramers, vice president for global key account management with Eichhammer. He also notes, in these applications, liquid coatings compete with powder coatings and alternative technologies such as in-mold decoration with felts.

**Finding functional and sustainable solutions**

Numerous other factors influence the choice of effect coatings beyond the appearance a designer wishes to create. In addition to providing an emotional response in car buyers, effect pigments are often expected to serve multiple additional functions, according to Kramers. The functional performance will be dictated by the type of coating and coating application systems. For external coatings, the compact application processes (primerless coating systems, three-coat-tri-layer, integrated processes) widely used today on exterior car bodies involve the application of only a basecoat and topcoat over the e-coat. “Effect pigments in these systems must provide hiding power and exhibit high chemical, moisture-, and UV-resistance properties in order to protect the e-coat,” he says. In addition, coating formulations have higher pigment concentrations in smaller volumes, and the coating layers are either thinner or the flash time is eliminated. “Both scenarios have a negative impact on coating appearance and require extensive reformulation of coatings to meet end-use expectations,” notes Thomas A. Cook, global manager for color and process technologies with PPG Automotive OEM Coatings.

The trend towards thinner coatings has driven the development of new low-ratio effect pigment particles like colored, silver dollar aluminum pigments that deliver brilliant metallic finish in high-chroma hues with good hiding and gloss. Generally, the use of smaller particle sizes will provide a smoother appearance with good gloss. However, to achieve the most chromatic color effects and good flop behavior, manufacturers must consistently deliver highly optimised particle size distributions, comments Mike Crosby, market segment manager for BASF’s Global Automotive OEM Pigments Business Unit. New lightweight substrates have surface-roughness and adhesion issues that also require coating reformulation, according to Bill Eiken, director of technology acquisitions for PPG Automotive OEM Coatings. On a positive note, Brown points out that ultra-smooth primers have helped to achieve a better glass-like appearance by creating a smoother base on which to paint. Such integrated processes are just one response by the automotive industry to improve sustainability, reduce the use of hazardous materials and its carbon footprint.
High chroma, multilayer effect pigments, newer shades of colored aluminum flake, and glass flake pigments have given color formulators the tools they need to achieve head-turning color shades that excite consumers and inspire pigment formulators to dig even deeper into what variations of these new technologies can yield.

ADVANCES IN PIGMENT TECHNOLOGY

In addition to the development of effect pigments already mentioned, pigment formulators have responded to changing coatings formulation and application trends and technologies with a variety of technology advances of their own. Dieter Mirquardt, manager of color matching, Europe, with PPG Automotive OEM Coatings notes two key advances. The first is process improvements in the manufacturing of synthetic micas that make them more affordable and will drive a shift away from natural micas and lead to the development of more chromatic colors and improved appearance. The second is new processes to generate colored aluminum based on inorganic layers and brighter aluminum feedstocks that offer stylists higher chroma and color saturation. Thiin, silver-dollar colored aluminum pigments are producing new and attractive color spaces with dramatic chroma and travel characteristics. Colored aluminum pigments also enable styling of rich, chromatic colors at a lower pigment loading through the use of a combination of traditional silver aluminum silver dollars with absorption pigments. They can therefore deliver good hiding with excellent gloss, even in thin-film automotive coatings, according to Crosby. Meanwhile, the process of deposing different layering systems on pigment cores has driven the introduction of more dramatic effects such as better color travel and more sparkle, according to Gareth Hughes, director of American Paint Company's Automotive refinishing. “The use of multiple layer stacks to optimize light travel and interference in pearlescent pigments is a major contributor to the new high-impact colors you see today,” Crosby agrees.

Kohala suma it up best: “High chroma, multilayer effect pigments, newer shades of colored aluminum flake, and glass flake pigments have given color formulators the tools they need to achieve head-turning color shades that excite consumers and inspire pigment research to dig even deeper into what variations of these new technologies can yield.”

The ongoing switch to water-based coatings is another key driver of effect pigment development. The goal has been to achieve highly brilliant products with identical optical properties as those of solvent-based and nonretreated pigments, according to Mark Stoll, global head of marketing & technical service with Eckart. Although stability issues with aluminum flake or glass flake pigments have, in general, been resolved with silica encapsulation technology, Venturati notes that the increasing adoption of waterborne coating continues to drive pigment transformation as producers seek more efficient ways to better stabilize their pigments and make them easier to use.

Additional important trends noted by Book include the incorporation of effect pigments in the clearcoat, where historically they have only been used in the basecoat. This application is commonly referred to as tinted clearcoats. “Increased color saturation and depth are achieved when effect pigments are present in the basecoat and finely milled organic pigments are added to the clearcoat,” he says. The effect is enhanced when new nanoscale pigments with increased dispersion saturation are used in the tinted clearcoats, according to Brown. “These systems have allowed us to achieve color spaces not obtainable in the past, such as our Ruby Red on the Ford Fusion and Burgundy Velvet on the Lincoln MKZ. Both colors were created using ANDAR® effect pigments from Book. However, as with other recent development, these finishes are not easily applied or repaired, and OEMs are looking for alternative two-coat solutions that can replicate this look,” according to Book.

PPG color experts would like to see durable dyes-like systems with ultra-high transparency for use in both solvent based and water-based coatings, as well as thinner flakes to minimize the number of clearcoat layers needed to be applied to the finish. Book does note that new colored aluminum pigments can create a tinted clearcoat appearance that is much easier to apply and repair.
High chroma, multilayer effect pigments, newer shades of colored aluminum flake, and glass flake pigments have given color formulators the tools they need to achieve head-turning color shades that excite consumers and inspire pigment formulators to dig even deeper into what variations of these new technologies can yield.

ADVANCES IN PIGMENT TECHNOLOGY

In addition to the development of effect pigments already mentioned, pigment manufacturers have focused on changing coating formulations and application trends and technologies with a variety of technology advances of their own. Dieter Mierquardt, manager of color matching, Europe, with PPG Automotive OEM Coatings notes two key advances. The first is process improvements in the manufacturing of synthetic micas that make them more affordable and will drive a shift away from natural micas and lead to the development of more chromatic colors and improved appearance. The second is new processes to generate colored aluminum based on inorganic layers and brighter aluminum feedstocks that offer stylists higher chroma and color saturation. Thiin, silver-dollar colored aluminum pigments are producing new and attractive color spaces with dramatic chroma and travel characteristics. Colored aluminum pigments also enable styling of rich, chromatic colors at a lower pigment loading that is a combination of traditional silver aluminum silver dollars with absorption pigments. PPG color experts would like to see durable dye-like systems with ultra-high transparency for use in both solvent based and water-based systems, as well as thinner flakes to minimize the number of clearcoat layers needed to obtain the finish. PPG does note that new colored aluminum pigments can create a tinted clearcoat appearance that is much easier to apply and can

travel and interference in pearlescent pigments is a major contributor to the new high-impact colors you see today,” Crosby agrees.

Kohala sums it up best: “High chroma, multilayer effect pigments, newer shades of colored aluminum flake, and glass flake pigments have given color formulators the tools they need to achieve head-turning color shades that excite consumers and inspire pigment formulators to dig even deeper into what variations of these new technologies can yield.

ADVANCES IN PIGMENT TECHNOLOGY

In addition to the development of effect pigments already mentioned, pigment manufacturers have focused on changing coating formulations and application trends and technologies with a variety of technology advances of their own. Dieter Mierquardt, manager of color matching, Europe, with PPG Automotive OEM Coatings notes two key advances. The first is process improvements in the manufacturing of synthetic micas that make them more affordable and will drive a shift away from natural micas and lead to the development of more chromatic colors and improved appearance. The second is new processes to generate colored aluminum based on inorganic layers and brighter aluminum feedstocks that offer stylists higher chroma and color saturation. Thiin, silver-dollar colored aluminum pigments are producing new and attractive color spaces with dramatic chroma and travel characteristics. Colored aluminum pigments also enable styling of rich, chromatic colors at a lower pigment loading that is a combination of traditional silver aluminum silver dollars with absorption pigments. They can therefore deliver good hiding with excellent gloss, even in thin-film automotive coatings, according to Crosby. Meanwhile, the process of depositing different layering systems on pigment cores has driven the introduction of more dramatic effect pigments such as better color travel and more sparkle, according to Gareth Hughes, director, Americas, PPG Automotive Refinish. “The use of multiple layer stacks to optimize light