

Metallic Color Challenges in Automotive Coatings



Consumers love metallic coatings on their vehicles, and the popularity of effect pigments offering these unique colors continues to grow. Meeting consumer demand for new effects is a continual challenge, sometimes exacerbated by environmental and processing influences. This paper will discuss some of the hurdles faced by both aluminum pigment and coatings manufacturers in their quest to deliver tomorrow's metallic coatings.

Color sells cars — and metallic colors have never been more popular. Silver, king of all metallic colors, has been riding a popularity boom for the past five years. While silver's popularity will not continue forever, our love affair with a metallic appearance will continue. From bright, sparkling, chromatic colors to smoother, more subtle effects, the demand for metallic colors on a global basis has never been greater. While today's "techno-silver" may begin to lose its appeal, gray, blue and brown metallics, utilizing high levels of aluminum pigments, will begin to take its place. This popularity and the demand for new effect colors has heightened and underscored the need for continuing research and development in the areas of appearance and performance. Hidden from most consumers are the efforts and "behind-the-scenes" challenges that face coatings formulators and manufacturers of aluminum pigments alike, in their quest to provide the new effects so desirable today. Faced with an amazing array of regulations and various other hurdles, however, we continue to deliver new products to support styling and consumer demands.

Over the last several decades, two key areas have created the highest hurdles for new aluminum flake development: environmental compliance and coating systems efficiency initiatives (cost savings). The days of low-solids lacquers, exhausting nearly 80% of their volume to the air, are long gone. And not only have we seen the demise of low-solids formulations, but also the introduction of application methods so efficient that nearly all of the paint is attracted to the substrate, resulting in little overspray. While these changes have been very beneficial to the environment in nearly all cases, they have proven very challenging to metallic coating appearance.

Before discussing some of the challenges facing metallic coating aesthetics, it is important to review the properties that promote optimum appearance. First, optimum metallic appearance will only come from a high-quality, well-designed aluminum flake pigment. Today, aluminum pigments used in OEM

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automotive coatings are almost exclusively lenticular in shape, with smooth surfaces and narrow particle size distributions. Along with these characteristics, it is also desirable to possess a degree of “toughness” or resistance to degradation. This combination of characteristics not only offers the potential for good appearance, but also good performance. A second critical requirement is optimizing flake orientation through proper paint application techniques. Alignment must be parallel to the film surface and substrate to maximize “head-on brightness” and create the “travel” that is so desirable in metallic finishes.

Optimized metallic appearance has been challenged by two factors:

- The move toward environmentally friendly coatings, and
- Production line engineering/application advancements.

The drive toward environmentally friendly coatings is certainly not a recent initiative, and is well advanced in terms of VOC reduction. Increasing vehicle solids or utilizing compliant waterborne coatings continues to effectively address VOC issues, although efforts continue for further improvement. In fact, today there is a higher degree of emphasis being placed on

100% solids coatings (powder coatings) for many ancillary automotive components. Each of these two directions, high solids and waterborne, have challenged aluminum pigment manufacturers to develop improvements and modifications in the pigment to overcome several issues.

Higher-solids coatings lack the solvent and resulting film shrinkage so necessary for good flake orientation. Silberline has addressed this issue through the continuous development of new pigment grades with greater head-on brightness and metallic travel. The most recent innovation is a family of grades based on a very smooth, lenticular surface with extremely narrow particle size distribution, known as Sparkle Silver® Ultra.

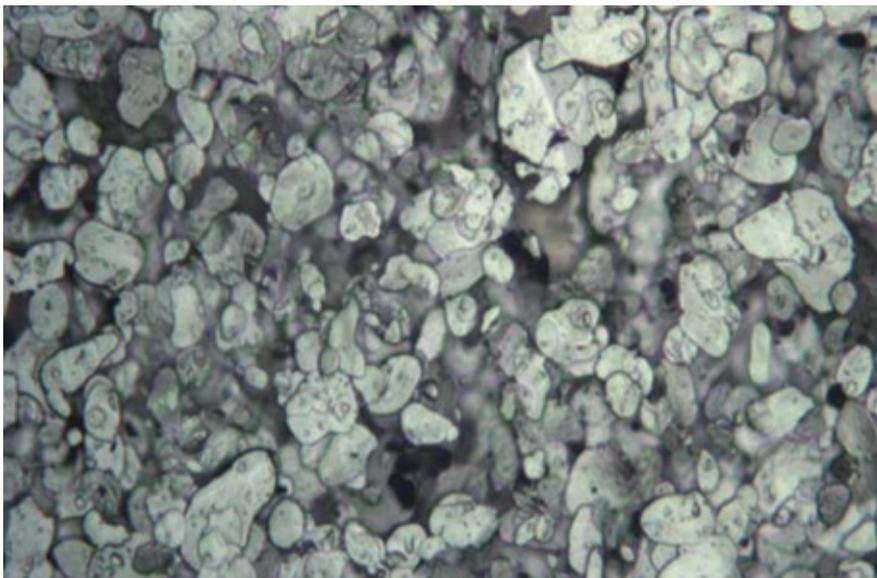
While improving flake appearance helps in solving high-solids appearance deficiencies, powder coatings, the ultimate high-solids coating, raise the bar by creating the ultimate challenge for flake orientation. The absence of solvent results in very little opportunity for the flake to move after application and orient in the preferred plane. A high level of research is presently underway to address this issue, much of it involving modification of the flake's surface chemistry. Through attach-

ment of polymers to the flake surface, a unique interaction with the powder coating system is possible, resulting in improved appearance and performance. The Holy Grail for metallic powder coatings is to achieve an appearance identical to solvent-based metallic coatings — and the potential for success has never been greater!

Waterborne coatings present an altogether different set of needs for flake producers, most notably the requirement to suppress the generation of hydrogen gas. Aluminum flake, unless passivated, can react and cause coating failures. Finding a solution has been a priority due to the increasing popularity of aqueous systems in automotive basecoats.

Pigment manufacturers, as well as coatings manufacturers supplying the auto industry, have developed a portfolio of technologies that run the gamut from organic phosphates (Aqua-Paste™) to inorganic surface treatments (SilBerCotes™). Additionally, the technology ranges from pre-passivation of the pigment to actual passivation during the paint-making process (in situ passivation). In total, achieving acceptable waterborne metallic performance has occupied, and continues to occupy, much research time in an effort toward continual improvement. On a global basis, automotive OEM coatings are now moving more to this technology as a solution for environmental regulations. Germany has taken global leadership in waterborne technology with close to 80% of all vehicle production utilizing waterborne basecoats.

While environmental issues challenge us in one direction, the need for continual processing improvement challenges aluminum pigment and coatings manufacturers in still other directions. The actual process of paint handling and application by automobile manufacturers is continually being modified and improved — but primarily in regard to savings and processing efficiency. Cost-saving initiatives are dri-



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vers for change, and in most cases create new issues for the maintenance of good metallic appearance. Smarter, faster and more efficient seem to be keystones for almost any processing advancement today. Efforts designed to reduce cost include efficient handling of the paint, quicker application to the auto body and ensuring that more paint goes to the substrate.

In the mid 1980s, a phenomenon was identified that had dramatic effects on metallic basecoat appearance. Metallic color reproducibility from one car to the next had become a significant problem for automotive coatings manufacturers. Something was happening to the coating prior to application, which had a negative effect on color reproducibility. Studies quickly demonstrated that the aluminum flake was being damaged during paint circulation, and the longer the circulation time, the greater the color change. The high line speeds, coupled with aggressive pumps and regulators were quickly shown to damage the flake, thus creating changes in coating appearance.

In late 1986, Silberline engaged resources in a high-level effort to understand and develop a solution to this issue. While many flake parameters were investigated, the ultimate solution was the development of a thicker, more robust flake, known today as Tufflake™. This technology was born out of necessity to address a very real need for our customers. Although not perfect, the level of color change before and after circulation has been significantly reduced to an acceptable level. Due to the success of this technology and the continuing



demands placed on the paint during circulation, non-degrading flakes have grown in popularity. Although Europe has not embraced non-degrading flakes to the level of the NAFTA region, there is a need, especially for colors with limited popularity. Expectations are that this technology will continue to grow on a global basis.

A more recent, and perhaps even more challenging, attack on good metallic basecoat appearance is the trend toward 100% electrostatic basecoat paint application. Getting more liquid paint onto the substrate not only addresses environmental issues, but also reduces cost through paint conservation. In recent years, typical basecoat application had been electrostatic for the first coat and air-assist for the second coat. The traditional air-applied second coat was needed to orient the flake, thus maintaining good metallic appearance. However, paint applied by air is inefficient, and the desire for transfer efficiency is strengthening to the point where many automotive manufacturers are, or have, moved to electrostatic for the entire basecoat. Turbo bell is the typical application of choice, and bell/bell is the descriptor used for the application. This movement has gained

most strength in the NAFTA region, however, it is gaining strength in other parts of the world.

The obvious benefits gained from bell/bell application overshadow the negative issues, unless you are a pigment or coatings manufacturer. Transfer efficiency improvements effectively mean that less paint will be sold; and the resulting finish produced by this application method produces a much poorer appearance. The

change in appearance is dramatic, typically darker reflectance at the near specular angle, and lighter reflectance at the flop angle. Improving the metallic effect is possible only after understanding the science behind this color change, and today efforts are underway to do just that. There are several theories offering reasons for the color differences, the most popular of which suggests that the flake is simply improperly orienting due to the application. Other theories involve flake damage and amount of flake ending up in the finished product. Although all pigment and coatings manufacturers share no absolute conclusion at this time, one common thread is the desire for improvement in appearance. Activity at Silberline is currently underway to understand these phenomena and to develop acceptable solutions.

The consumer demand for new and exciting metallic finishes drives our need to meet and exceed the challenges presented to us. Although the bar is continually being raised, Silberline, along with other effect pigment producers, will continue to provide the tools needed to excite the consumer and exceed expectations. ☺

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