Escalating growth for the automotive market in Asia

Automotive coatings have advanced at such a speed in recent years across Asia that modern innovations, such as nanopaint and sensorial textile effect paint are set to test traditional paint methods. Jonathan Thomson reports

Car makers have experienced tremendous growth in the Asia Pacific region recently, as China and India in particular generate new sales and manufacturing opportunities. General Motors recently announced that its 2005 first quarter production figures for the region were up by around 14% compared with 2004, with Ford and other leading manufacturers predicting similar growth. In January, Honda's Asian production went up by 32% compared to same month in 2004.

Inevitably, such a shift in production has seen the larger automobile industry suppliers from the US and Europe following suit, with many developing new production facilities in the Asia Pacific region, or strengthening partnerships with local OEMs (original equipment manufacturer).

For example, US giant DuPont has established joint ventures with the Japanese based Shinto Paint Company, while PPG has allied to Kansai Paint. However, while the Asian Pacific market growth has provided the global automotive finishing industry with a welcome boost in recent years, there is also a growing pressure to innovate in the sector in order to meet regulatory changes, as well as the aesthetic demands of consumers.

It is certainly true that the major players in automotive finishing have ploughed resources into satisfying efficiency and environmental concerns, while at the same time ensuring the primary function of coatings - protection from corrosion - remains intact.

For example, DuPont, which following its tie in with the Shinto Paint Company is set to open a new automotive centre in Tokyo later this year, has managed to reduce solvent emissions of automotive paint through the introduction of its 'Super Solids' ultra-low emissions coatings technology. This has reduced volatile organic compound (VOC) emissions of the final protective clear coat at some plants by around one quarter.

Figure 1. Shanghai General Motors' Excelle model - exclusive to the Chinese automotive market - finished using BASF waterborne basecoats (Image courtesy of BASF)

Likewise, Toyota has been championing the use of powder coatings, which contain only paint layer-formation components, resulting in no concern of air pollution due to VOC emissions from organic solvents.

Undoubtedly, research in this area has put automotive finishing suppliers in a good position to respond to global legislative demands for limiting emissions of VOCs. PPG, which is allied to Kansai Paint, said it already had the necessary product range and technical support in place to respond to such demands, the net effect of which would be to simply 'accelerate a switch from non-compliant to compliant paint systems.'

INTEGRATED PROCESS SYSTEM

Given that the automobile industry is one of the most globalised, it is often hard to pinpoint specifically Asian technical developments, with new inventions developed in - say Germany - just as likely to find their way onto cars in Tokyo as in Stuttgart. Take global paint company BASF. It has developed what it calls the 'integrated process' system, designed to reduce both costs and emissions by removing a bake step following the application of the primer.

In a conventional process, an automotive chassis is prepared, dipped in an electrocoat and then has a primer applied to it to provide corrosion protection. For adhesion, these layers are baked onto the chassis in an oven. Then the base coat, which provides the actual colour, and clearcoat for appearance and scratch resistance are applied. The chassis is again baked in an oven to complete the painting process.

The 'integrated process' allows the removal of the time-consuming and energy-demanding bake after the primer is applied. BASF describes it as a 'wet-on-wet-on-wet' process that uses waterborne coatings systems, in particular an innovative powder slurry clearcoat. Powder slurry is a powder coating, which is more environmentally friendly than a solvent-based coating, finely dispersed in water by a special method and is then applied electrostatically. These developments are likely to be integrated in car production around the world.

NANOTECHNOLOGY

An interesting side-effect resulting from the introduction of some of these new materials and processes, has been an improvement in finish, particularly scratch-resistance. This has heralded a shift in research towards improving aesthetics, not least due to an emerging interest in nanotechnology.

A milestone in nanotechnology was reached in

Figue 2. DuPont Coatings technical service center opened in Shanghai, China, in 2003. (Image courtesy of DuPont)

1981, when the physicists Heinrich Rohrer and Gerd Binning invented the scanning tunnel microscope. This allowed for the magnification of objects ten million times, enabling scientists to look at individual molecules and atomic surface structures for the first time. The invention opened the door into the nanoworld, a realm whose basic unit of measure is one billionth of a meter and whose structures are several tens of thousands of times thinner than a human hair.

PPG, in collaboration with DaimlerChrysler, appears to be taking the lead in this area, having developed a nano-particle clearcoat, which it claims offers significantly greater scratch resistance and an improved gloss.

After four years of development work with PPG, the clear lacquer has gone into series production at Mercedes-Benz. It contains microscopically small ceramic particles, each less than a millionth of a millimetre in size, and integrated into the molecular structure of the binding agent. These particles float around freely at first in the liquid clearcoat, before 'cross-linking' as the drying process takes effect.

NANOPAINT

Conventional paint consists of organic molecules with long carbon chains. Nanopaint, by contrast, contains inorganic silicon particles that are bound together by organic polymers. Because of the inorganic particles' nanosize, they can be packed tightly together, resulting in increased hardness and scratch resistance.

The effectiveness of the new technology was borne out by the results of an extreme test conducted in a laboratory car-wash. After simulating the effects of around 100 washes, nano-painted sheet metal emerged with around 40% greater gloss than samples with conventional clear lacquer, according to the car manufacturer.

It seems that research into nano-paint will not be stopping there, however. DaimlerChrysler's Hartmut Presting said, 'We are pursuing the vision of a solar coating that will be sprayed on like a paint or glued on like a film. The idea is to turn a car's body into one big mobile solar cell. And with the help of nanotechnology, the vision of a solar paint could become a reality for research vehicles in a few years.'

The major advantage of a solar paint is its large surface area. The researchers refer to its 'high nanoporosity' which has already achieved an efficiency of around 10% in current laboratory models and has a relatively low dependence on the light's angle of incidence. In a small demonstration model, Presting's research team has established that a power-supplying paint can work. Solar paint applied to a steel sheet measuring just a few square centimeters was able to generate enough energy to operate a small electric motor.

Nanospecialists working with Presting are confident that they will come up with some initial solutions in around five years. The researchers expect to develop a 'solar-active' car - a vehicle in which the whole body serves as a solar cell - capable of producing about one-half kilowatt, within that timeframe.

The use of superhydrophilic and superhydrophobic surfaces opens the way for the creation of easy-to-clean or self-cleaning products. DaimlerChrysler said it was also researching the 'lotus effect' of nanopaints in an attempt to produce self-cleaning wheel rims. The lotus effect describes the extremely fine surface structure of the lotus flower, which allows water and dirt to roll off its petals without leaving a trace.

CHAMELEON COLOURS

Another possibility could result from altering the alignment of the pigments in what DaimlerChrysler calls 'chameleon-effect nanopaints' by introducing an electrical charge. Here, the outer surface of the car would change colour depending on the voltage applied.

A separate field of interest is surface physics, which could also lead to colour changes without the need for pigments! This area of research is looking at producing colours from a material's microstructure rather than its chemistry. It is basically a step beyond the idea of 'interference colours' through the use of iridescent paints which emerged on cars in the mid-1990s.

Of course aesthetics are more than just the appearance of something, it also relates to how a product might feel. Dutch company Akzo Nobel is currently exploring this area with the development of 'sensorial textile-effect paint' which can reproduce the look and feel of suede, leather, or woven fabric. Clearly potential exists for use in both vehicle interiors and exteriors.

UV is another technology where research seems likely to increase, with BASF in particular hoping to expand usage of this innovative curing process into more mainstream use.

These paints are dried and cross-linked with ultraviolet (UV) radiation, and offer a range of benefits according to BASF, including scratch resistance. They also involve fewer or even no volatile solvents and more efficient industrial-scale processing times.

Other developments, which could be a threat to the traditional paint industry, are dry paint films. INPRO, the Germany-based industry partnership which tests innovative production technologies, recently heralded a new process used to manufacture high-performance plastic parts to match the colour and appearance of the car body with the aid of a special film that eliminates the need for subsequent traditional painting. It described the technology as 'innovative and highly interesting.'

Looking ahead, further challenges will emerge for the automotive finishing sector, particularly as vehicle manufacturers make use of more lightweight aluminum and plastic substrates. APCJ

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