Holding up
Landing gear

Power play
GE90 MRO market

The long haul
A330/340 maintenance

Skin deep
Paints & coatings
Surface skim

Aircraft paints and coatings continue to develop and improve. **Ian Harbison** talks to some of the main players in the market

There is a clear trend towards more complex airline liveries, which is being matched by increased demand for special effects in the cabin. On the question of structural protection, however, there are some divergent views in the face of an impending deadline on the use of chromates.

**AkzoNobel**

John Griffin, Business Director, North America for AkzoNobel Specialty Coatings, who is also responsible for global aerospace strategy at the company, confirms that base coat/clear coat (BC/CC) is rapidly becoming the industry standard. Griffin says AkzoNobel is three to four
years into an eight to 10 year adoption cycle, as such more than 50% of the paint his company supplies to both Airbus and Boeing is still high solid content. However, he expects this to change to more than 90% BC/CC in the next two years, especially as production line approvals are also held for Bombardier and Embraer.

He notes that OEMs are pushing for reduced costs and drying times, as well as the use of less material – especially as production rates are at an all-time high – adding that MROs also want these same benefits. As a result, there is a lot of research effort going into the optimisation of processes. Much of the control in applying the paint still rests with how the technician uses the spray gun, with the technology of the gun having remained much the same for some time. There are so many variables associated with manual applications, such as the timing of each spray pass, the distance from the fuselage and the amount of pressure that is used, that it is difficult to achieve consistency during the introduction phase of new coatings. It should be noted that optimising the process is an evolution that requires multiple adjustments in application equipment, materials and workflow. It takes time and experience to find the correct balance and to reach a level of comfort with the new systems in order to fully take advantage of the coating’s properties.

An area that is easier to define is drying time. This is the holding factor in BC/CC paint systems, specifically that of the clear coat, which can take up to 10 hours. There seems to be two approaches to reducing drying time to a couple of hours, they either involve chemical accelerants contained in the coating or curing using UV radiation. Griffin says the automotive division of AkzoNobel experimented with a spray gun incorporating a UV LED for instant curing, but the technology proved unsuitable for use on aircraft. More robust technologies require higher energy, making them impracticable on an aircraft fuselage as large-scale installation would be clumsy and power hungry. A more portable scanning robot could be one solution, but he says practicality is still the overriding requirement.

New technologies are being explored to support robotic solutions for internal structural anti-corrosion protection. This would be used primarily for smaller structural components produced in significant quantities, as the complex shapes of the final assembly would still require manual finishing. He notes that robotics are often considered, but cost/benefit analysis has usually shown borderline results. “We don’t experiment with robotics, but we try to adapt our formulas to fit with possible robotic applications,” Griffin says.

At a more basic level, and taking a lot of the company’s R&D time, is the development of chromate-free products that have the right combination of resin, inhibitor, adhesion and flexibility to provide maximum protection with good in-service life, plus both cost and weight reductions. The most important factor is that the OEMs are able to trust them to behave over the life of the aircraft. He adds that the required 3,000 hours of exposure to a salt spray may not be the most realistic representation of 30 years of flight operations. One alternative is to use a magnesium powder as the sacrificial agent in place of chrome to protect the aluminium. This has shown good protection levels in long-term tests and is under consideration by the US military and one business jet manufacturer.

He also suggests that, as the aluminium industry has responded to the threat posed by the greater use of composites by developing new alloys suitable for aviation, it would be rash to assume that the next generation of aircraft will necessarily avoid the use of metals. Metallic protection will continue to be a requirement.

In contrast, for external protection, Griffin says the industry is a long way towards solving the problems of achieving chromate-free anti-corrosion products. For AkzoNobel, Airbus and AMS 3095 approvals are in place, while for Boeing the approval is pending.

Sherwin-Williams

Julie Voisin, Product Manager, Aerospace Coatings, says the development of BC/CC has now reached the point where manufacturers are developing second or third generation products. Now the emphasis is on easier application, improved appearance and greater opacity, allowing for full coverage with less paint to reduce weight. She adds that the company is also extending its customer base to include business jets and smaller aircraft.

AkzoNobel Aerodur paint is specified for high laminar flow areas such as the vertical stabiliser and engine nacelles on the Boeing 787-9. The use of BC/CC means operators no longer have to maintain a white nacelle as per Boeing’s original advice, as at correct layer thickness it is smooth enough to maintain the aerodynamic performance of the aircraft. (Photo: Ian Harbison)
On chromate free, Voisin acknowledges the looming deadline of a REACH ban on chromates by 2017, which is pushing manufacturers to come up with alternatives. Sherwin-Williams research and development teams are constantly examining new formulas and processes, in order to find new solutions. This approach includes an extensive outreach programme to small businesses and universities, covering both chemistry and materials.

When it comes to testing, the validity of salt spray as a realistic way of simulating an aircraft’s entire operating life is questionable. It seems it was a good way to predict performance when evaluating hexavalent chromium, but new test methods may need to be examined to evaluate the product formulas of the future.

Inside the cabin, the most interesting development in interior paints is the company’s new JETFLEX Elite Polyurethane Enamel. As well as bright whites and neutrals, there is a wide colour palette. The difference to previous projects is that, this time, the development has involved working closely with designers and the company’s architectural division. The purpose of this collaboration is to develop proprietary pigments that are more responsive to the LED mood lighting that is increasingly found in aircraft cabins. These create an internal glow with highlights and coloured shadows and can be used on plastic, metal and composite surfaces. The new product is based on Boeing BMS 10-83 approved technology. It is a single-stage coating and does not need a clear coat, while still providing good durability against scratches, stains and marks.

As it is a polyurethane paint, it does, of course, contain VOCs. However, Voisin says that water-based paints are in increasing demand, and these will be able to meet the stringent FAR/JAR 25.853 regulations for burn, smoke and heat release, as well match current durability levels.

Mankiewicz

Andreas Ossenkopf, Director and Head of the Aviation Department at Mankiewicz, agrees that the BC/CC paint system is definitely on the way to becoming the aviation industry standard. The process now accounts for 90% of the company’s production in the aircraft exterior sector. This has come about from an increasing number of airlines realising the convincing benefits the system has to offer, he adds.

As a pioneer of BC/CC, the company has amassed eight years of experience with airlines around the world, some in harsh operating conditions. A common complaint is that colours such as red, yellow and light blue are susceptible to fading through exposure to ultraviolet light at altitude, but the new system seems to have overcome this problem. It also has benefits in faster application and drying times, reductions in materials and emissions, and full coverage with fewer layers. Customers have also noticed that the gloss finish is being retained for much longer. In fact, he says it has been demonstrated that the paint appearance now lasts for an entire overhaul schedule. The first aircraft to reach that point were still in good condition in terms of paint appearance, thus repaint cycles could now be significantly reduced, which in turn saves costs.

For future developments, the clear coat layer holds some interesting possibilities of incorporating what Ossenkopf calls ‘functionality’. This could be a further improvement in stain resistance, or to prevent the build-up of ice. The company has already been involved with functional coatings, notably with Airbus in the development of a shark skin paint designed to replicate the turbulence reducing riblets that allow sharks to swim at high speed. The project was started in 2011 within the framework of the EU Clean Sky research scheme, alongside Lufthansa and the Fraunhofer Institut für Fertigungstechnik und Angewandte Materialforschung (IFAM).

Think ink

Airbus engineers from the A320 Family paint shop in Hamburg have developed an inkjet printing process that can be used to quickly and efficiently reproduce any aircraft livery design – be it a photographic motif, a representation of modern art, or any other complex pattern – faster and more efficiently than traditional painting processes, and with much finer detail.

The direct printer functions much like a traditional model, using an inkjet head with nozzles that spray three basic colours (cyan, magenta and yellow) and black. Utilising a 7m² bench, the inkjet head prints a design line by line, from top to bottom. After the process is completed, the aircraft component is sealed with a clear coat. The system can be used to create colour gradients or photo-realistic motifs and is capable of printing components of any size or shape. In the past, heavier printed film was used to produce complex designs. However, such film is susceptible to the effects of heat, cold and high pressure, and could ultimately tear or peel.

The business case for direct printing is convincing. Compared with painting, where the design has to be built up layer-by-layer, there are far fewer working and drying steps – greatly reducing the lead time. There is also no overspray or solvent vapour when ink is used, providing better working conditions for Airbus employees.

At present, the inkjet method is still at the experimental stage. Technical Readiness Level 6 (TRL 6) was reached at the end of June, and the ink and associated processes will be qualified early in 2015. Nonetheless, the project has already become part of the A320 Final Assembly Line (FAL) benchmark initiative, which tries to ensure stable scheduled lead times of components for delivery to the line while high production rates continue.
Mankiewicz developed UV-curing paint that was able to implement the riblet structure, while Airbus and its partners developed a method that allows stamping by using a film with the inverse of the riblet microstructure. Once stamped it was immediately cured with UV light before the film was removed. The end result was also dirt-repellent, UV-stable and highly abrasion- and erosion-resistant.

Test of the paint involved eight patches each 10cm x 10cm in size attached to the fuselage and wings of two Lufthansa Airbus A340s. The results were very promising, showing that a fuel reduction of a little more than 1% may be possible. Airbus has subsequently announced that the project partners have decided to continue with production.

The biggest challenge will be to develop an accurate, fast and efficient process to allow the painting of much larger areas of the aircraft.

Turning to chromate-free products, Ossenkopf says there is more pressure to develop these, particularly from REACH regulations. In addition, all the expectations of the different aircraft OEMs and the refurbishment industry need to be fulfilled. A product that suits everyone is needed.

The company has also had a long involvement with interior paints, calling on over 40 years experience with different OEMs. Ossenkopf explains that decorative laminates were widely used for aircraft interior surfaces in the past, but are now being frequently replaced with paint, mainly for cost and weight reasons, as well as for easier maintenance. Another positive of paint is that special effects can be used very effectively to reinforce airline branding. The use of a wide portfolio of design effects and topcoats are perfect for airline customisation, Ossenkopf says, which is becoming increasingly important. Of course, the interior paint not only has to meet visual and design requirements but, most importantly, has to offer improved processes and meet FST, VOC and REACH requirements at the same time.

Ossenkopf says the Aviation Department can draw on expertise from other high-tech divisions of the company. UV inkjet printing could be a future possibility, with the Mankiewicz CYCONJET system already developed for the coating of large areas. Airbus has also introduced printing into the aviation industry (see Think ink box story).

One of the company’s most recent airline projects was the supply of BC/CC to Eirtech Aviation’s facility in Ostrava in the Czech Republic for a special paint scheme on a Brussels Airlines Airbus A320. This involved 20 different colours and was completed in 1,500 man-hours in total, taking just 10 days.

The design features a 37m long black shark, based on Professor Calculus’ shark submarine from the Tintin adventure, ‘Red Rackham’s Treasure’. It was developed in association with Moulinsart, the custodians of the work of Hergé, the famous Belgian comic book artist who created Tintin. The scheme is intended to promote Belgium and a fuselage message reads ‘We fly you to the home of Tintin’. The special livery will remain until 2019.

Volga-Dnepr Airlines has painted one of its Antonov An-124-100 freighters using a BC/CC system from AkzoNobel to increase the aircraft’s aerodynamic qualities and produce a fuel saving of up to 1.5% (or over $100,000) a year. The aircraft will be monitored by Volga-Dnepr’s technical experts to gauge the level of fuel savings. If the technology demonstrates the results the airline is hoping for, it will ultimately be applied to the rest of Volga-Dnepr’s An-124-100 fleet.

The painting of the aircraft was completed by Spectr-Avia, Russia’s leading aircraft painting centre.

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Eirtech

Andrew Richardson, Head of Sales & Marketing at Eirtech Aviation, says the generic terms of BC/CC can, in some cases, be misleading. This is because it only describes paint layers and not their performance. In Eirtech’s experience, each paint company’s offer differs in terms of performance, and you should not always expect all products to be the same. Some have easier application characteristics than others, or perhaps a better finish ‘from the gun’. There is certainly a difference in opacity between colours, and not all colours cover in one coat. This is in direct conflict with what some people in the industry expect. The end result is that it is misleading to say that the use of this type of technology will save time. It might, but experience has demonstrated that it depends on a number of factors that are often not considered: what are the shift patterns to be used? Are there other aircraft in the hangar? How many coats need to be applied? How complex is the livery? Is the clear coat applied in one or two layers? Of course, there have been time savings of between 25% and 30%, but some BC/CC aircraft have also taken as long to complete as standard paint schemes.

The other issue Eirtech sometimes finds when wanting to apply new paint technologies, even when they are approved to AMS3095A (recognised and referenced by Airbus and Boeing in their maintenance manuals), is that the enabling revision to the manuals supplied by the OEMs often lags behind the paint approval. This means there is a period when the application of the new system is actually not allowed if the official paperwork is followed. This contradiction needs to be addressed, otherwise the money paint companies spend on qualifying new systems is, in effect, wasted, hampering its introduction into the MRO market.