Take cover

Whether you're protecting materials, components or assemblies against corrosion, heat or fatigue, there are specialist coating choices to be considered. Steed Webzell reports

In an era when manufacturing and process operations are leaner than ever, many plants are now scrutinising overheads and so-called 'non-value add' processes to push competitiveness to even greater heights. And, with maintenance frequently pinpointed as among the most costly 'overheads', engineers are finding themselves under pressure to simplify and/or reduce service schedules, while simultaneously increasing plant life.

Protective coatings are often taken for granted in this regard, but the fact is they perform a pivotal function in preserving all kinds of plant equipment and machinery. The big question, however, is which coating to use, as options range from metallurgical and ceramic technologies to chemical solutions, such as those involving plastics and epoxies.

Making that choice is about being aware of the intended purposes and limitations of available coating systems. That done, you need to consider factors such as the base material itself, melting point, density, surface preparation requirements, application methods, environmental compatibility and, of course, cost.

Irons in the fire

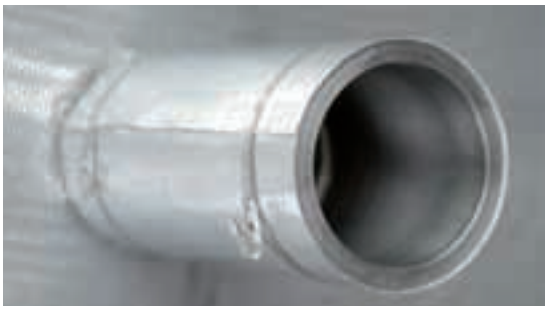
Coating selection is naturally dependent on the application and, typically, where there is more demand, there is generally more innovation – so more options. For instance, engineers bemoaning the plight of high-wear industrial components, such as valve or pump housings used in chemical, steel, petrochemical and paper plants, would now do well to examine tungsten carbide cladding. According to Kennametal, for example, its Conforma Clad has been adapted to suit cast iron components and now outperforms conventional thermal spray coatings – extending equipment life up to a claimed eight times. Not bad for a coating initially developed to meet the requirements of the energy and power sector, providing protection to high-wear parts, such as coal-burner nozzles and popcorn screens.

High wear problems are, of course, common in the energy industry where repetitive and rotational motion are among the keys to providing power. That's also the case in the relatively new and growing field of wind power generation, although here plant engineers' primary attention is on the bearings that support the turbine rotors – which ideally need to survive for at least 20 years.

In this case, new technology from Schaeffler, for instance, is a black oxide coating, called Durotect B, for its FAG cylindrical roller bearings that has also been found to reduce wind turbine gearbox failures. Interestingly, this is a mixed iron oxide coating, which provides increased resistance to slippage during alternating, low load conditions. What's more, it's applied in thickness between 0.4 and 2.0µm, so does not cause problems associated with impaired geometrical interchange.

That said, most engineers will be aware that base material is frequently the stumbling block when it comes to choosing coatings. For example, exotic materials, such as titanium, present adherence challenges. The issue for titanium, however, is that it suffers from intense 'galling' (sticking) in friction-

Below: Arc Energy Resources has just completed a contract involving weld overlay cladding of 16 large valves for Goodwin International, a manufacturer of dual plate check valves



based applications. Here, again, engineering innovation has come to the rescue – in this case, with Hardide developing another tungsten carbide-based coating that's capable of providing wear, abrasion and chemical resistance. Its titanium project, which overcomes the problems of galling, was in research and development for five years, but has been fast-tracked during the last 12 months specifically to meet increasing demands from aerospace and defence plants.

Meanwhile, in the oil and gas, and petrochemical industries, plant engineers are constantly challenged with finding new ways of providing heavy-duty protection against corrosion, erosion and wear on equipment ranging from pressure vessels to subsea piping and wellhead devices – and involving all sorts of materials.

Dynamic ceramic

Increasingly popular here is weld overlay cladding, as highlighted by Arc Energy Resources, which has just completed a contract to clad 16 valves for Goodwin International, a manufacturer of dual plate check valves. These 12 inch valves are being supplied to John Bell Pipeline, main contractor for In Amenas Trunklines, the largest wet gas project in Algeria. Cast and machined in carbon steel, they are being shipped to Arc Energy for overlay cladding, which involves Inconel 625 being applied to all wetted surfaces. The resulting corrosion-resistant surfaces give the end customer a far more cost effective solution to the alternative of valves cast in solid Inconel!

However, while metallurgical coatings have many benefits, thermal protection is rarely one of them. Where this is an issue, ceramic coatings tend to be the preferred choice. On the flip side, though, the notoriously brittle nature of ceramic-based materials has always presented limitations, particularly regarding flexibility. Now, though, as a result of five years' research, thermal management specialist Zircotec has developed what it believes is the first ever flexible ceramic coating. Supplied in rolls of thin aluminium-backed foil, its lightweight ZircoFlex offers a solution to the thermal protection of industrial pipes – another big market – and can be simply applied using either clips or double-sided adhesive tape.

Moving on to polymer-based coatings, ease-of-application has always been an issue for engineers eager to exploit the benefits of these innovative materials. For instance, thermal (flame) spray technology has historically been limited to the application of metal alloys, cermets and some low performance polymers to form protective coatings.

Advancing this technology to a new level, however, Victrex has now developed a cost-effective flame spray process for applying its PEEK polymer-based coating to a range of metal and ceramic substrates. The system involves using an Alamo PG550 flame sprayer that accommodates a stream of Vicote powder, and heating it to melting point before depositing it at high velocity as overlapping 'splats' on the surface of the substrate. Most geometry can be flame sprayed, according to the firm – even complex assemblies, such as pump housings.

One final thought: whatever coating you choose, it doesn't last forever. Or does it? Researchers at the Beckman Institute at the University of Illinois, in conjunction with Autonomic Materials, are developing a coating capable of 'healing over' scratches and other surface blemishes. Their self-healing system consists of two kinds of microcapsules: one filled with polymer building blocks, the other with a catalyst. Because the capsules, made of polyurethane, keep the reactive chemicals inside and isolated, they can be mixed into a range of coatings.

When the coatings are scratched, the microcapsules are torn open and their contents flow into the cracks and form siloxane, a polymer likened to bathroom caulk. Unlike other self-healing systems, the new coatings don't require elevated temperatures or moisture to mend. Trials on steel plates at a military ship plant have been particularly encouraging and Autonomic Materials is currently discussing partnerships with a number of coating companies. PE

Pointers

- Most coatings have target applications and limitations, but are seeing development
- Tungsten carbide cladding, for example, can now be used with cast iron, massively extending its life
- Weld overlay cladding is increasingly popular for otherwise very expensive plant needing protection
- A very recent addition is a flexible ceramic coating, now available on a roll
- Self-healing coatings are arriving, based on microcapsules of polymer
- Black oxide coatings for wind tubine plant bearings are cutting gearbox failures

Left: the first flexible ceramic coating, now available on foil rolls from Zircotec

Having a blast

Plant engineers know that preparing and cleaning surfaces remains the key to obtaining any high-integrity coating. And, while it's easy to assume traditional surface preparation processes, such as blasting, remain largely unchanged, in fact several recent refinements are introducing new benefits.

Finishing equipment manufacturer Guyson, for example, is now able to take an STP 3D graphics file of a customer's component that requires blast finishing or peening, and produce accurate 3D simulations of the treatment, showing blast cone coverage for all critical areas. The software allows off-line programs to be developed in hours, compared to days when using pendant programming.

But blasting no longer has the market to itself when it comes to de-coating, cleaning or preparing surfaces. A case in point is Tube Tech, which is promoting laser technology that it claims is four times faster than alternative approaches. It works by applying a laser beam in a single plane and rotating the object to be cleaned, which, it says, removes coatings, along with rust deposits.

The same company is also enjoying success with its FastIce process, having recently helped a Lincolnshire power plant to remove scale from gas turbine blades. This de-coating system uses CO_2 pellets propelled, using both compressed air and a fine mist of water at high pressure, to remove scale deposits on turbine blade surfaces. It is not only faster than traditional dry ice and manual operations; it also produces zero secondary waste, because the cleaning medium evaporates.