
An extreme form of
PROTECTION

Frederic De Borman Chautems, Axalta Polymer Powders (Switzerland), and Raf Van Os, Van Os Duracoat NV (Belgium), explore sustainable, effective and reliable corrosion protection in demanding environments.

Corrosion protection has long relied on a number of wet or dry processes including PVC, polyurethane, thermosetting powder coating and liquid systems. Each of these have weaknesses, whether in the level of protection provided or in their durability, cost, environmental impact or application method.

According to The World Corrosion Organisation, the direct cost of corrosion represents approximately US$2.2 trillion, or over 3% of the world's GDP.[1] The potential to reduce this cost is significant, and in this respect thermoplastic powder coatings offer many advantages for the applicator as well as for the operator.

The introduction, in the early 1990s, of Abcite® thermoplastic powder coatings represented a major breakthrough. Indeed, Abcite – by Axalta Coating

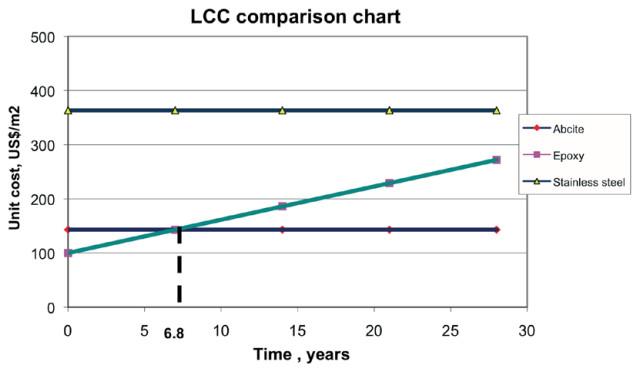

Figure 1. Lifecycle costs (LCC) – a comparison between stainless steel, epoxy and thermoplastic (Abcite). Image courtesy of Van Os-Duracoat, Belgium.

Systems – offers a unique combination of properties with many advantages for a very wide range of applications, including the most extreme environments.

Thermoplastic coatings vs traditional systems

Thermoplastic coatings are based on a polymer whose chemical nature defines the properties and behaviour of the coating. Unlike thermoset coatings, which require a controlled curing cycle, a thermoplastic powder coating simply melts when heated and solidifies when cooled. After cooling, the coated parts are ready for use/ installation.

Moreover, because the process is reversible, thermoplastic coatings can be repaired without any loss of integrity or performance. By comparison, liquid paints or thermoset powder coatings are cured and their repair is not without risk.

Another benefit of thermoplastic coatings is the non-porosity of the film, which creates a highly effective barrier against many chemicals.

Benefits

Thermoplastic coatings are made of a broad range of polymers with different functionalities including PVC, polyethylene, fluoropolymers, polyamide, and ethylene copolymers. Abcite coatings fall into the latter category and consequently offer several unique advantages.

Highest degree of corrosion protection

Where corrosion protection is required, particularly in harsh environments, efficient and lasting protection is a must. This degree of protection can be achieved with three to five layers of a liquid paint system or a single layer of Abcite.

External laboratory tests conducted at the iLF (Forschungs- und Entwicklungsgesellschaft Lacke und Farben mbH) confirmed that a single Abcite layer, applied directly on grit-blasted steel, satisfies the most severe requirements of ISO 12944-6 and ISO 20340 and achieves a durability level 'high'. According to ISO 12944-6 this means an expected lifetime exceeding 15 years, even with a damaged coating, in corrosive environments C5M (marine conditions) and Im3 (buried in soil). The tests include a 1440 hr salt spray and 3000 hr immersion in salted water, with very strict requirements on coating defects, adhesion and corrosion spread around a defined damage in the coating. ISO 20340 defines a cyclic corrosion test for offshore coatings, during which a damaged system is subjected to UV, salt spray and freeze cycles. Here too, a single layer of Abcite passes the ageing test requirements of adhesion, delamination and corrosion spread.

Adhesion and resistance to abrasion

Due to its specific chemistry, Abcite enables an excellent adhesion to steel without the use of a primer, adhesion promoter or other surface treatment. Custom abrasion tests in wet sand, performed at the Rochester Institute of Technology (RIT) in the US, also confirmed the outstanding abrasion resistance of Abcite. Furthermore, the excellent mechanical properties of thermoplastic coatings ensure that no damage or chipping will occur during transport, installation or burying of coated parts.

Cost-effective

With a three-layer liquid coating system, each layer contributes to the overall performance of the system. The effectiveness of the system depends on the application conditions, the properties of each layer, as well as on the cohesion of the total system. In comparison with such liquid systems, a single layer thermoplastic powder coating allows a reduction in total material consumption of more than 40%, as well as a drastic reduction of the total cycle time from days to minutes.

Maintenance-free throughout service life

As with any other investment, the lifetime of an asset is critical, and maintenance costs can easily exceed budget. For these reasons, some operators specify reliable but expensive materials, such as stainless steel, in order to avoid potential future maintenance issues.

For long-term corrosion protection, other solutions are available as well, in particular epoxy and high performance thermoplastic coatings such as Abcite.

In Figure 1, the LCC compares the performance of Abcite thermoplastic coatings to epoxy and stainless steel, taking into account the cost of the initial installation or application, as well as ongoing maintenance costs.

Environmentally responsible

An important consideration for both job coaters and operators is the environmental impact of coatings. While certain chemicals – such as halogens, plasticisers or Bisphenol A – contribute to the functionality of a coating, they also have an impact on the environment and consequently, their use is increasingly regulated. In this respect, the increasingly strict VOC regulations do not affect thermoplastic powder coatings as they do not

contain any volatile organic components, and Abcite does not contain any of these substances.

Application examples

Abcite has been in use in demanding applications for more than 20 years. A good example of this are dredging boats, which are used worldwide, including in subtropical and tropical climates for pumping sand in the building of artificial islands. The so called 'jet-water pipes', with a diameter of up to DN 1000, are designed to pump up sea water that contains sand, which is inherently abrasive. These pipes, as well as the cooling water pipes, are coated with Abcite inside and outside.

There are multiple advantages that thermoplastic coatings offer for this sort of application, most notably their extremely long-term corrosion protection properties despite the extreme conditions and climate. Thermoplastic powder coatings also demonstrate excellent abrasion resistance and offer impressive weight savings, which can lead to the use of thinner pipes. Thermoplastic coatings also allow for the use of standard steel instead of expensive cupronickel alloys. And the maintenance and repair costs are virtually zero despite the harsh conditions.

Thermoplastic coatings in practice

Fluidised bed

Even though spraying is becoming increasingly popular, fluid bed application remains the most common, quickest and most economical application method for thermoplastic coatings.

The application procedure is as follows. After cleaning, degreasing, and simple but careful surface preparation (mechanical surface preparation such as grit blasting Sa 2.5 is recommended), the substrate is preheated, dipped in a fluidised bed for a few seconds, agitated, pulled out of the bed and hung up to cool. The heat stored in the metal causes the powder to melt and to build a smooth coating layer. After cooling, the parts are ready for further processing or use, and post heating is not necessary.

The film thickness depends on the substrate temperature, dipping time, agitation, and on the geometry of the item being coated. Generally, a film thickness between 300 µm and 600 µm is obtained. Finally, it is worth noting that the required heating energy is not the same for all thermoplastic powder coatings, as it depends on the polymer melting temperature and melt viscosity. Compared to other thermoplastic coatings, such as polyamide or fluoropolymers, Abcite has a lower melting point and requires less heat, resulting in lower energy costs.

Spraying or hot flocking

As with thermosetting powders, Abcite can be applied using a common corona or tribo spray gun. The powder is sprayed onto the pre-heated surface, and post heating is often not required. The advantages of the spray method include the possibility to coat larger parts or parts with complex geometry, and the lack of investment in a fluidised bed. Compared to thermosetting powders, the application of Abcite is more efficient due to less overspray.

Overcoating

Abcite is compatible with topcoats – either liquid paint or thermoset powders – and can be overcoated provided adequate activation of the surface to ensure optimal interlayer adhesion. This process can be used to comply with specific aesthetic requirements such as low gloss ranges or bespoke colours. WP

References

1. HAYS, George F., 'Now is the Time', PE Director General, World Corrosion Organisation, http://corrosion.org/wco_media/nowisthetime.pdf

Figure 2. When hit with a hammer, the pipe will deform. The thermoplastic coating is able to adapt to the steel deformation, remaining undamaged and showing no failure or cracks. Image courtesy of Van Os-Duracoat, Belgium.

Figure 3. Abcite-coated piping after almost 20 years of use without any maintenance and in near-perfect condition. Image courtesy of Van Os-Duracoat, Belgium.