DESIGN FEATURES THAT LEAD TO THE DEVELOPMENT OF A 2-COAT SYSTEM

We know coatings fail for a number of different reasons, though primarily because of a loss of adhesion, embrittlement, ultraviolet rays and chemical contamination. We also know that most traditional protective coating systems are applied between 300µm - 400µm (DFT), are built up using a primer, intermediate and topcoat and for the most part survive no more than 15 years in C5 environments.

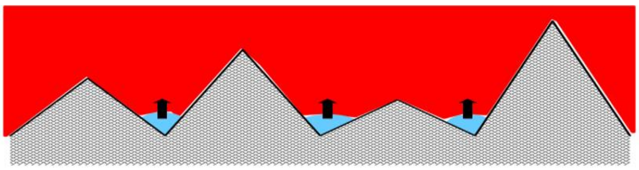
It is therefore somewhat incongruous that MCU-Coatings have now tested a 260µm, 2-coat moisture cured urethane coating that was applied on weathered steel after a ST3 surface preparation and have achieved a '+25 years to 1st maintenance rating' pursuant to the ISO 12944-6, C5 VH standard. This is a remarkable achievement that has only been possible because of the way this magnificent 2-coat system has been designed and formulated.

The 2-coat system that was tested specified a 170µm MCU-Zinc primer coat and a 90µm MCU-Miotopcoat. Comparing that with conventional 3-coat systems, which typically have zinc rich primer coats between 70µm - 125µm, the MCU-Coatings 2-coat system has between 20% - 50% more high quality zinc than conventional coating systems, which is evenly distributed, encapsulated and bonded to the surface to provide the best protection possible (*Author's note: the 85% zinc loading definition in AS/NZ 2313 is too simplistic, for a wide variety of reasons but most notable because it makes no mention of zinc purity and potentially creates problems (!) because the higher the loading the more brittle and porous the primers' become, while the lack of resin means the primers are unable to fully wet the surface*). Let me say that again in case it escaped anyone's attention – MCU-Coatings 2-coat system with its zinc primer has 20% - 50% more, high purity, zinc than conventional coating systems.

MCU-Coatings primers and topcoats also include several other features and innovations that are worth mentioning:

a) **Moisture cure urethane base resin**: Moisture cure urethanes have an innate advantage over epoxies, alkyds, and polyurethanes because: they are single component (no separate catalyst), there is always an abundance of moisture in the atmosphere to cure the resin, and they absorb and react with any residual micro-moisture on steel surfaces.

   This reaction with any available moisture is incredibly important because the resin cure process eliminates any and all micro-moisture on the surface, one of the 2 primary elements that cause corrosive reactions, in the micro-spaces under the coating. Furthermore, if there is no micro-moisture left on the surface, there is nothing for any residual salts or other contaminants to react with.



b) **Adhesion**: MCU-Coatings primers adhere tenaciously to prepared steel surfaces. Independent test results have confirmed that even on ST3 prepared surfaces the adhesive bond they achieve exceeds 10 MPa, and on Sa 2½ and Sa 3 surfaces the bond strength usually exceeds 14 MPa. With MCU-Aluprime the bond strength increases to 19 MPa. With these numbers it is obvious that there is a strong covalent bond between the steel and primer. This bond strength shines through, even after 10,000 hours of salt spray testing (conducted on all MCU-Coatings primers) as it prevents under creep corrosion.

c) **Resin Flexibility**: All MCU-Coatings' polymers are based on a 100% pure urethane resin, which converts into a pure polyurea once it has cured. This proprietary base resin has been developed by MCU-Coating and is not comparable with any other coatings.

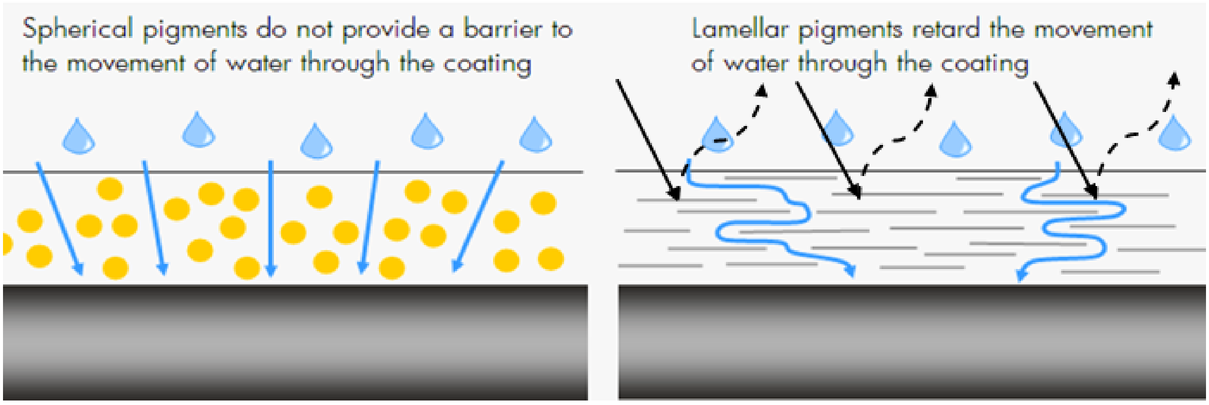
   When this moisture cured urethane resin reacts with moisture it forms long molecular strings and has minimal cross linking. As a result, the cured resin is really stable and unreactive, and has excellent resistance to thermal degradation, because the strong bonds in the long chain backbone minimise cross-linking and secondary weathering type reactions, which would otherwise reduce the resin's flexibility. As a consequence, MCU-Coatings do not embrittle over time and are not prone to heat stress and mud-cracking. Paradoxically traditional coatings are all based on blended polymers that have a lot of cross linking and free radical activity, which is why they embrittle over time.

d) **Use of micaceous iron oxide (MIO) and aluminium additives**: This is an interesting design innovation because micaceous particles align with their magnetic orientation and create a multi-layered, protective barrier (akin to fish scales). (*The name "micaceous" is used to indicate its similarity to mica in its crystalline form, but no mica mineral is associated with this pigment product*).

   This method of protection has many advantages because:

   - it improves particle distribution by creating multiple protective layers, thereby creating an impossible (or arduous path) for contaminants to navigate before they can reach the substrate;
   - the resin is able to encapsulate individual micaceous particles, thereby eliminating any direct pathways for contaminants to reach the substrate;
   - the shiny micaceous platelets reflect and dissipate ultraviolet rays and heat, which limits any heat build-up within the resin. This is important because heat and ultraviolet rays would otherwise set-off secondary polymeric reactions that would break-down the polymer's linkages and prematurely age the material;
   - it contributes to the adhesion bond because of the alignment and overlapping of the flat 'platelets';
   - improves the coverage on metal edges and corners.

   Interestingly, the resin coating is thin enough, so it does not impair the cathodic electrical currents and it also allows for the CO_2 gasses generated by the resin cure to escape, thereby enabling thicker film builds and preventing blistering.



(*Steel is chemically unstable - it rapidly rusts in the presence of oxygen and moisture to form iron oxide (rust). Iron oxide is however chemically stable as it cannot rust any further. Iron oxide is therefore an excellent pigment, and MIO is even better when it comes to the protection of steel*).

e) **% zinc content**: Australian Standards define 'Zinc-Rich Primers' as having at least 85% zinc, which when viewed in isolation is strange because there is no mention of zinc purity and /or particle sizing – which is significant because zinc has a high specific gravity and is therefore prone to settle. Furthermore, because the zinc filler particles do not bond with resin, these heavily loaded primers tend to be brittle and porous because there is not enough resin.

MCU-Coatings only uses high grade, high purity pigments and additives in coatings. MCU-Coatings have also carried out extensive research to achieve the right balance between resin and additives in all of its products, having due regards to their shape, performance and sizing, in order to optimise their coatings' barrier protection.

f) **Particle size**: MCU-Coatings formulations use smaller particle sizing than most traditional systems (less than 3µm), so that the pigments and additives are held in suspension. This helps ensure that the fillers are spread evenly during application. It also means that MCU-Coating resins are better at wetting the surface, filling small pit holes and crevices and covering edges.

g) **Use of high-quality pigments and additives**: It seems fairly obvious that the inclusion of high quality, high purity raw materials that are not easily broken down and oxidised will improve the performance and longevity of any protective coatings. MCU-Coatings are only made with the best quality raw materials.

h) **Colour pigments**: MCU-Coatings do not include lead-based colour pigments, which is consistent with European regulations. Interestingly in the U.S. they still permit low level lead concentrations.

i) **Salt tolerance**: MCU-Coatings zinc primers tolerate slightly higher salt values than other coatings because they use up and absorb any and all surface micro-moisture, which means they are a lower risk alternative. They also do not leach like most conventional coatings because the fillers are encapsulated and because of the platelet / fish-scale barrier protection.

A word of caution however, to prevent any chance of osmotic blistering, MCU-Coatings do not encourage coating surfaces when salt values are over 50mg/m².

j) **Absence of zinc salts**: Our MCU-Coatings zinc primers do not form zinc salts on the surface, even when exposed for many months in C5 coastal atmospheres. The reason is because our resins have a tight micaceous profile and micro-sizing, which ensures the zinc particles are suspended and encapsulated by the resin, so the particles cannot fall out of suspension. It is only when the coating is mechanically damaged, and the zinc particles are exposed, that they become anodic and protect the steel in the damaged area.

   This is one of the many reasons why our coatings perform so well, have open recoat intervals and outperform both inorganic zinc and hot-dipped galvanizing over an extended period.

k) **Environmental footprint:** MCU-Coatings are generally applied 25%-35% thinner than conventional 2-pack coatings and survive at up to 4 times longer. Their VOC footprint is also compliant with European and Australian regulations. As they are applied with a 25-30% lower DFT, and last up to 4 times longer, their environmental footprint is by default as much as 90% lower than conventional coating systems.

   The five factors that NACE have identified that have a large effect on the rate of corrosion: oxygen, temperature, chemical salts, humidity and pollutants have all been 'countered' in the design and formulation of all MCU-Coatings products.

Another twenty reasons to join the MCU-Revolution!