Galvanic corrosion between stainless steel and aluminium occurs when the two metals touch in the presence of an electrolyte [like moisture or salt], causing the aluminium to act as a sacrificial anode and corrode rapidly. Preventing it requires breaking the electrical circuit using physical barriers, isolating fasteners, and applying protective coatings.

Understanding the science and adopting preventative measures is essential to ensure longevity in mixed stainless steel/aluminium landscape products.

The Science: How it Happens

Putting the metals together, and adding moisture or salt, in effect creates a 'battery' and electrons flow from the aluminium to the stainless steel.

The Anode: Aluminium is less 'noble' and chemically active, making it the anode.

The Cathode: Stainless steel is more 'noble' and highly resistant to corrosion, making it the cathode.

The Electrolyte: Moisture [especially salt spray or rain] completes the circuit, allowing electrons to flow from the aluminium to the stainless steel.

The Result: The aluminium degrades rapidly on an atomic level, while the stainless steel remains perfectly intact. The larger the stainless steel surface area in contact with a smaller piece of aluminium, the faster the aluminium will fail.

The most clear sign of this issue is when a landscape product made from aluminium has essentially 'dissolved' at the points where it is touching stainless steel, whilst the stainless steel fastenings remain intact and 'shiny and new'.

The Obvious Solution

The most obvious solution is "just don't do it". Always use the like-for-like metal throughout the whole design and assembly. Wherever this is achievable, then it should always be done.

However, the metals have distinctly different properties and sometimes using them together is unavoidable. For example:

The frames of outdoor seating might be specified as aluminium, for its unique combination of low weight and high corrosion-resistance; but stainless steel fasteners would almost always be used, as aluminium fasteners are too soft and can 'gall' [seize up or snap] under the structural loads required for seating.

Aluminium is a lot cheaper that stainless steel – and a lot lighter – and it is equally corrosion-resistance; but aluminium lacks the strength and stiffness of stainless steel. So a landscape product design may well combine the unique properties of both: where [say] lightweight aluminium cladding is attached to a robust stainless steel structure.

In lighting installations, a similar argument applies, but for different reasons. As well as being light in weight, aluminium also possesses excellent thermal conductivity. So for [say] illuminated planters and/or seating in public real, stainless steel would be preferred for its superior structural strength; however a lot of the LED lighting components, such as internal heat sinks, will be aluminium.

Where planters are integrated with a balustrade or edge protection at height, the essential structure might be utility-grade stainless steel; whilst the visible handrails or guardrails might be mirror-polished polished stainless finish, for aesthetic reasons; but the infill panels might be perforated aluminium for cost and weight savings.

Where mixing metals is desired – or cannot be avoided – the following mitigating strategies should be carefully assessed and implemented as necessary.

Essential Prevention Methods

To stop galvanic corrosion, the electrical path between the two metals must be broken.

Use Dielectric Barriers: Never allow the two metals to touch directly. Use non-conductive materials such as rubber, neoprene, nylon washers, or plastic sleeves [often called a "top hat" washer] between the metals and inside bolt holes.

Isolate Fasteners: If there is no choice but to use stainless steel bolts or screws in aluminium, wrap the threads or use an anti-seize paste/zinc chromate primer. Alternatively, use aluminium fasteners if the structural load permits – and check the viability of this 'like-with-like' option first.

Apply Protective Coatings: Coat the stainless steel, the aluminium – ideally both – with a dielectric paint [like epoxy or polyurethane] to prevent moisture from bridging them.

Use Sealants: Apply a high-quality marine or polyurethane sealant at the joint to prevent moisture from seeping into the crevices.

Applying these preventative methods – systematically, so as to be effective – requires extreme manufacturing discipline.

Best Practices in Design and Specification

Astute design and specification can also greatly contribute to mitigating the risks.

Control the Area Ratio: Always ensure the anodic metal [aluminium] has a much larger surface area than the cathodic metal [stainless steel]. For example: never use large stainless steel plates with tiny aluminium fasteners in a wet environment.

Eliminate Crevices: Tight, overlapping joints create areas where moisture can get trapped and linger. IOTA would always recommend fully-welded and faired constructions in all circumstances – and most certainly where metals are being mixed.

Consider Alternatives: If the project is in a highly corrosive environment [like coastal], then it is simply better to "bite the cost bullet" and specify that ALL components, sub-components and assemblies must be 100% 316-grade stainless steel.

In these situations, there are many detailed design and specification issues that IOTA would expect to be 'sweated out' during the process of manufacturing design, after the contract is awarded.