Fibre-Reinforced Plastic Stopping Corrosion in its Tracks

Eliminating the costs and associated risks of corrosion and electrical conductivity

PermaStruct®
www.permastruct.com
Introduction

For buildings and infrastructure within the marine, offshore, port, shipping, sewerage, power generation and mining industries, the use of materials that are vulnerable to corrosion and/or are electrically conductive remains an ongoing concern.

The use of steel, aluminium, wood and concrete in highly aggressive environments means they are constantly and steadily worn down by salt water and chemical corrosion.

And while aluminium is often thought to be corrosion-resistant in marine environments, it is, like most metals, vulnerable to galvanic corrosion, where the presence of two different types of metal in the environment, along with salt water, causes one metal to give up its metallic ions and effectively dissolve.

The only way to prevent galvanic corrosion is to insulate the metals from each other using coatings, paint, or other design mechanisms.

Corrosion has a massive cost impact: according to G2MT Laboratories, corrosion will cost the US economy alone over US$1 trillion in 2015, factoring in both direct and indirect costs. Engineers in Australia estimate corrosion costs 3 to 4% of annual GDP globally, translating to a conservative $60 billion for Australia in 2014.

Ongoing costs of corrosion

Corrosion has obvious costs and downtimes associated with the inspection, maintenance, repairs, and replacement of corroded parts. Direct costs to the facility/structure owner include:

1. Operational expenditure in conditional monitoring of buildings and structures
2. Cost of repairing or replacing components and structures
3. Maintaining and keeping an inventory of replacement components
4. Cost of maintenance downtime on production

Then there are the indirect costs, which might include:

1. Penalties and litigation from accidental material discharge into the environment caused by corrosion-based failures
2. Loss of life or injury caused by failure of corroded structures
3. Loss of electrical power supply, if the affected facility is a power station

Increased project costs

Corrosion also adds to the cost and time needed during the design, engineering and construction phases. Engineers must modify their designs or add complex work-arounds in a bid to minimise the impact of corrosion, such as;

1. Increased wall thicknesses for certain materials and parts, to compensate for losses due to corrosion
2. Designing around and implementing condition monitoring sensors and systems
3. Designing around and implementing protective mechanisms like coatings, paints, sealants, inhibitors and cathodic protection systems

The only way to prevent galvanic corrosion is to insulate the metals from each other using coatings, paint, or other design mechanisms.
An electrical risk

Similarly, use of electrically conductive materials can cause various issues.

1. Electrical currents can stray from the anticipated path due to improper wiring or defective devices: conductive materials used can increase the risk of electrocution during construction and maintenance
2. Short circuits can damage plant and equipment
3. Sparking can occur, creating a fire and explosive hazard in volatile environments
4. Unexpected radio frequency and magnetic interference
5. Electrolytic corrosion caused by stray currents

The use of corrosion-vulnerable and conductive materials in challenging applications adds to the costs of design and engineering. It also results in the use of inelegant and inefficient work-arounds, as well as contributing to ongoing losses due to maintenance costs and down-time. Safety is also a major issue.

The solution: PermaStruct® Fibreglass Reinforced Polymer

Perma Composites® supplies PermaStruct®; a range of Fibreglass Reinforced Polymer (FRP) materials.

Non-corrosive and non-electrically-conductive, PermaStruct® is a superb replacement for conventional construction materials such as timber, steel, aluminium, and concrete. Its properties allow it to be used to construct infrastructure such as platforms, access stairs, boardwalks, marinas, etc.

With its strength, non-corrosive, and non-conductive properties, structures and buildings in challenging environments enjoy increased life spans, with zero need for ongoing maintenance or repair.

Engineers and architects no longer have to factor in corrosion-mitigation measures, while the end customer enjoys improved safety and cost savings over the lifetime of the structure.
PermaStruct® is particularly valuable in the marine and utilities industries such as water treatment plants: the non-corrosive property means there are massive savings to be made in eliminating corrosion monitoring and maintenance costs. Facility owners can benefit from increased production uptime as they no longer have to shut down machinery or production to maintain or replace worn and corroded materials and structures.

PermaStruct® has also been used to great effect in projects that include electrical infrastructure. It is used to create strong and maintenance-free cable trays, conduit trenches and ladders that can be safely situated in close proximity to electrical cables and equipment.

Since it does not conduct electricity, there is little to no risk of accidental electrocution, electromagnetic interference or sparking.

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<table>
<thead>
<tr>
<th>Electrically conductive?</th>
<th>Degradation</th>
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<tbody>
<tr>
<td>PermaStruct® FRP</td>
<td>Non-corrrosive</td>
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<tr>
<td>Timber</td>
<td>Warps and rots over time, vulnerable to mold, mildew, termites and wood-eating shipworms</td>
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<tr>
<td>Steel</td>
<td>Vulnerable to natural corrosion (rusting). Can be corroded by green timber or timber treated with copper chromium arsenic. Vulnerable to galvanic corrosion.</td>
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<tr>
<td>Aluminium</td>
<td>Treated timber can cause corrosion if placed in contact. Vulnerable to galvanic corrosion.</td>
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<tr>
<td>Concrete</td>
<td>Degraded by aggregate expansion, rebar corrosion, effects of sea water (crystallisation of salts trapped in concrete pores), bacteria, calcium leaching, carbonatation, chlorides, sulfates and distilled water.</td>
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A versatile drop-in replacement material

PermaStruct® can be worked with in much the same way as other materials are used, allowing it to be designed and engineered into structures without requiring major modifications. When engineered correctly, PermaStruct® provides strength in structural design equal to that of its steel counterparts.

For conventional uses, the material can be supplied in a range of conventional profiles, such as I Beam, Channel, Angle, Box RHS, SHS, Flat and Tube sections. It can be installed with standard tools and fittings.

Additionally, PermaStruct® Grating and Decking range is available in many styles and finishes, including non-slip surfaces for structures like stairs, decks, platforms and walkways. For more visible applications, the material can replicate the appearance of concrete, and since it can be supplied in different colours to match your project, this eliminates the time and cost required for further surface preparation, coating, or painting.

Enabling innovative design and building

For more ambitious projects, however, Perma Composites® design and engineer PermaStruct® in bespoke profiles for a range of industries and applications.

With PermaStruct®, architects and engineers now have a massive scope for flexibility and innovation in designs, thanks largely to the exacting pultrusion process which allows Perma Composites® to cost-effectively produce any range of profiles, regardless of size and shape.

This is perhaps the greatest differentiating factor when it comes to working with Perma Composites® rather than just being a building materials supplier, the company works in an active partnership with engineers and architects to design, construct and create solutions that are uniquely and optimally suited for their individual project requirements.

PermaStruct®, a fibre-reinforced plastic from Perma Composites®, eliminates the costs and risks associated with corrosion and electrical conductivity.

Conclusion

PermaStruct®, a fibre-reinforced plastic from Perma Composites®, eliminates the costs and risks associated with corrosion and electrical conductivity. It delivers value to the end customer by improving uptime, lower monitoring and maintenance costs, and improving safety.

For engineers, architects, project managers and estimators, PermaStruct® dramatically streamlines the design and construction process, since there is no longer a need to design in or implement corrosion-mitigation measures.

Because PermaStruct® is available in conventional steel-based profiles, design, engineering and construction work is simplified. For more ambitious architects and engineers, Perma Composites®' ability to work closely with them to produce customised profiles will enable unparalleled design innovations and efficiency.