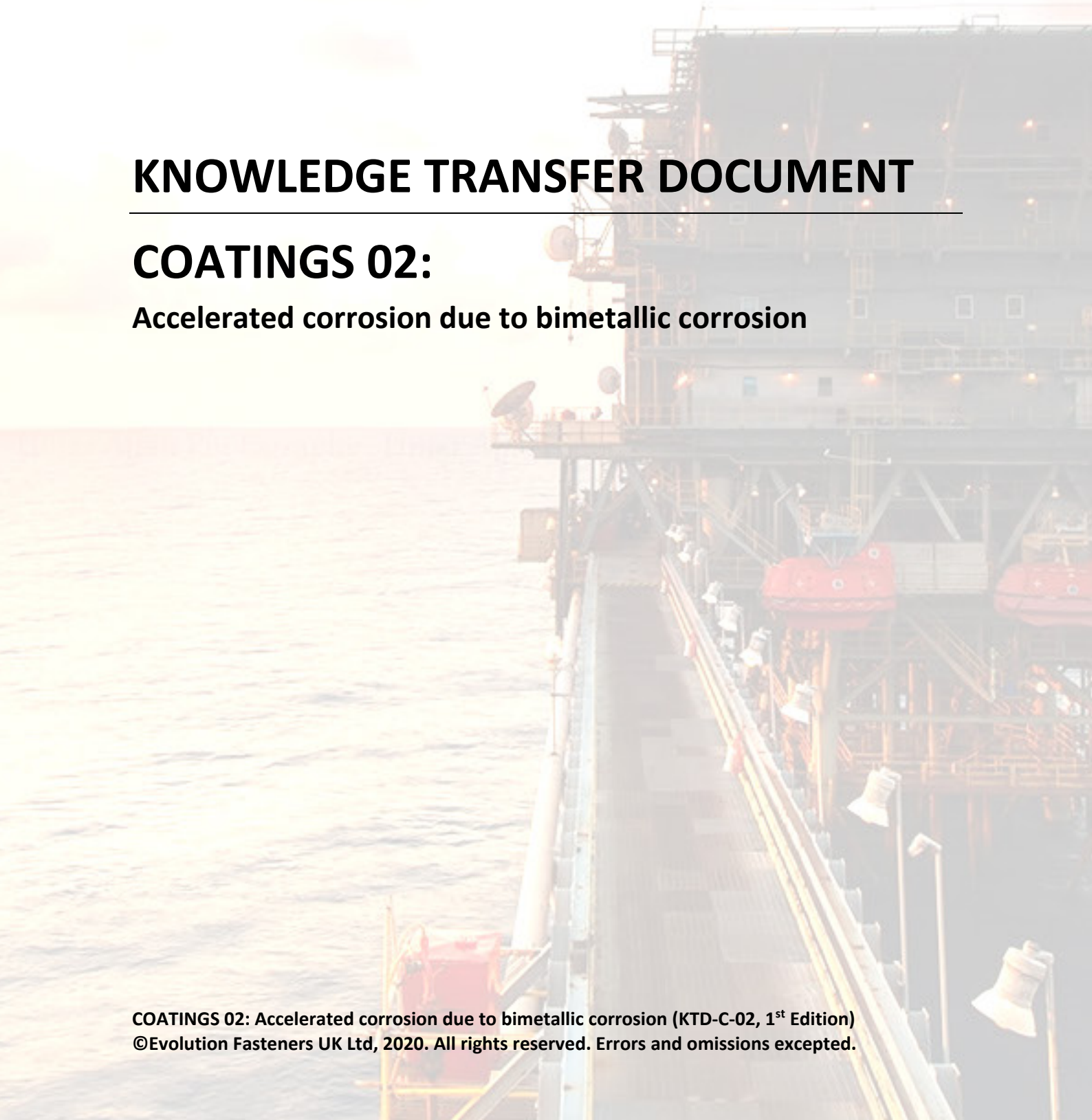

KNOWLEDGE TRANSFER DOCUMENT

COATINGS 02:

Accelerated corrosion due to bimetallic corrosion

COATINGS 02: Accelerated corrosion due to bimetallic corrosion (KTD-C-02, 1st Edition)

KNOWLEDGE TRANSFER DOCUMENT[1]

COATINGS 02: Accelerated corrosion due to bimetallic corrosion

1.0 Principle of phenomenon

The phenomenon of bimetallic corrosion (for the purposes of this document the terms “bimetallic” and “galvanic” can be considered synonymous) is a poorly understood topic in the world of construction fasteners.

The scientific principal of the phenomenon is that standard corrosion is accelerated due to ion exchange between two dissimilar metals in the presence of an electrolyte (Wikipedia, 2019).

However, this is a simplistic explanation. The ion exchange happens due to the movement of electrons between two metals of differing electrode potentials where both metals are immersed in an electrolyte. The electrolyte is the conductive medium that completes the electric circuit (American Galvanizers Association, 2012). Figure 01, below, shows the circuit diagram in a simplified form.

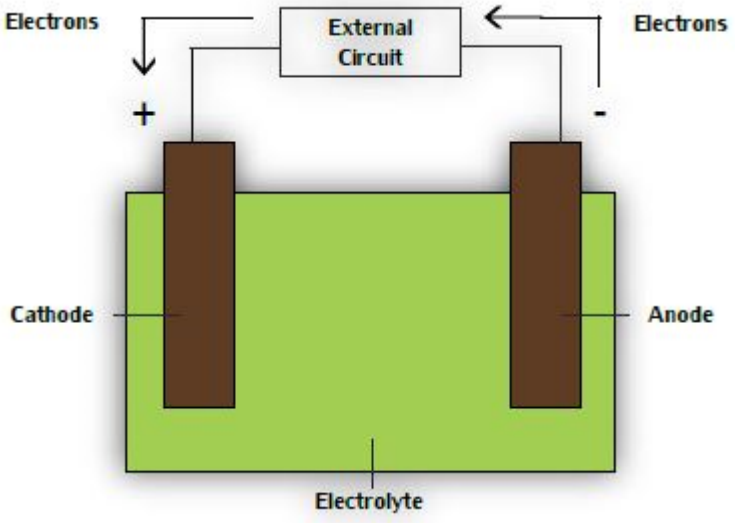

Fig. 01 – Circuit diagram of a galvanic corrosion cell[2]

[1] Cover image used pursuant to Pexels® license. Photographer: Zukiman, Mohamad,
[2] Figure provided by, and credited to, the American Galvanizers Association.

2.0 Selection of fasteners

For safety reasons, the fastener selected by a specifier should always be made on the basis of choosing a fastener made of a material which is more noble than the material of the substrate that is being fixed. This is due to the fact that the fastener has a much smaller surface area of contact in comparison to the substrate, thus, failure of the fastener would result in critical failure of the connection.

To aid specifiers, we have summarised the most common fastener materials, coatings and substrates found in the construction industry in table 01 (below) and the severity of the impact of bimetallic corrosion in each scenario. It is important to note that this table was derived from the electrode potentials for the metals when immersed in sea water (Wikipedia, 2019). However, this only holds true in certain scenarios, as changing the electrolyte will change the order of the galvanic series (United States Department of Defense, 2016).

Table 01 – Severity of impact on lifetime of fastener due to accelerated corrosion[3]

Substrate	Fastener material			
	Electroplated	Organic coating[4]	HDG[5]	Stainless steel[6]
Electroplated	Negligible	Negligible	Negligible	Negligible
HDG[5]	Negligible	Negligible	Negligible	Negligible
Aluminium	Moderate	Moderate	Moderate	Negligible
Mild steel	Extreme	Extreme	Extreme	Negligible
Stainless steel	Extreme	Extreme	Extreme	Negligible
Tin	Extreme	Extreme	Extreme	Negligible
Copper	Extreme	Extreme	Extreme	Negligible
Brass	Extreme	Extreme	Extreme	Negligible

Please note that this document does not take into account other routes to corrosion and solely focusses on the singular issue of bimetallic corrosion. Readers must consult other technical literature and documentation in the course of deciding upon their fastener specification. For further support please contact our Technical Department.

[3] Use of this table doesn't alleviate any reader of their design responsibilities. Readers must always seek confirmation of suitability for their application prior to specifying fasteners,
[4] Refers to organic coating (such as EvoShield®) of a carbon steel fastener,
[5] HDG refers to "Hot-Dip Galvanising",
[6] Specifically, an appropriate austenitic grade pursuant to BS EN ISO 3506-1.

3.0 Bibliography and references

American Galvanizers Association, 2012. Galvanic Corrosion. In: *Hot-Dip Galvanizing for Corrosion Protection: A Specifiers' Guide.* Centennial: American Galvanizers Association, p. 4.

United Stated Department of Defense, 2016. Department of Defense Standard Practice: Dissimilar Metals. In: Commander Sikora, M., ed. *MIL-STD-889C*. Patuxent River: Naval Air Warfare Centre – Aircraft Division.

Wikipedia, 2019. *Galvanic corrosion.* [Online]
Available at: https://en.wikipedia.org/wiki/Galvanic_corrosion
[Accessed January 2020].

Wikipedia, 2019. *Galvanic series.* [Online]
Available at: https://en.wikipedia.org/wiki/Galvanic_series
[Accessed January 2020].

[END OF DOCUMENT]