



CORROSION: HOW THE GCM CAN HELP YOU

Whether it's because of an old car disintegrating in front of your eyes, the rusting rebar on a concrete structure that is in need of emergency repairs or a leaking pipe that quickly turned a regular home into an indoor pool; we are all affected by corrosion. While this phenomenon brings all kinds of interesting scientific questions, it is also worth noting the gigantic scale of the problem: 430 billion dollars of costs only in the USA for 2006. Furthermore, corrosion is the epitome of waste: the metals are destroyed and the energy, as opposed to a battery, is wasted. Paradoxically, the modern economy relies a lot on metallic materials that are unstable in the Earth's environment. In some cases, the oxidation can effectively protect the material by forming a thin adherent oxide film but in others the corrosion is continuous and the material goes back to its most stable form.

From a general point of view, corrosion is characterized by the breakdown of a material because of chemical reactions with its environment. While some alloys are more resistant than others, all materials are susceptible given the right environment. In practice, electrochemical reactions require the presence of an electron donor (in this case iron) but also of an acceptor (often water and oxygen – Figure 1).

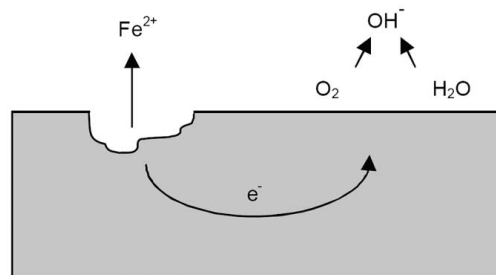


Figure 1 : Corrosion process

Types of corrosion

Rust is one of the most well-known forms of corrosion but is also one of the easiest to monitor since bare carbon steel tends to form a continuous and flaking iron oxide film that is very easy to see. However, other alloys (ex: stainless steels) have the tendency to form small holes on the surface (pitting corrosion) that are significantly harder to detect. For example, the series of explosion in the Mexican city of Guadalajara, that killed 250 people and caused more than 300 million dollars in damage in 1992, was partially caused by pitting corrosion of a water line. This created localized leaks in a piping system that was otherwise in good condition. Cracks and defects naturally present in a material can also be fertile ground for corrosion (crevice corrosion) if aggressive species like chloride ions can penetrate them. A typical example is the degradation of metallic structures under the bolt heads or in joints between steel members.

Also, since the corrosion resistance of different materials varies tremendously, their combination is often problematic. In fact, when two metals are in contact in a corrosive environment, the most reactive one will tend to corrode at an accelerated rate to “protect” the other. This phenomenon, called galvanic corrosion, can cause a lot of damage in an unexpected way. For example, when new copper pipes are connected directly to existing galvanized water lines, a new leak will often form very rapidly on the steel side because of the presence of a more noble metal (copper) and an electrolyte (water).

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Figure 2 : Galvanized steel pipe partially blocked by corrosion products.

Protection methods

The most efficient way to avoid corrosion damage is obviously to select a material that resists its service environment. However, several other factors (cost, mechanical properties, etc...) can affect the decision. It is also possible to apply an inert barrier (ex: paint) a sacrificial one (ex: galvanization) or to use corrosion inhibitors. Finally, it is also possible to protect a structure immersed in a corrosive environment by the application of a cathodic (negative) potential using a source of current that replaces metal oxidation. In any case however, expert advice is necessary to avoid costly mistakes.

THE GCM, WITH ITS EXPERT PERSONNEL AND ITS ADVANCED INSTRUMENTS CAN, AMONG OTHER THINGS, HELP YOU SELECT A MATERIAL, ANALYZE CORROSION PRODUCTS AND DESIGN ADVANCED COATINGS! IF YOU NEED MORE INFORMATION OR HELP FOR YOUR PROJECT DO NOT HESITATE TO CONTACT:

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