What Are Volatile Corrosion Inhibitors?

A corrosion inhibitor is a chemical substance or combination thereof, which prevents or significantly reduces corrosion without reacting with the environment [1]. A corrosion inhibitor provides protection via three fundamental mechanisms [2]:

1. Form of an ionic bond on the surface
2. Form a film by oxide protection of the surface
3. Change the corrosiveness of an aqueous media

In 1985, a review of vapor phased corrosion was conducted under a US Army contract [3]. It was reported that volatile corrosion inhibitors (VCIs) were an effective and relatively inexpensive means of corrosion protection in closed environments.

In solid form and ambient conditions, organic VCIs have sufficient vapor pressure to penetrate complex geometries. Traditional VCIs include those that are nitrate/nitrite based. When these VCI vapors are in the presence of moisture they become polarized. Once polarized, they form an ionic bond with the surface of the metal, forming a barrier against corrosion [4].

Recent advances in VCI technology have been moved toward environmentally friendly, nitrate/nitrite free formulations. These new formulations create a barrier between the metal substrate and corrosive agents including oxygen, moisture, chlorides, and other corrosion accelerants in the atmosphere. VCI efficacy can be assessed by conducting a controlled charge using stringent standard test methods [5], [6], [7] and perhaps most importantly, field trials.

A practical VCI has an optimal vapor pressure. If the vapor pressure is too low, it will take too long for the concentration of the corrosion inhibitor to reach an effective level. Conversely, if the vapor pressure is too high, the VCI will be consumed too quickly and limit the duration of the effective concentration [3].

Blending VCIs with different vapor pressures provides protection over the short, medium, and long term.

Furthermore, multiple formulations provide protection for assets made from a variety of metals.

The rate of corrosion generally increases as temperature rises. Fortunately, as the temperature rises, so does the rate of VCI vaporization. Thus, the environment is self-correcting with fluctuations in temperature [4].

Furthermore, VCI molecules in vapor form also provide a self-healing capability since they are attracted to any bare metal.

An elegant engineering solution has been found to manage the VCI concentration when bounded by permeable barriers. Adhesive encapsulation of the VCI allows effective concentrations of VCI vapors to be released over extended periods of time [8].

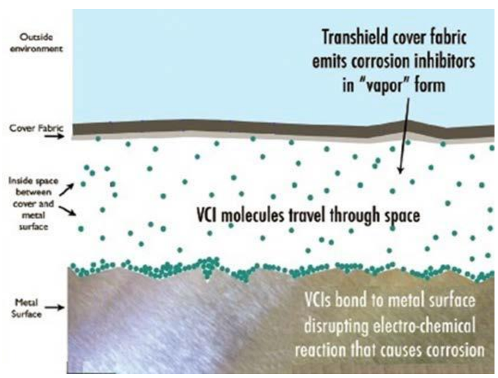

Figure 2. VCI in vapor form migrating and bonding to the metal.

References
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[5] MIL-STD-3010B Method 4031 - Vapor Inhibiting Ability (VIA) of Volatile Corrosion Inhibitors Materials
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