WHITEPAPER

3 QUESTIONS TO ASK WHEN CHOOSING AN HVAC-R COATING FOR MARINE ENVIRONMENTS

HERESITE® PROTECTIVE COATINGS, LLC

HVAC-R coil corrosion is costly. The corrosion of HVAC-R coils may lead to reduced equipment performance or premature failure. However, corrosion can be delayed if the coil is protected with a coating proven to provide protection in the unit's operating environment.

Coastal/Marine Coastal or marine environments are particularly harsh environments characterized by the abundance of sodium chloride (salt) which is carried by sea spray, mist, or fog. The combination of sodium chloride, temperature fluctuations, moisture, and other pollutants have been shown to have significant corrosive impact on HVAC coils as far away as 5 miles from the coast. As a result, protection of HVAC equipment from ocean-borne electrolytes in inland areas is often required as well. Line-of-sight distance from the ocean, prevailing wind direction, relative humidity, wet/dry time, and coil temperature will determine the severity of corrosion potential in the coastal environment. If the condenser coil faces the ocean or into the prevailing winds from the coast, there is a high probability of sodium chloride/salt contamination. Appropriate protection is strongly recommended.

There are three questions to be considered when choosing an HVAC-R coating:

1. How much protection is needed?
2. How is the coating applied?
3. How was the coating tested?

Obtaining answers to these three questions will ensure a proper coating selection and optimal performance for your HVAC-R equipment.

1. HOW MUCH PROTECTION IS NEEDED?

The International Standards Organization (ISO) classifies environments in atmospheric corrosivity categories of C1 through C5-M or C5-I based on long-term material mass loss and thickness loss testing. Although the corrosivity category classification dictates the level of protection needed, it is important to note that coating systems are typically tested against higher levels of corrosivity. Higher levels of testing are used because a coating that can protect against the most severe C5-M or C5-I environments is certainly capable of providing protection in a less severe environment.

The corrosivity categories are:

C1 – Very Low

- Example environments include: heated buildings with clean atmospheres such as schools or offices

C2 – Low

- Example exterior environments include: atmospheres with low levels of pollution, mostly rural areas
- Example interior environments include: unheated buildings where condensation may occur such as depots or sports halls

C3 – Medium

- Example exterior environments include: urban and industrial atmospheres, moderate sulfur dioxide pollution, or coastal areas with low salinity
- Example interior environments include: production rooms with high humidity and some air pollution such as food processing plants, laundries, breweries, or dairies

C4 – High

- Example exterior environments include: industrial areas and coastal areas with moderate salinity
- Example interior environments include: chemical plants, swimming pools, coastal ship and boat yards

C5-I – Very High (industrial)

- Example exterior environments include: industrial areas with high humidity and aggressive atmospheres
- Example interior environments include: buildings are areas with almost permanent condensation and with high pollution

C5-M – Very High (marine)

- Example exterior environments include: coastal and offshore areas with high salinity
- Example interior environments include: buildings or areas with almost permanent condensation and with high pollution

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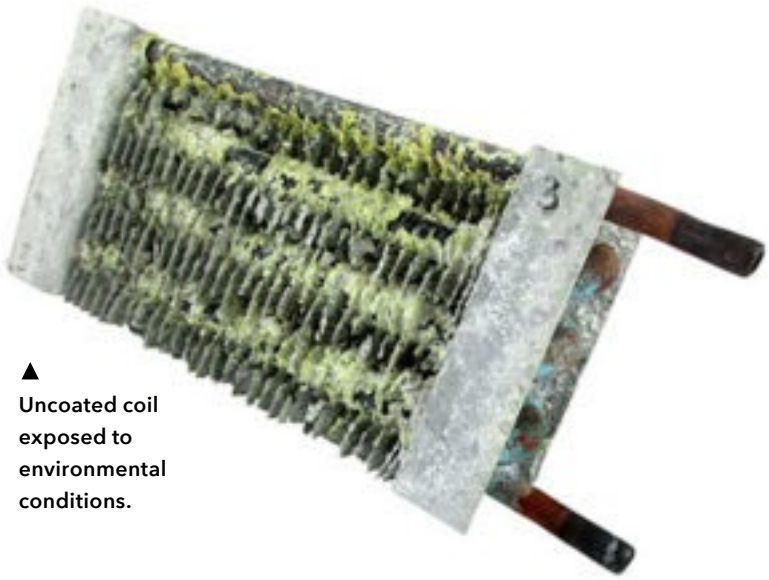
When choosing a coating, be sure that it has been tested against the environment in which your unit will be located. Remember, HVAC-R coatings that pass tests for corrosivity categories higher than your environment can be successfully used on HVAC-R units at lower levels of corrosivity. Choosing a coating with a higher corrosivity rating will ensure that HVAC-R units are protected from the inherent variability of conditions present in most environments as weather patterns cause environmental severity to fluctuate from day to day.



▲ **Uncoated coil exposed to environmental conditions.**

2. HOW IS THE COATING APPLIED?

HVAC-R coil coatings can be applied in several ways. The application method can directly impact the effectiveness of the coating. Two of the most common methods of coating coils are spraying the coating on the coil or fully immersing the coil in a coating solution. Each application method has advantages and disadvantages.

Immersion method

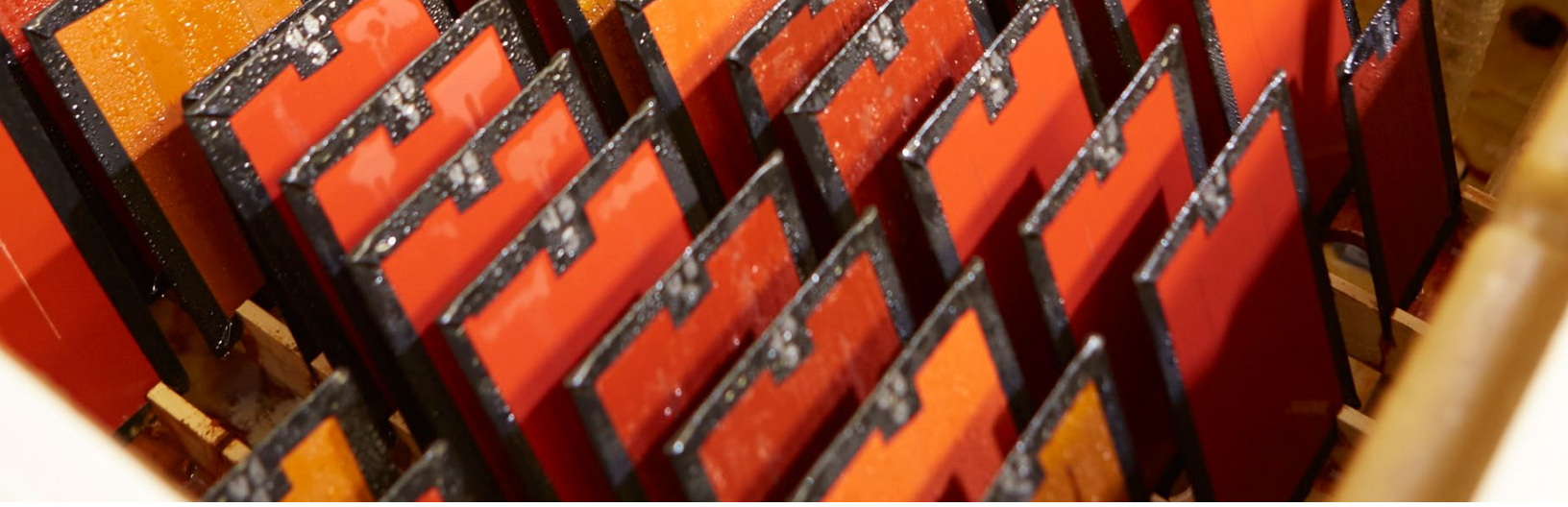
The full immersion (or dipping) method is ideal for coils in high corrosivity environments, such as marine and industrial environments, because it offers complete, uniform coverage of all areas of the coil, including the center. The formulations used in immersion coatings provide advantages over those used in spray coatings, including:

- **Marine corrosion test performance.** Some immersion formulations (including Heresite's P-413) have performed extremely well in lengthy cyclical tests duplicating demanding environments, such as the ISO 20340 offshore standard.
- **Chemical resistance performance.** To meet the requirements of various environments, coatings must be able to provide protection in acidic environments as well as (in some cases) against basic chemistry, including sanitation chemicals. Immersion coatings provide maximum chemical resistance due to the coating's oven curing process. For example, foodservice environments require protection against both acidic and basic chemical exposure. NSF-approval in foodservice environments can be required for HVAC-R equipment. Heresite's P-413 meets NSF requirements.

The main disadvantage to immersion-applied coatings is that the coils must be shipped to a factory where the product can undergo coating and oven curing. This oven cure is required to provide the highest protection level. Although some engineers believe that immersion-applied coatings can be brittle, impact and mandrel bend tests have proven that current formulations demonstrate the same level of flexibility as other coatings.

Spray method

The spray method is a good alternative for coils that cannot be transported to a facility for a full immersion process. Spray coatings are typically more economically priced as the application equipment needed is relatively limited. However, spray coatings have some disadvantages. A significant disadvantage for spray coatings is reduced coverage for coils with greater depth or high fins per inch (e.g. >4 tube rows or >17 fins per inch). When the coating is sprayed on, it is unable to penetrate every surface of the coil. If the spray does not reach the center of the coil, some parts of the coil might be unprotected. In addition, most spray coatings do not offer the same corrosion protection as oven-cured immersion coatings. Without an oven cure, the coating's resistance to both marine and chemical corrosive environments is reduced.



3. HOW WAS THE COATING TESTED?

It is important to review test results when selecting a coating. Results can be easily obtained by reviewing the supplier's technical data sheet. Be sure to review the tests that were used and the specifications of each test. Testing procedures have evolved, and newer tests use methods such as cyclic testing which provide more accurate results regarding a coating's anticipated durability in a real-world environment. It is also important to note if a topcoat was used during the test process. The use of a topcoat will impact test results. Topcoats might increase corrosion resistance and improve UV resistance in panel testing, but topcoats do potentially suffer from the coverage challenges for coils presented by spray-applied products. In addition, be sure to note the type of material and method used to prepare the tested sample, for example, if pretreatments or primers were used. Finally, for salt spray, note if the part was scribed and the evaluation method used in the testing. The standard allows manufacturers to make choices in preparing samples for testing and those choices can dramatically influence the test results.

Potential tests can include:

ASTM B-117
ASTM B-117 was the first internationally recognized salt spray standard. It has been in use since 1939 and was considered the gold standard in corrosion testing for many years. Although it is still commonly used, there is limited correlation to the fluctuating conditions that exist in a real-world environment. Therefore, newer tests should also be used to provide a correlation with your equipment's actual environment.

ISO-9227
ISO-9227 is nearly identical to the ASTM B-117 test. The main difference between the two tests is ASTM B-117 is a standard used in the United States, while ISO-9227 is recognized nearly worldwide. Like the ASTM B-117 test, newer testing procedures provide more accurate results of in-use performance.

ISO-12944-6
ISO-12944-6 was published in 1998 and represents a significant improvement in coil testing because it introduces environmental cycles to the testing procedure.

ISO 20340
The newest test, ISO 20340 is the most demanding corrosion testing standard available for marine/salt air environments. ISO 20340 has been adopted as the pre-qualification offshore performance standard for barrier coatings that may be broken down due to long term exposure to sunlight, moisture, sea water spray, and wind chills. Any HVAC-R system coating exposed to offshore or coastal marine environments should be tested according the ISO 2034 standard.

Conclusion

Evaluating the combination of protection level, application method, and testing procedure is crucial for ensuring the longevity of your HVAC-R equipment. It is also important to consider planned equipment lifespan, particularly for marine environments, which are changing. Studies conducted by National Oceanic and Atmospheric Administration (NOAA), a government agency that focuses on the conditions of the oceans and the atmosphere, show the average pH at the ocean surface has dropped from 8.2 to 8.1, a 30 percent increase in acidity. While these numbers may seem small, they demonstrate a drop in the pH of the ocean which is predicted to continue for the foreseeable future. The changes in the ocean's environment make environmental testing at higher corrosivity levels more important than ever, since coatings able to pass tests at levels such as C5-I or C5-M are well suited to protect at lower levels. By knowing your equipment's protective needs and matching these needs to test results, you will be able to choose the best coating for your units.

About Heresite Protective Coatings

Established in 1935, Heresite Protective Coatings has spent more than 80 years developing and perfecting protective coatings that solve corrosion problems in a variety of applications including commercial heating, cooling, refrigeration or other industrial process coils, as well as components that are regularly exposed to corrosive conditions, including coastal and marine environments. The company's ongoing focus on technology leadership, rigorous quality and process control, and customer satisfaction has led to the development of multiple industry-leading coatings based on phenolic, epoxy phenolic, urethane and silicone chemistries. Heresite coatings not only provide protection in corrosive high salinity marine conditions, but industrial applications such as wastewater treatment, swimming pools, food processing, mining, oil and gas, semi-conductor production, pulp and paper, textile factories and other environments where these systems are exposed to chemical fumes. For more information visit heresite.com or call 800-558-7747.

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