G.I. INDUSTRIAL HOLDING SPA

generic manual

Coils treatments

Surface treatments for copper/aluminum and microchannel coils.

CLINT

SOMMARIO

1 INTRODUCTION

Heat exchanger coils, whether copper/aluminium or microchannel technology, are key components for the efficiency and durability of HVAC units.

To protect them and enhance their performance, specific surface treatments are applied, tailored to different operating conditions.

Surface treatments are coatings or treatments applied to the coil surface that modify the properties of the metal. Depending on the technology, they can be ultra-thin and invisible to the eye, or more consistent and visible.

Surface treatments serve a dual function:

- Performance enhancement – they can improve heat transfer and condensate management.
- Corrosion protection – they shield the coil from aggressive environmental agents (salt, industrial pollutants, acid rain), preserving the integrity of the metal and extending the heat exchanger's service life.

With the right surface treatment, HVAC systems become more reliable, durable, and efficient, even when operating in demanding environments.

2 SURFACE TREATMENTS FOR PERFORMANCE ENHANCEMENT

Surface treatments play a crucial role in optimizing the functional performance of heat exchanger coils. This aspect is particularly important for heat pumps operating in winter, where the combination of low ambient temperature and high humidity often leads to frost formation on the outdoor coil. Frost acts as an insulating barrier, blocking airflow and reducing heating capacity.

By optimizing condensate management and minimizing frost formation, performance-oriented coil treatments enable HVAC systems to deliver higher efficiency, reduced operating costs, and improved reliability across all seasons.

2.1 Hydrophilic coating

Hydrophilic coating is used as a fin treatment in copper/aluminium coils to manage water vapour condensation on the fin surface.

Surface tension is responsible for the shape of the droplets: although easily deformable, water droplets tend to assume a spherical shape due to the cohesive forces of the surface layer with which they come into contact.

The hydrophilic coating modifies the surface tension and gives the water droplets a ‘flattened’ shape, thus making the fins ‘wettable’; the coating thus hinders droplet formation and has the following advantages:

- avoids the reduction of the air flow cross-section and thus the increase of pressure drops;
- allows the use of smaller fin pitches;
- allows a higher air velocity to be maintained, reducing the risk of water droplets being carried.

3 SURFACE TREATMENTS FOR CORROSION PROTECTION

Corrosion is the natural process that converts a refined metal into a more chemically stable oxide. This process leads to the gradual deterioration of the metal or alloy, due to the reaction with the environment.

UNI ISO 12944 standard defines atmospheric corrosion as the process that involves a layer of humidity on the surface of the metal. This layer can be so thin that it is not detectable by the naked eye.

The speed of corrosion is increased by the following factors:

- Increase in relative humidity;
- Condensation;
- Increase in the rate of pollution in the atmosphere.

Equipment installed outdoors, where pollution is heavy, compared to indoors, where humid microclimates with condensation can be created, can be subject to different corrosion phenomenon.

Fortunately, the harmful effects of coil corrosion can be significantly delayed or avoided if the application environment is correctly identified and the appropriate corrosion protection option is selected.

3.1 Types of corrosion

The types of corrosion that can affect a heat exchanger can be divided into two main categories:

- Localized corrosion (Galvanic corrosion)
- General corrosion

Both corrosion types can lead to heat exchanger damage and failure, depending on the material used and the ambient conditions.

3.1.1 Localized corrosion

Galvanic corrosion is the localized corrosion that occurs when dissimilar metals are in contact with each other and with an electrolyte (a substance that, when dissolved in water, conducts electricity).

Standard finned coils, made of aluminum fins mechanically bonded to copper tubes, if placed in an environment where electrolytes are present, can be subjected to galvanic corrosion where the two metals are in contact.

The aluminum fin initially corrodes at the Cu/Al interface (point of contact between two different metals). As corrosion of the aluminum fin progresses, the coil thermal performance is reduced.

As a result of the corrosion, aluminum oxide accumulates between fins, further reducing performance by impeding the air flow through the coil.

There are different options for preventing galvanic corrosion:

- Cu/Cu coils: using the same metal for fins and tubes, the necessary requirement for galvanic corrosion is eliminated.
- Isolate the heat exchanger from the electrolyte: a protective coating can be applied on the coil.
- Insulate the electrical connection between the two metals: using pre-coated aluminum fins the two different metals can be isolated.

3.1.2 General corrosion

General corrosion is the result of the reaction between the metal and the environment. This type of corrosion usually produces metal oxides.
The unprotected metal surface corrodes until the equipment's integrity is jeopardized. General corrosion leads to leaks and failure of the heat exchanger.

Pollution, wind direction, humidity, water, fog, temperature and dust are some factors that can accelerate the corrosion process.

3.2 Corrosive environments

Some corrosive environments categories are seacoast, industrial sites, heavily populated urban areas, some rural locations and combinations of these environments.
Some localized microclimates can increase the corrosive potential. For example, swimming pools, water treatment sites and industrial process areas.
Moreover, some substances, released by industrial processes, like sulfur, nitrogen and ammonia, may contribute to the formation of electrolytes.
The UNI ISO 12944 standard identifies 6 categories of environments with different degrees of corrosiveness:

Corrosivity classes	**Environments examples**	
	Outdoor	Indoor
C1 VERY LOW	-	Schools, offices, hotels, shops.
C2 Low	Natural areas with low pollution.	Warehouse, sport buildings.
C3 MODERATE	Urban and industrial areas, coasts with low salinity.	Food industries, laundries, breweries.
C4 High	Urban and industrial areas, coasts with moderate salinity.	Chemical plants, swimming pools, onshore industries.
C5 MOLTO ALTO	Industrial areas with high humidity and aggressive atmosphere.	Buildings with permanent condensation and high pollution.
CX EXTREME	Onshore and offshore plants, with high salinity, tropical environments.	Industrial buildings with extreme humidity and aggressive atmosphere.

In-situ or artificial laboratory tests make it possible to choose the most suitable coating.

3.3 Coil treatments available for corrosion prevention

To delay corrosion effect and prevent premature failure, treatments can be applied on finned coils. Treatments are operations on the surface of the coil, with the purpose of maintaining the characteristics of the coil itself, in order to avoid or delay the effects of corrosion in aggressive environments.
To test the effect of treatments on the coils, laboratory ageing tests are carried out. However, the results of artificial ageing tests must be used with caution: artificial ageing does not necessarily have the same effect as natural exposure. Many factors influence the process of degradation development and, in laboratory, it is not possible to accelerate all of them to an appropriate extent. It is therefore difficult to establish a reliable ranking of coatings with very different compositions.

3.3.1 Pre-coated fins

Finned exchangers are built using fins obtained from an aluminum coil pre-painted with a grey polyurethane epoxy paint.

i Only the finned pack is treated.

3.3.2 Black epoxy

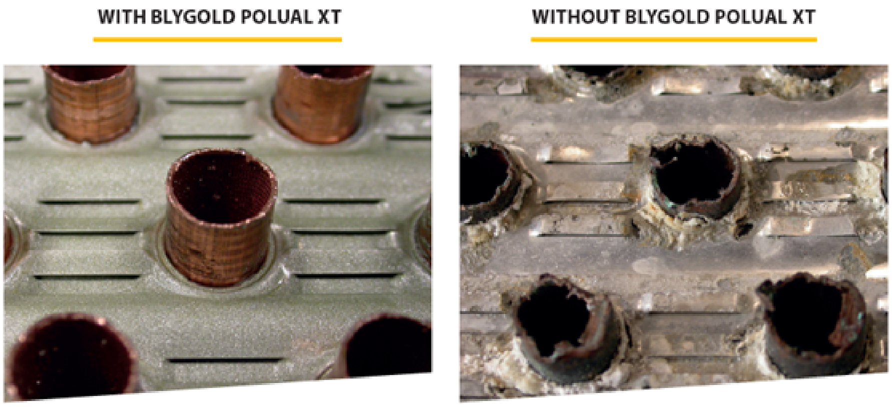
It consists of a double layer of polyurethane film applied to the entire heat exchanger. The first layer is created using total immersion cathodic deposition; the second layer consists of a spray-applied acrylic resin finish.

i The entire heat exchanger is treated.

3.3.3 Blygold

The Blygold treatment is an aluminum pigmented polyurethane coating, especially developed for the protection of air-cooled heat exchangers.
Besides, it offers flexibility, excellent adhesion and an excellent chemical and UV resistance.

i The entire heat exchanger is treated.



3.3.4 Heresite + UV treatment

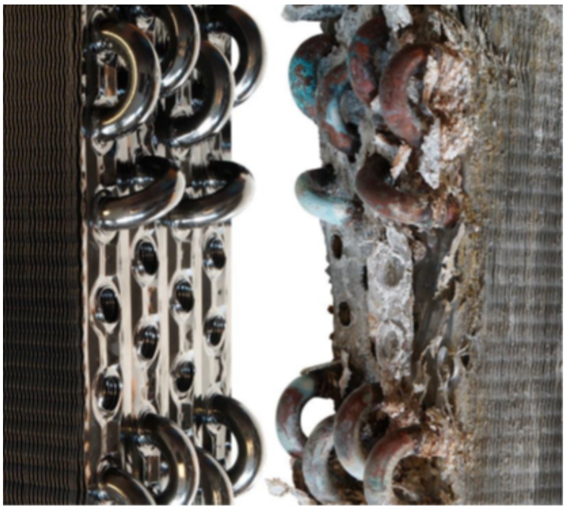
High protective coating made for HVAC and refrigeration systems that operate in moderate to severely corrosive environments, including both costal and industrial applications.
The phenolic epoxy has an advantage of dense cross linking and can therefore be applied as a very thin film, maintaining stable heat transfer.
Application of Heresite takes place through multiple coats by immersion. The coil receives a uniform coating on all surfaces, including fin edges.
If the coils are subjected to direct ultraviolet (UV) exposure, a spray-applied UV-resistant topcoat is an option.

i The entire heat exchanger is treated.

3.3.5 Electrofin + UV Treatment

Electrofin is a water-based, flexible cationic epoxy polymer. It is a factory-applied electro-deposition coating process, which guarantees the complete heat exchanger coverage. The coil is fully immersed in a bath, where it acts as a magnet, attracting the coating to every surface. The result is a thin, flexible, durable, corrosion-resistant coating.
The Electrofin coating was designed to provide corrosion resistance for fin and tube heat exchangers in costal marine environments.

i The entire heat exchanger is treated.



4 AVAILABILITY OF SURFACE TREATMENTS

	Standard Treatments				
List price code	ty	TX	TXC	TXE	TXB
Definition	Coils with hydrophilic fins	Coils with precoated fins	Condensing Coil with precoated fins (roof tops units only)	Evaporating Coil with precoated fins (roof tops units only)	Coil with epoxy treatment
Availability for CuAl coils	OK	OK			NO
Availability for Microchannel coils	NO	NO			OK
Description	The finned pack is built using fins obtained from an aluminum coil pre-coated with hydrophilic treatment.	Finned heat exchangers are built using fins obtained from an aluminum coil pre-painted with a grey polyurethane epoxy paint.			It consist of a polyurethane double layer film on overall coil. The first layer is made by full immersion cathodic deposition; the second layer is an acrylic resin top coat applied by spray method.
Application	Only the finned pack is treated.	Only the finned pack is treated.			The entire heat exchanger is treated.
Resistance to neutral salt spray (ASTM B117)	250 h	1000 h			1500 h
Test in acid salt fog	-	-			300 h (ASTM B287)
Colour	Blue	Gray			Black

	Special Treatments					
List price code	TXK	TXKC	TCKE	TXG	TXI	TXL
Definition	Coil with black epoxy treatment	Condensing coil with black epoxy treatment (roof tops units only)	Evaporating coil with black epoxy treatment (roof tops units only)	Coil with blygold treatment	Coil with Heresite treatment + UV top coat	Coil with ElectroFin® treatment + UV top coat
Availability for CuAl coils	OK			OK	OK	OK
Availability for Microchannel coils	NO			OK	NO	NO
Description	The finned pack is built using fins obtained from an aluminum coil pre-painted with a black polyurethane epoxy paint and the coil is completely coated with black epoxy paint.			Aluminum pigmented polyurethane coating, especially developed for the protection of air-cooled heat exchangers.	Thermosetting phenolic coating applied as a very thin film, maintaining stable heat transfer.	Water-based, flexible cationic epoxy polymer using an electro-coat process specifically engineered for HVAC/R coils.
Application	The entire heat exchanger is treated.			The entire heat exchanger is treated.	The entire heat exchanger is treated.	The entire heat exchanger is treated.
Resistance to neutral salt spray (ASTM B117)	1500 h			> 4000 h	> 6000 h	> 6000 h
Test in acid salt fog	300 h (ASTM G85)			> 4000 h (ASTM B287)	-	>2000 h (ASTM G85)
Colour	Black			Champagne	Brown	Black

i The performance data and test results reported in this document (e.g. resistance to neutral salt spray, etc.) are provided for reference only. Actual values may vary depending on suppliers, coating technologies, and specific operating conditions.

i The corrosivity classes (as defined in ISO 12944) shown in this document is provided for general guidance only. They do not imply, nor should it be interpreted as, full compliance or certification of the product with the referenced corrosivity class. Actual performance may vary depending on environmental conditions, installation, and maintenance.

The data indicated in this manual is purely indicative. The manufacturer reserves the right to modify the data whenever it is considered necessary.

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