The high cost of HVAC CORROSION

a 'forgotten' issue!

By Corrie Cook

Corrosion in the HVAC industry is a forgotten issue, says Xavier Castelltort of Blygold NEW ZEALAND, speaking at the Australasian Corrosion Association's 2013 Roadshow in Auckland recently.

It is estimated that HVAC (heating, ventilation and air-conditioning) costs can represent approximately 50% of a building's energy consumption, yet maintenance and corrosion of commercial HVAC units are often overlooked when they are mounted on roofs or'hidden' at the side of buildings. Airborne salt and humidity are major causes of corrosion for New Zealand buildings, as are pollutants like sulphur oxides, hydrocarbons, chlorides and ammonia from vehicles, industrial processes and agriculture.

Every part of a HVAC system's heat exchanger coils is typically exposed to at least some of these every day. Rarely are components cleaned, let alone protected against them. Maintenance should be ignored at a building owner's peril, says Mr Castelltort. When HVAC units are not maintained and corrosion sets in, it is calculated that operating efficiency can soon be reduced by between 50–70%, and unit life halved.

Cooling performance, indoor air quality, energy efficiency, reliability and a unit's service life are all affected. This in turn causes progressively increasing discomfort and health risks for occupants, higher running and capital costs for building owners, and the discharge of more CO2 into the atmosphere.

THE WEAKEST LINK

"Heat exchanger coils are the weakest link," says Mr Castelltort. "In some cases, their aluminium fins are no more than 0.1 mm thick, with a pitch of typically 1.5–2.0 mm. These are then mechanically coupled to copper tubes and manifolds with soldered joints. Preventing corrosion setting in where metals or alloys touch different metals is notoriously difficult." Building owners are usually told to expect in excess of 15 years of service life from their heat exchanger coils, but any corrosion cuts this time considerably. Corrosion diminishes the capacity of the coil to transfer heat. As the heat exchanger's capacity reduces, the condensate temperature rises to maintain cooling performance.

Most aluminium heat exchangers (coils) use copper pipes; when two different metals in a conducting liquid (for example, rain) are in direct contact with each other, corrosion of the least noble metal can result – this is called galvanic corrosion

Untreated coils made of aluminium fins and copper tubes, or similar coils treated with an epoxy coating, exposed to 4000 hours of salt spray will deteriorate as shown here – that's just six months' exposure

A higher condensate temperature:

- Reduces efficiency, leading to increased power consumption and cost for the same cooling performance
- Reduces maximum cooling capacity, which leads to premature coil failure and the need for early replacement
- Requires higher system pressure, forcing an increased compressor duty cycle and higher thermal and mechanical loads on the system. This means the unit is less reliable, with more frequent failures and consequently higher maintenance costs to both find and fix failures.

PRE-COATINGS

Protective coatings are the most readily available and most frequently used measures to prevent coil corrosion, Mr Castelltort explains. Pre-coating coil components with epoxy-based inhibitors before assembly is a straightforward solution, and relatively inexpensive.

"The problem with this process is that when fins are cut to shape and holes are punched, raw metal edges are immediately exposed again. This makes the unit's coil vulnerable to corrosion. Another disadvantage is that headers and returns aren't treated either, which opens another front for pin leaks and corrosion," he says.

Because epoxy coatings are relatively thick polymers with low thermal conductivity, precoating fins and coils with epoxy forms an insulating layer at the critical junction of fins and tubes. This then acts as insulation that reduces the unit's efficiency by up to 15%. Sometimes, corrosion of units can start within a few weeks when protected in this way, meaning the overall life of the unit is hardly longer than without any form of corrosion protection at all.

"Unfortunately, epoxy coatings are neither flexible nor UV resistant," claims Mr Castelltort.

"Eventually, these coatings disintegrate, which leaves the coils completely exposed to pollution and corrosion."

POST-COATINGS

In the UK, the BSRIA Institute examined the issue of corrosion in relation to energy saving and sustainability. It is an independent research house that advises the UK government, and it found that energy savings of up to 20% can be delivered, and the lifespan of the units can be doubled, if a high-quality aluminium-pigmented polyurethane is applied after the coils have been assembled.

Post-coating the coils using such a coating offers a wide-ranging temperature tolerance. Although it is initially more expensive, experience nevertheless shows the return on investment will be between 12–18 months. Every surface and joint is able to be reached with a spray coating of this corrosion-resistant film that's only 25–30 microns thick, thus maximising thermal conductivity without dropping pressure. That in turn hardly affects the unit's performance – studies suggest it would be affected by no more than 3%. Because the entire surface of the coil is coated, any small gaps between the fins and tubes formed in the manufacturing process, or even corroded areas on units that have been in operation, are effectively filled with conductive material that in turn maximises the unit's operating efficiency.

Post-coatings can be applied onsite to older units or in-house to new ones, and because this process delivers a smooth surface overall, it resists dirt adhesion while offering high UV resistance and flexibility.

ABOUT THE ACA

The Australasian Corrosion Association is a not-for-profit industry association established in 1955 to service the needs of Australian and New Zealand companies, organisations and individuals involved in the fight against corrosion.

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