Modern closed-circuit system treatment & corrosion

Modern commercial closed-circuit heating and cooling systems consist of many different materials and products sourced from numerous global suppliers. This is to reduce costs, increase life expectancy and improve system efficiency. In general, due diligence and a considered approach is placed into the specification of the products that are to be used in a system, but sometimes less thought is put into the system protection.

When a commercial HVAC system has been commissioned, a water treatment specialist is engaged to treat and maintain the fluid in the system. It is very common for the treatment specialist to apply a system inhibitor without an informed understanding of the entire heating or cooling system. It's easy to understand why. The requirements of every installation are different and keeping on top of the latest product innovations and componentry is a fulltime job. All too often the misinformed application of an inhibitor or water treatment results in disaster. Products that have not been adequately protected fail prematurely resulting in high maintenance fees, elevated running costs, or worse - complete system failure.

It is critical to understand what materials are used in today's systems – how they react to each other and to introduced inhibitors and system treatments.

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Ferrous materials:

Componentry: Pipe, radiators, buffer tanks, pumps and heat exchangers.

Consideration: Corrosion of these products is primarily caused by the presence of oxygen. The incorrect application and concentration of some inhibitors can also cause aggressive corrosion.

Copper & Copper alloys:

Componentry: Pipe, valves, instruments and heat exchangers.

Consideration: These components are largely resistant to corrosion, however erosion corrosion of copper pipe due to high flow rates and dezincification of brass are common results of poor system design and use of unsuitable inhibitors.

Aluminium:

Componentry: Heat exchangers and radiators.

Consideration: Corrosion of aluminium is largely related to excessively high (>8.5) or low (<6.5) pH levels. This is often the result of using inhibitors that are primary designed for the protection of steel which deliberately aim to achieve in-use pH levels of 9-12. Some aluminium alloys, for example aluminium silicon, can tolerate higher pH levels making them more suitable for being used in systems that also contain ferrous materials. Careful consideration of cleaners and inhibitors is still required.

Stainless steel:

Componentry: Pipe, buffer tanks, heat exchangers.

Consideration: The presence of high chloride levels can result in the corrosion of some stainless steel. 316L stainless steel is resistant to high chloride levels.

Plastic:

Componentry: Pipe. As raw materials become depleted and more expensive the application of plastic will become more prevalent in future HVAC systems.

Consideration: Many plastic pipes allow for the ingress of oxygen. The high oxygen concentration can corrode metals. Where possible, plastic pipes with 100% oxygen tight layers should be used. Plastic pipes can also be damaged by some chemicals. An example would be high chloride levels which can affect some pipe.

Mixed metals in contact with each other:

Componentry: Brass fittings, galvanised steel pipe and tanks.

Consideration: Galvanic corrosion should be considered in systems when various metals are in contact with each other.

Combining metals and plastics

The majority of systems today will consist of a mixture of metal and plastic components, the type of inhibitors used in these systems should be carefully considered. It is important the entire system is protected from corrosion as all systems containing metal components are susceptible to deterioration without careful system design and selection of inhibitors.

One of the most important requirements to prevent the formation of corrosion is the reduction of oxygen within the system. In a perfect scenario, a completely closed system with no oxygen ingress or leaks would not need any inhibitor to prevent corrosion (although additives would be required for other reasons). In most systems this is not possible and there is either ingress of oxygen through plastic pipes or make-up water.

Make-up water contains 8-11mg of dissolved oxygen per litre of water, these are comparatively low quantities but over time can add up to become a significant cause of corrosion. Automatic top-up systems should be monitored to ensure excessive make-up water is not required. If excessive topping up is required, this should be investigated. Where make-up water or pipes without 100% oxygen barriers are required a suitable system corrosion inhibitor will definitely be needed.

A further consideration is that some traditional water treatment inhibitors that are still in use today are harmful to human health and not environmentally friendly.

There are many considerations to ensure a complex mixed material system is protected. To make the decision-making process easier, companies like Fernox UK have created mixed metal system inhibitor products. These products prevent the forms of corrosion already discussed in this article as well as many others.

Fernox was established in 1964 and is the world's first heating system water treatment company. Today it is the market leader and is specified by many European HVAC system manufacturers as the preferred choice due to their track record and experience.

Central Heating New Zealand is the sole distributor of Fernox in New Zealand and has supplied Fernox products to over 10,000 domestic and commercial systems. Fernox products are easy to use with simple affordable testing systems and are environmentally friendly and safe for human handling. Central Heating New Zealand stocks a large range of Fernox products and can supply solutions for small domestic systems through to large commercial builds.

While this article has focussed on corrosion and inhibitors, the correct selection of cleaners and filtration is just as important. Incorrect selection and use of system cleaning products and filters can cause significant damage to a system and should be carefully considered.

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