FOCUS ON
EVAPORATIVE COOLING TOWERS

CORROSION IN COOLING TOWERS

Corrosion

DIN EN ISO 8044 (previously DIN 50900) defines the term corrosion as follows: "The reaction between a metallic material and its environment, which results in a measurable change in the material. Corrosion may impair the function of a metallic component or an entire system. In most cases, this reaction is electro-chemical, but in some cases it may also be chemical or metallophysical." Electro-chemical corrosion is described as, "the dissolution of metal (oxidation) due to the influence of a liquid medium with electrolytic conductivity and the reduction of an oxidizing agent resulting in the formation of an electrical circuit, comprising an electron current in the metal and an ion current in the medium."

Corrosion in evaporative cooling towers

The chemical and physical conditions prevailing in evaporative cooling towers encourage the corrosion of metal surfaces. Firstly, a substantial amount of oxygen and contaminants enter the system from outside. Secondly, the temperature, flow rate and concentration of dissolved minerals also promote corrosion. The increased pH level usually found in such systems tends to be in a corrosion inhibiting range, but it does allow inorganic compounds, such as calcium carbonate, to accumulate. Just like biofilms formed by microorganisms, these scales, given their composition and the substances involved, may also attack metal surfaces. The negative consequences of corrosion damage are far-reaching: rising maintenance costs, reduced heat exchanger efficiency, contamination of circuits, operational breakdowns or even a system shut down.

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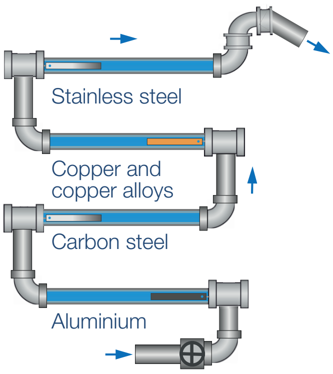
Corrosion measurement

Given the corrosive conditions, it is essential to treat cooling water with corrosion inhibitors in order to prevent major damage from corrosion. Numerous inhibitors are available on the market, e.g. molybdate, polyphosphate, phosphonate, etc. Selecting the right one depends on the materials used and the composition of the cooling water. However, this specific treatment will only minimize corrosion. Since corrosion processes cannot be prevented completely, the system should be monitored continuously in addition to using corrosion inhibitors. Measuring corrosion makes it possible to assess the effectiveness of the inhibitor, and it provides information about the actual state of the system and thereby allows emerging damage to be detected at a very early stage.

Coupon corrosion measurement

The most obvious way of determining corrosion in evaporative cooling towers is to expose small plates of the materials used to the flow of cooling water at visible points. These so-called coupons of a known size, thickness and mass are removed, cleaned and weighed at regular intervals (typically every 30, 60 and 90 days). The calculated weight loss can be converted into an average corrosion rate, stated in mpy (milli inches per year). Coupon corrosion measurement provides an average rate of corrosion over a certain measurement period. Fluctuations over time remain undetected.



LPR corrosion measurement

This method is based on measuring the Linear Polarization Resistance (LPR). It is the only approach that allows the real-time analysis of corrosion processes in the system. The measuring unit utilizes a sensor with two identical electrodes of the same material as that used in the cooling system. By applying a DC voltage E, these two electrodes immersed in an electrolyte (cooling water) are polarized, resulting in a current flow I. The quotient E/I determines the polarization resistance. Within a certain voltage range, this polarization resistance is linear and therefore, can be converted into a corrosion rate (stated in mpy). This rate of corrosion established by means of an LPR measurement reflects the current system state, and thus even records short-term changes in process conditions that may cause corrosion damage (e.g. metering of oxidizing biocides increases the corrosion rate).