Representativeness: How "correct" is a measurement with Risycor?

Measuring the corrosion rate with a Risycor is straight forward. No special knowledge is required, as is often the case with other corrosion measurement systems. But to what extent are the Risycor results "correct" and representative of the entire system?

Comparison to other corrosion measurement systems

The University of Antwerp (UA) researched the measurement principle of the Risycor by making a comparison with:

- physical measurements (thickness of a corrosion coupon, mass of a corrosion coupon)
- LPR, a corrosion measurement method based on linear polarization resistance and the Stern-Geary equation.

The researchers came to the following conclusions:

"The various laboratory tests indicated a very good correlation between the measured corrosion parameters and the corrosion rate indicated by the Risycor. The results are thereby in line with the theoretical background.
In comparison with the LPR measurement principles of the reference industrial sensors that already exist, the Risycor shows a better causal relationship between the corrosion rate and the measured corrosion parameters. The existing LPR sensors also appear to require very high maintenance, and specialized knowledge for their correct interpretation.
The direct measurement principle of the Risycor provides a highly accurate correlation with the actual corroded mass."

Speed of the reaction

Oxygen reacts very strongly with steel. Therefore, the rate of consumption of oxygen by the corrosion process in an installation is also very high. There is little data on this worldwide, but there is a certain consensus that it is "very quick", most sources speak of "minutes" to "several hours" (see also below).

Distance and time

Even in large buildings, the distance between the point where the oxygen enters and the Risycor is rarely more than a hundred meters, so the dwell time between the oxygen entering and the measurement by Risycor is usually quite short. Normally, the water speed in heating and cooling systems is between about 0.5 m/s and 3 m/s, so that the oxygen ingress reaches the Risycor measuring point in seconds or at most a few minutes. Of course, the dissolved oxygen in steel pipes has already reduced somewhat during this time, but this has turned out to be of little relevance.
10 years of practical experience with more than 1000 Risycors have shown that the Risycor measuring function provides representative and relevant data and gives an early warning if the system is threatened by a corrosion rate that is too high. (see TT17 and TT27).

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District heating and Heat Networks

In very large systems, the dwell time between the point of oxygen ingress and the point of measurement can be longer and the dissolved oxygen can be (partially) reduced in pipes that are kilometres long before it can be measured by a Risycor. Nevertheless, measurements in the boiler house of district heating networks often provide useful information. As far as we know, the oxygen input is also detected promptly and fairly accurately in these systems. It is not yet known to what extent the value of the corrosion rate measurement in the boiler house deviates from a measurement in the vicinity of the point of oxygen entry, since we have not yet been able to carry out such investigations.

The science

Professor Dr Oliver Opel of the University of FH Westküste in Schleswig-Holstein adds:

> *From 2015 to 2017, while still affiliated with the Leuphana University in Magdeburg, he led a research project funded by the German goverment on corrosion in heating and cooling installations (EQM Hydraulik; ENERGIE- UND QUALITÄTSMANAGEMENT GEGEN KORROSION UND BELAGBILDUNG IN HYDRAULICN SYSTEMEN: UNILVORHABUNGEN; DAMAGE PICTURES). It concerned the practical testing of a scientific corrosion measurement method (called FeQuan) that is based on the measurement of water chemical parameters (such as pH, conductivity, redox potential, temperature, but also dissolved metal ions and dissolved gases, ...).*
> *He is also affiliated with the VDI (Verein Deutscher Ingenieure), where he teaches corrosion in heating and cooling installations, and is co-author of the VDI6044 guideline.*

He writes in a message about the Risycor:

"In my experience, such a sensor that reacts with oxygen can also detect (oxygen entry) leaks that are further away, if they are significant. In the small amounts relevant to corrosion, the oxygen has a longer half-life than would be assumed based on classical kinetics; this is known as diffusion restriction. Iron and oxygen meet less often!"

Summary

Risycor does what what Risycor is supposed to do: measure the rate of corrosion, which is a valuable indication of whether there's a problem or not. Whether the actual corrosion rate is a few µm/year higher or lower than the Risycor indicates is not really relevant. In more than ten years, several thousand systems have shown that the warning and monitoring function of the Risycor is more than sufficiently accurate and representative.

See also

Research report University of Antwerp

Universiteit Antwerpen

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