Whitepaper - How Hevasure is using data to inform active service interventions

Introduction

''It's not what you've got, it's what you do with it that counts''. Although not usually applied to the modern data-driven world, this is an expression that retains much resonance today - after all, what is the point of numbers if you can't make effective use of them?

We are all gradually coming to terms with the myriad of data and information that monitoring and Internet of Things (IoT) systems generate, realising the huge potential this technology offers. Ultimately, it is all about making our lives easier, using data to help in the decision-making process and reduce the overall cost of ownership. It should, most definitely, not be about sinking under a sea of data.

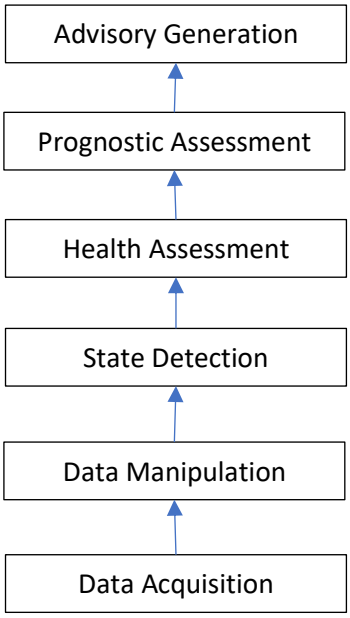
Even today, too many organisations record key information on disparate sheets of paper which make intelligent interpretation either time consuming or nigh on impossible.

Hevasure has been at the forefront of condition monitoring since its inception in 2014, leveraging IoT technology to prevent corrosion in commercial heating and chilled water systems. Data, obtained remotely and in real-time from a wide range of sensors, is used to inform us of corrosive conditions and enable effective interventions while minimising the need for scheduled (and often unnecessary) site visits.

This paper explores in more detail how we obtain the data and make the best use of it to identify and prevent corrosion - through appropriate diagnosis of cause followed by effective and efficient remediation.

Data / diagnostics hierarchy

British standard BS ISO 13374 sets out the framework for 'Condition monitoring and diagnostics of machines'. Essentially, it defines a hierarchy of six data-processing and information-flow blocks (see figure 1). Increasing amounts of intelligence is applied higher up the hierarchy, with more value extracted from the data.



Data processing and information hierarchy (BS ISO 13374)

So where does Hevasure sit in this hierarchy and how does our monitoring technology aid our clients? Taking each block in turn:

- ✓ **Data Acquisition**: We measure a large range of parameters using a bank of high-quality sensors. These are then captured in a state-of-the-art data acquisition system
- ✓ **Data Manipulation**: We perform signal analysis (either locally or in the cloud) to compute meaningful measurements expressed in appropriate engineering units
- ✓ **State Detection**: Our intimate knowledge of water treatment, corrosion and HVAC systems enables us to know what constitutes healthy conditions and set alarms for any single parameter when critical levels are exceeded
- ✓ **Health Assessment:** By aggregating all sensor readings we can diagnose faults before corrosion causes significant damage. Thanks to our interactive dashboard, users can also flag when critical events take place. Everything is date/time stamped to assist root-cause analysis.
- ✓ **Prognostic Assessment**: We use algorithms based on experimental data to determine corrosion rates and accumulative metal loss. We can apply this knowledge to determining the remain lifetime of steel pipes. We also monitor changes in dosing levels and so can predict when chemical top-up is needed to maintain effective corrosion control.
- ✓ **Advisory Generation**: Using Hevasure's 'intelligent messaging' built into our BACnet product we can aggregate the information with other data within a BMS to recommend appropriate actions. In the longer-term we will look to connect with i maintenance scheduling software to automatically create maintenance requests when necessary.

This theoretical framework is best understood by looking at specific case studies where Hevasure technology has brought meaningful insight, led to informed interventions, and prevented serious damage.

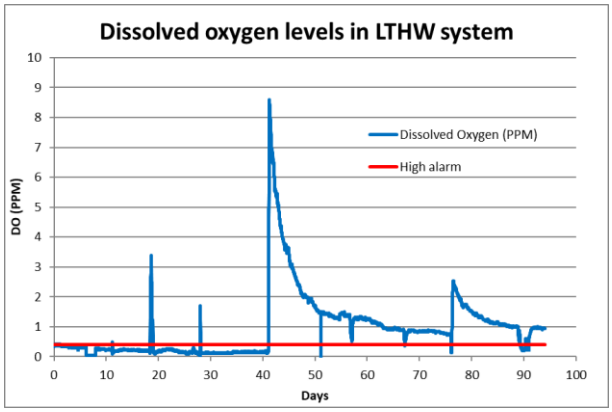
Case 1. Health assessment of the Low Temperature Hot Water (LTHW) system - Herts & Essex hospital

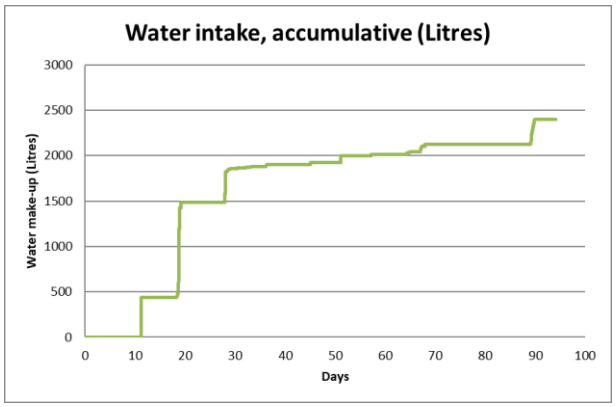
The LTHW system at Herts & Essex Hospital, Bishop's Stortford, was suffering from excessive corrosion of steel and brass components, as evidenced from the Hevasure patented crevice corrosion sensor and water analysis.

Dissolved oxygen (DO) levels were significantly higher than recommended for a closed system and analysis showed that this was mainly due to the intake of fresh aerated water.

The Hevasure monitoring system also detected several incidents of large quantities of make-up water being drawn into the system during the monitoring period. This was deemed to be the root cause of aeration and corrosion.

Relative pressure remained above 1 bar for virtually the whole of the monitoring period and therefore gaseous air intake could be ruled out as a cause of the oxygenation.





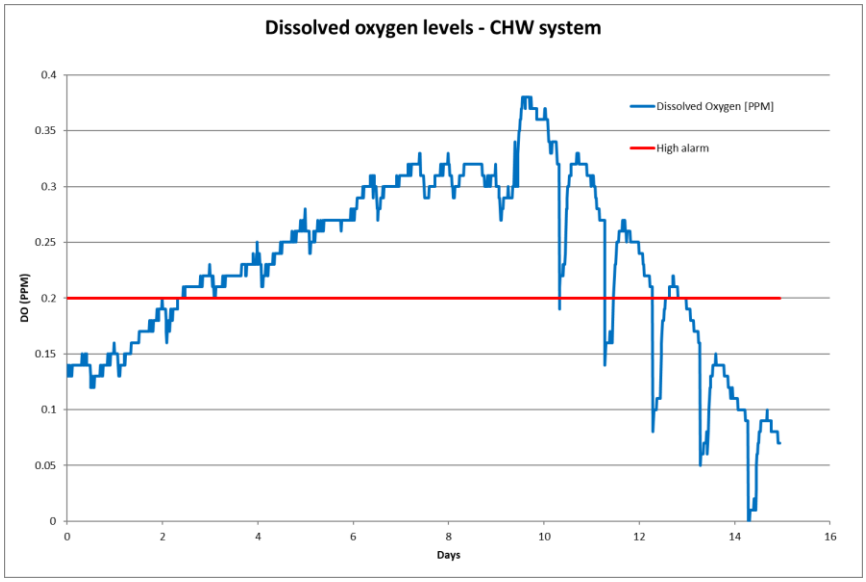
DO levels were higher than ideal for much of the monitoring period and increased dramatically on days 11, 18 and 28 when large quantities of fresh water were detected entering via the make-up line into the pressurisation unit.

Case 2. Aggregating Hevasure data with BMS for overall Health Assessment

In 2019, Hevasure was commissioned to monitor the prevailing conditions of a chilled water system in a large, prestigious office block in the city of London. It soon became apparent that, not only were DO levels unacceptably high (alarms constantly being raised), but that spikes in readings occurred at the same time every morning.

Analysis of the BMS records showed that a valve in the Chilled Hot Water (CHW) system opened at the same time as the rise in DO. This led to informed intervention, nipping in the bud what could have been a serious problem.

Note: Since this event took place, Hevasure has developed a BACnet solution to the water monitoring system, enabling data to be collected by a BMS and aggregated with data from other BACnet enabled devices.



Spikes in dissolved oxygen were found to occur at 3:00 am every morning and could be attributed to the opening of a specific valve. Changing the flow of water through the system resolved the oxygenation issue.

The future is now – Prognostic Assessment and Advisory Generation.

In order to determine the overall effect of unhealthy and sometimes transient conditions, it is necessary to calculate the cumulative values of certain specific parameters over a given time period. For instance, dissolved oxygen is not a problem to a closed heating or chilled water system if it is above acceptable levels for only a few hours. Equally, high corrosion rates for a short period will only do limited damage, but not if it lasts over several days. For this reason, Hevasure has enhanced the dashboard on which data is displayed, to show cumulative values on a system being monitored. The cumulative corrosion assessments allow users to determine the extent of corrosion which, when combined with the corrosion history of the system, enables effective maintenance scheduling to resolve issues with minimum disruption to building occupants.

Alarms are then set, not if transient values exceed critical levels, but if the cumulative value exceeds critical levels.

We can assess the cumulative DO levels (expressed in ppm hours) or the cumulative corrosion rates (expressed in mm). This latter function is extremely useful as it enables us to determine total metal loss and estimate the remaining lifetime of steel pipework (**prognostic assessment**)

Hevasure dashboard showing cumulative values (as used in prognostic assessment)

The ultimate goal of any monitoring system is to be able to automatically generate service interventions with minimum human oversight. Hevasure has invested considerable time and effort into achieving this objective and the latest version of the product now has a BACnet interface allowing data to flow between the Hevasure unit and the BMS.

In addition, intelligent messages are automatically generated depending on the alarm state of a multitude of sensors. This not only helps diagnose the root cause of any issue but can automatically determine the appropriate service intervention. For example, a fault identified with the pressurization unit would signify a problem with air ingress leading to corrosion. Or the detection of water loss could lead to fixing a leak and topping up the system with inhibitor.

In summary

All monitoring systems generate data but making effective use of this is key to achieving real benefits. Also, too many organisations are still relying on paper-based records to document important system parameters. Not only is this a snapshot in time which can miss key events but integrating the data and making sense of this is an almost impossible task.

Even recording data electronically has limited use unless it can be properly integrated and real meaning added.

Hevasure monitoring systems not only capture real-time data from a plethora of sensors but preventing corrosion is aided by the application of propriety algorithms and intelligent interpretation.

The latest version even has a BACnet interface allowing data to be integrated with that already held within a BMS. Site managers can now oversee a process of active service interventions, minimising the risk of failure while eliminating unnecessary and costly site visits.

We call it '**Intelligent Corrosion Control'**.

Steve Munn

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