Case Study: Telephone House

Telephone House is a large office complex located in central London close to the Embankment. The building, which dates from around 1900, is listed due to its special architectural interest. Guardian Water Treatment was asked to investigate the building's LTHW system in 2017 due to a number of issues that had arisen.

Hidden problems

Historically, the radiators throughout the building had been leaking on a regular basis – every week in fact. Although the BSRIA Chemistry and bacterial results were in guideline limits and iron levels and solids were also in spec, this leakage suggested another cause of corrosion, one not picked up by the usual sampling methods.

Midland Corrosion's detailed analysis cited Gross Aeration as the problem when they discovered oxide deposits in the radiators' water channels. At some point, oxygen had got into the sealed system. How or when this had happened wasn't clear; the system could have been partially drained down for an extended period during commissioning. Whatever the cause, the pressing issue was to get on top of the problem before it started to do real harm to the system, which could potentially lead to costly repairs and operational downtime. Flushing – which is many engineers' standard reaction to closed water system issues - in this instance would not have been effective.

Real-time monitoring

Guardian installed Hevasure's real-time monitoring solution, Hevasure, in May 2017, to provide a three-month health check on the system. Owing to the success of this initial trial, the period was extended to January 2018, by which time all aeration issues were sorted and the system had stabilised.

The results taken from graphs created over the period indicated that insufficient water pressure on the 4th floor was the problem. During every "standby" period, when the water was cooler, the pressure dropped and the oxygen levels spiked. Conversely, when the system was hot and the pressure stable (3.3bar basement, 0.7bar 4th floor) the DO levels were seen to reduce and stabilise.

Following this analysis, Guardian was able to recommend that the client investigate the matter further leading to the identification of air ingress that pointed to fixes to the expansion vessels, pressurisation units and AAVs. The system resting pressure and operating parameters were also reviewed. Once the pressure had stabilised and the DO levels were kept in check, corrosion rates became negligible and the inhibitors worked effectively.

Conclusion

By installing Hevasure's system, Guardian was able to provide its clients with not only a live diagnostic too, but real peace of mind. By nipping the pressure issue in the bud, straight-forward adjustments to the system prevented the spread of serious corrosion problems which would have lain undetected by sampling.

If the oxidation in the LTHW had continued, there would have been an eventual breakdown of the whole system, leading to major repair expenses and disruption to the organisations housed in the building. By fixing the root cause of the problem, unnecessary chemical usage, maintenance costs and the building's environmental impact, have been reduced.

When conditions are continually monitored issues are flagged up before they get out of hand, allowing inexpensive repairs to be carried out by in-house maintenance teams. With the Hevasure system, water system condition is no longer a mysterious art; the preserve of costly consultants, it is something FMs, building managers and owners can view and act upon themselves. Guardian believes Hevasure has the potential to turn LTHW and CHW system care and maintenance on its head and prevent corrosion for good.

Hevasure findings

The Hevasure unit was installed by Guardian on Friday 12th May. Sited in the basement near the LTHW pump set, the system was online and sending real-time data within just a few hours of installation.

The system monitored a range of parameters in order to get a real-time view of system integrity, water characteristics and corrosion:

- Dissolved oxygen
- Pressure
- pH
- Conductivity
- Galvanic currents (related to corrosion rate of steel surfaces)
- Crevice corrosion
- Leaks (water makeup)
- Temperature
- Inhibitor/glycol concentration

- Monitoring identified problems undetectable by sampling
- Chemical usage was reduced
- Flushing was not required
- Breakdown and expensive repairs were avoided
- The problem was fixed, not masked

Key findings:

►Report details - Part 1
The following series of graphs shows, in detail, the data collected over the period.

Graph 1 – shows the same DO and pressure over the whole monitoring period – apart from the first week and the period from 5-11th June, the pattern is repeated and the peaks and troughs are consistent with heating /standby periods (i.e. pumps or boilers on/off cycles).

Graph 2 - shows the pattern of pressure in relation to the temperature of the LTHW system.

DO in a stable system wouldn't normally rise above 0.2ppm and the graphs would show less fluctuation if the system was stable. As conductivity remained stable throughout the period there weren't any significant water losses or gains.

Interim conclusions
- The system appeared to be letting in air, particularly during standby periods.
- No major leaks were detected.
- Crevice corrosion was detected over a short space of time
- Galvanic currents remained stable
- The pressure measurements were taken at the base of the system, which is the point of highest pressure. This pressure decreases as the water goes higher in the building (1 bar for every 10 metres approximately). At the top of the building, pressure was possibly too low at times.

Recommended actions
Once the readings were interpreted, the following actions were undertaken to improve the health of the system:
- Air vents were replaced by Optimum on the two high points of the LTHW by the AHUs
- Guardian provided an additional pressure sensor which also reported back to the Hevasure unit
- Following this remedial work, Guardian monitored the system closely to assess if air ingress/pressure issues remained.
- Guardian recommended raising the pressure on the system, to prevent oxygen ingress.

►Report details - Part 2
Data report 15th June to 17th July

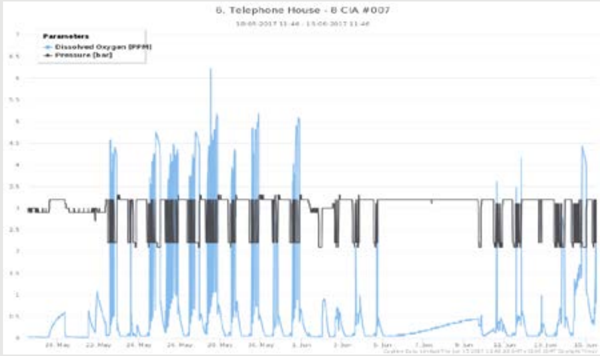
Overall the established trend continued, with each drop in temperature and pressure coinciding with a rise in dissolved oxygen.

Guardian installed an additional pressure sensor in the 4th floor plant room to record pressure readings at the top of the system. This sensor began transmitting data from the 27th June.

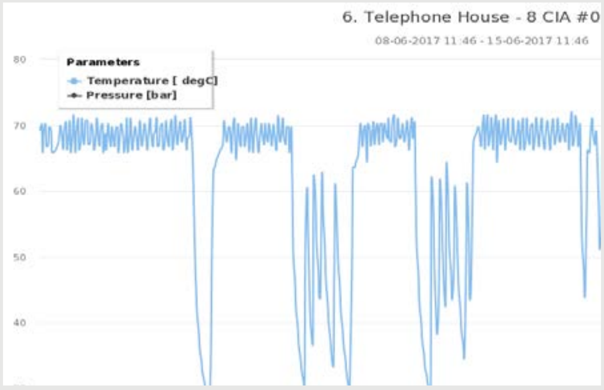
The site team also replaced the AAVs on the top of the system – two on each side of the building by the AHUs.

Graph 3 – shows the dissolved oxygen (blue) and the pressure (black) as measured at the base of the system. The oxygen levels peak every time the pressure drops.

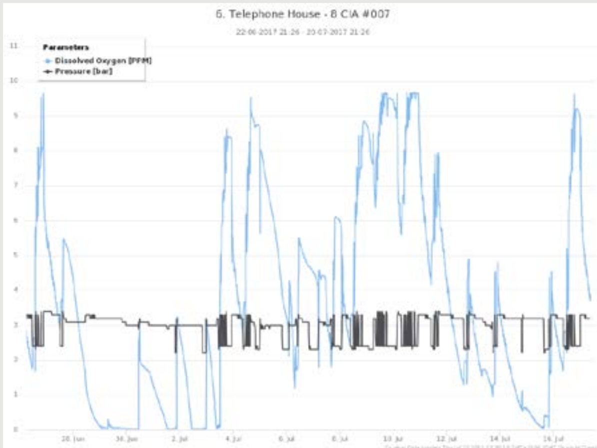
Between 28 June and 4th July, indicated by an arrow, the pressure doesn't drop far from the 3.3Bar level and during this period the oxygen levels remain mostly low and more stable. When the pressure is less stable and drops below 3 bar, oxygen levels rising again, peaking at 8ppm.



Graph 1



Graph 2



Graph 3

Graph 4

From this data we can see that at a higher resting pressure – or stabilisation of the resting pressure -restricts the ingress of fresh oxygen.

Graph 4 – shows the pressure recorded in the upper plant room sensor on the 4th floor. (measured in bar). The arrow shows the same “stable” period as the graph above.

Several times the pressure drops to 0 bar indicating negative pressure and air ingress on the 4th floor.

Analysis
As suggested at the end of phase one, the pressure on the 4th floor is dropping low enough to cause air ingress and this is the source of the dissolved oxygen. The stable higher resting pressures from 28th June-4th July show a far lower oxygen ingress.

The conductivity remains consistent indicating water loss is minimal or not happening at all.

► Report details - Part 3
Data report – up to 25th August

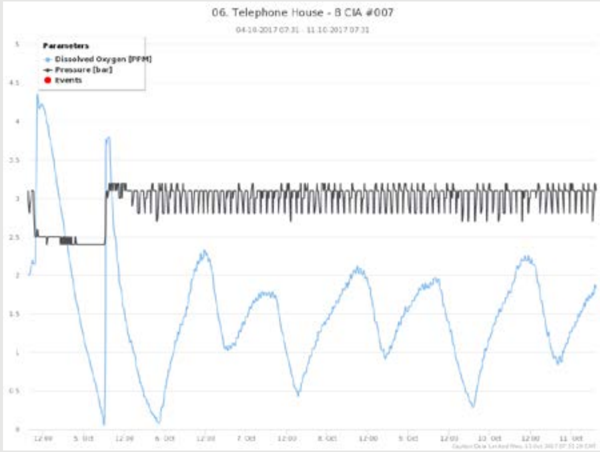
The data obtained for pressure and DO continued pretty much with the same pattern from the last update except for two periods of “stable” DO levels, between the 8th and 12th of August and the 21st and 24th August.

► Report details - Part 4
Monitoring data from 25th August – 10th October

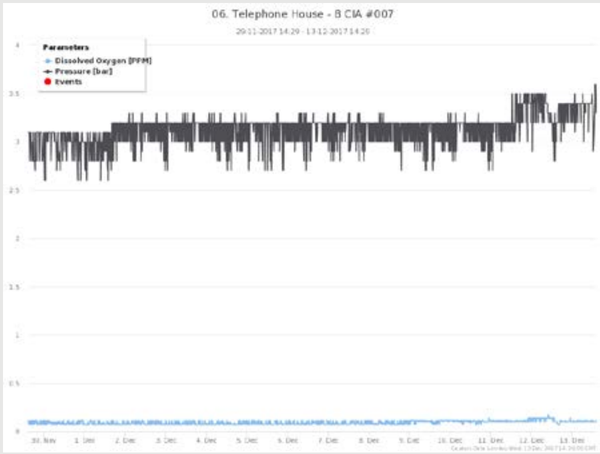
During this period work had been carried out to address some of the mechanical issues on the system. The expansion vessels were serviced and a fault was found with one of them. This was rectified in early August.
The Air/dirt separator was also replaced on around the 28th September.

Graph 5 – The readings taken at the end of the period, show that there is some stability in the system over the seven days (3rd – 10th October) although the DO is still higher than desired. During this period there are no dramatic drops in base pressure, stopping the peaks in DO.

Graph 6 – The oxygen has fully stabilised, the system is healthy.



Graph 5



Graph 6

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