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Campden BRI
food and drink innovation

Instrument Assessment Report

Unison Engineering Service Ltd

Assessment of the Pastest Heat Exchanger Test Unit

Appraisal Of Unison Engineering Technology Ltd's Technology For Integrity Testing Of Plate Heat Exchangers

Background

Unison Engineering Services Ltd. have a patented process for the detection of leaks across the plates of heat exchangers (Government of Ireland Patents Office S85725 "Heat exchanger integrity testing"). For the British market Unison have licensed the technology to Moody Service of Retford.

The technology relies on detection of a pressure increase in a closed volume of the heat exchanger. This competes with alternative technologies include utilising saline solutions or gases such as helium.

Scope of Work

- Visit Unison Engineering Services Ltd. where there is a suitable test unit.
- Appraise the technology over the appropriate set of process conditions.
- Expert report.

Experimental Methods

- One of the plates has a deliberately set hole that was a maximum 200µm in diameter when it was drilled. It was observed to be still smaller than a 400µm gauge.
- The unit was tested for a range of pressure differences, run times and pass/fail set points. It was also tested with and without the plate with a leak. All heat exchanger integrity tests may be performed with process water, there is no advantage to using e.g. product.

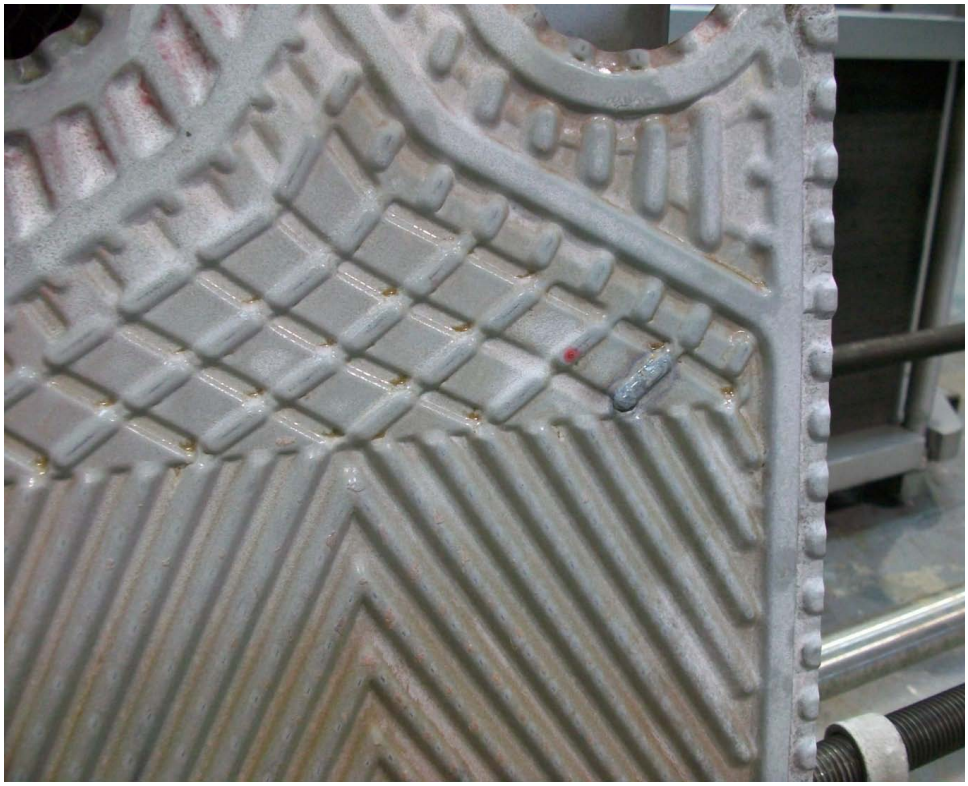
- The procedure requires removal of connectors before the test to enable removal of any debris that could potentially plug a leak.
- Backflush is employed (pressurising the low pressure side to higher than the high pressure side) before the test to clear debris from any leaks.
- Flush both the high pressure and low pressure sides.
- The high pressure side is then pressurised and recycled. The low pressure side is closed.
- The run time and pass/fail set point are set on the unit.
- The test is performed.

The test unit at Unison. The small vessel bottom middle enabled recycling around the high pressure side. There are two plate heat exchanger units although only one was required for these tests.

The unit had a clear operating screen and graphical output of the test results. Also a USB output for removal of data.

This is a portable unit that enables effective site work.

A new portable unit has been designed that is smaller than the previous one.



Part way through the trials the leaking plate was removed for visual inspection of the orifice. This photograph was taken after dye testing and the orifice can be seen close to the centre of the photograph. Red dye was sprayed on the opposite side and the facing side was cleaned. The orifice was barely detectable without dye testing.

Results and Discussion

It should be noted that the analysis time, in other words the time to reach the set point, will vary according to the volume of the unit on the low pressure side (for a given size of leak). Therefore, it is possible for clients to estimate the analysis time for their units. In the test unit each plate had a surface area of 0.18m^2 and there were twenty plates in the pack. Similarly, with a leaking plate if the set point was not reached (set too high or run time too short) then a pressure increase was still apparent on the plot that the unit produced on the screen. The run parameters can then be changed and the test performed again. If the set point is too high the back pressure on the low pressure side will reduce the flow through the leak over the course of the run. This effect can be seen in some of the graphical results (below and overleaf).

A false positive result would occur if the water on the low pressure side warmed up, because thermal expansion would increase the pressure. However, the test unit monitors temperature and so if there is a significant increase then the test is recorded as failed.

The results seemed to suggest that at least 3 bar pressure was required to drive the water through the 200µm orifice. It was perceived as very likely that liquid flow would not occur through such a small orifice unless a minimum pressure difference was set.

The results demonstrated the efficacy of the unit in detecting the small leak. The nature of the unit's graphical output meant that very small leaks would be detected even if the run is operated with non-ideal parameters. This was provided that the pressure difference was adequate, and Unison recommend operating at up to a maximum of 6 bar pressure difference in the field. The usefulness of the unit is rapid detection of small leaks thus highlighting a problem for the processor. If such a problem is found then clearly closer inspection of the plate pack would be required, perhaps with for example dye testing to find the leaks.

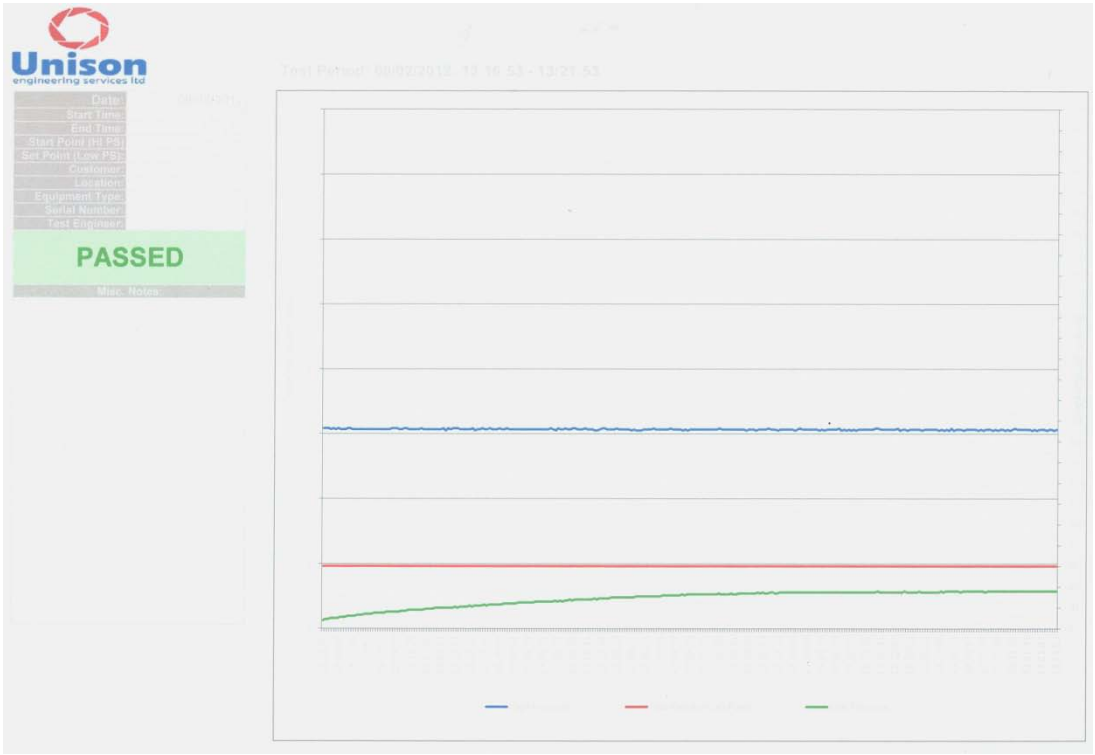
The fact that the unit detects the small leak at pressure difference at least 4 bar illustrated that the leak was not active at pressures less than this. Conceptually the heat exchanger would operate properly at below 4 bar differential pressure. However, such operation would not fit well with many HACCP systems. Also the leak is likely to get worse. Therefore this highlights again the "early warning" benefit of the unit.

The test water would slightly dilute for example refrigerant loops when testing on site. However, this is perceived as a vary minor issue compared to for example addition of saline solutions to process streams.

The results below and overleaf were a selection of the tests:

Leaking plate fitted. Pressure difference 1.471 bar, set point 60 mbar. Blue line high pressure side pressure, red line low pressure side set point, green line low pressure side pressure. At this low pressure difference no leak detected.

Leaking plate fitted. Pressure difference 2.097 bar, set point 60 mbar. Blue line high pressure side pressure, red line low pressure side set point, green line low pressure side pressure. At this low pressure difference no leak detected.

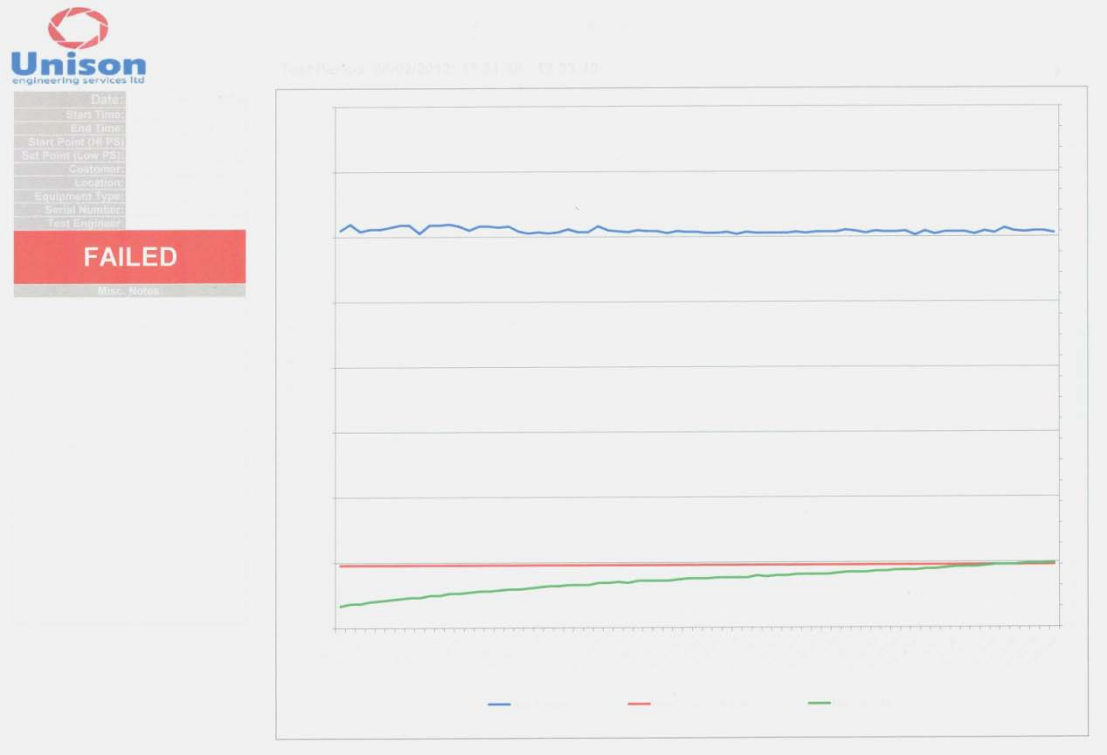


Leaking plate fitted. Pressure difference 3.083 bar, set point 60 mbar. Blue line high pressure side pressure, red line low pressure side set point, green line low pressure side pressure. At this pressure difference there is leaking detected, but it does not reach the set point without an extended run time. However, the operator would see from the graph that the run parameters need adjusting and re-test.

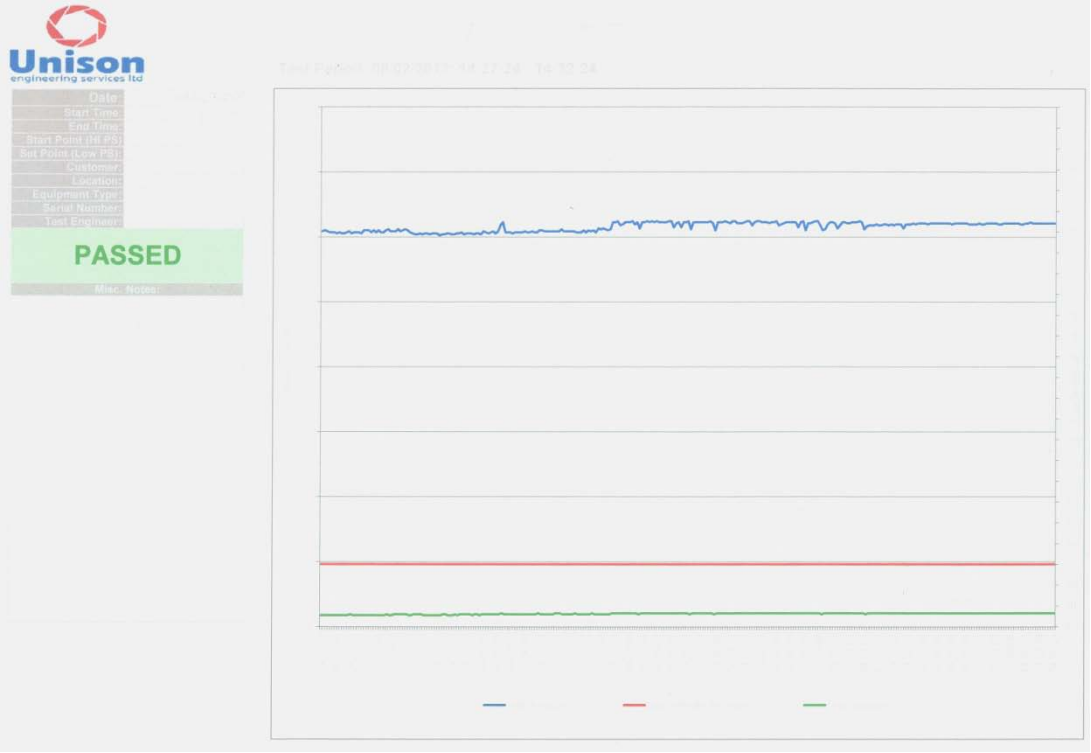
Leaking plate fitted. Pressure difference 4.084 bar, set point 60 mbar. Blue line high pressure side pressure, red line low pressure side set point, green line low pressure side pressure.

Leaking plate fitted. Pressure difference 5.07 bar, set point 60 mbar. Blue line high pressure side pressure, red line low pressure side set point, green line low pressure side pressure.

Instrument Assessment Report



Leaking plate fitted. Pressure difference 6.103 bar, set point 60 mbar. Blue line high pressure side pressure, red line low pressure side set point, green line low pressure side pressure.



Leaking plate removed. Pressure difference 6.087 bar, set point 60 mbar. Blue line high pressure side pressure, red line low pressure side set point, green line low pressure side pressure. Correct operation confirmed.

Conclusions

- The unit from Unison Engineering Services Ltd. was found to be capable of detecting small leaks on plate heat exchangers.
- The test was noted to be relatively rapid (perhaps half an hour for a large heat exchanger).
- Thus the technology was considered to be very effective for systematic testing of the integrity of plate heat exchangers.
- A failed test would suggest closer inspection of the plate pack to identify leaks if possible. However, it should be noted that finding small leaks would be very difficult, hence further validating the benefit of the Unison system for early warning of problems.

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