Condition Report on Plate Heat Exchanger in a Commercial Building in the Perth CBD

Eric Brogle 19 January 2021

Introduction

Delta T Technologies (WA) as the Western Australian representative for Sondex recently had the opportunity to work with a local mechanical contractor to replace the plate packs on two Sondex S86 plate heat exchangers in the Perth CBD in November 2020.

History

The heat exchangers were manufactured in 2009 and commissioned in 2010. The original plates were 0.4 mm 316 stainless-steel. The replacement non-genuine 316 stainless-steel were 0.5 mm thick.

One heat exchanger had its plate pack replaced by others with non-genuine 316 stainless steel plates and NBR gaskets in 2020.

The new, non-genuine, 316 stainless-steel plate pack had failed within months of installation. The failure was detected by monitoring of water quality in the closed loop.

The problems were originally detected by excessive water consumption in the cooling loop.

Photo 1 Shows signs of leakage from one of the heat exchangers.

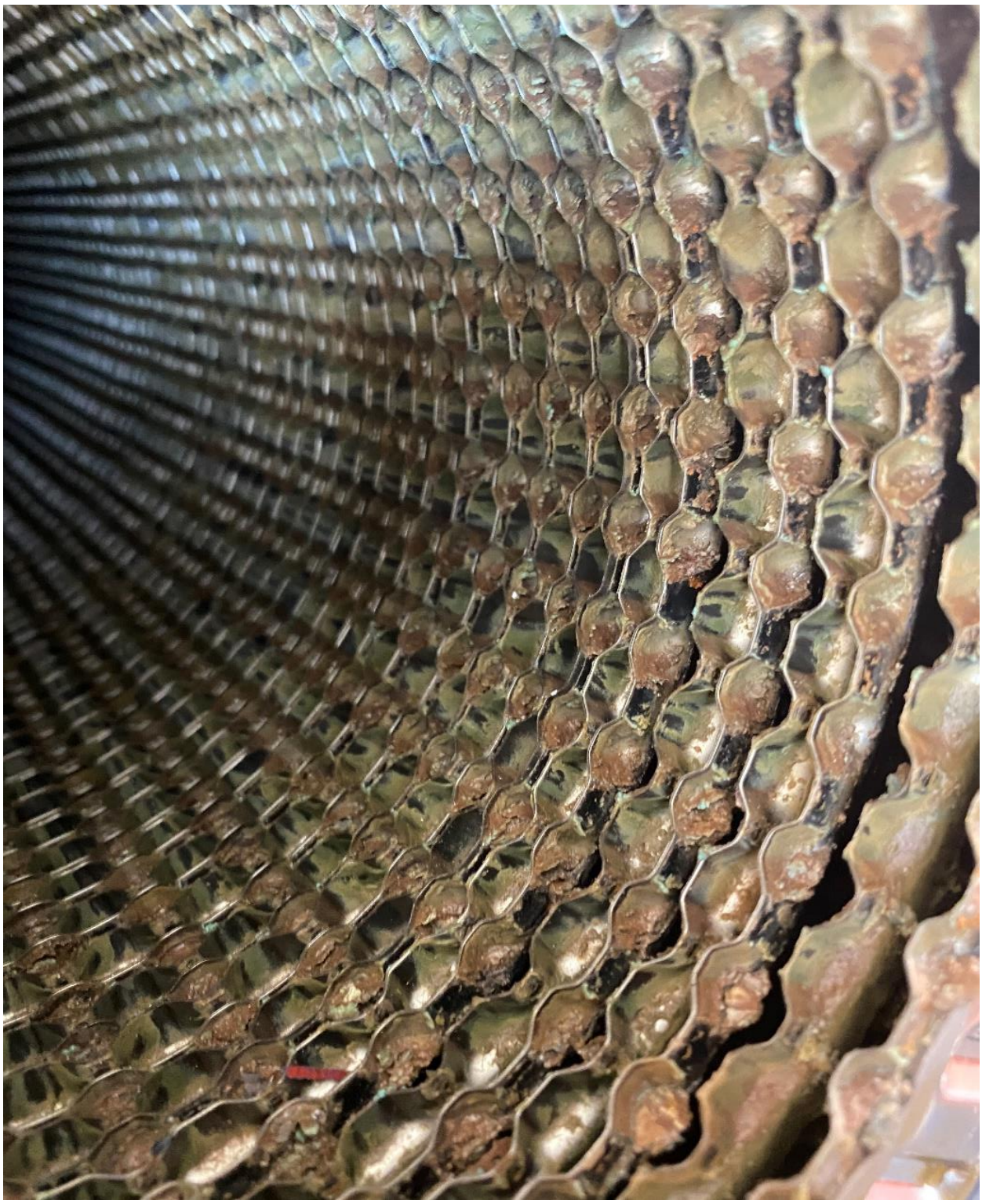

Photo 2 Showing scale and sludge deposits at plate entry.

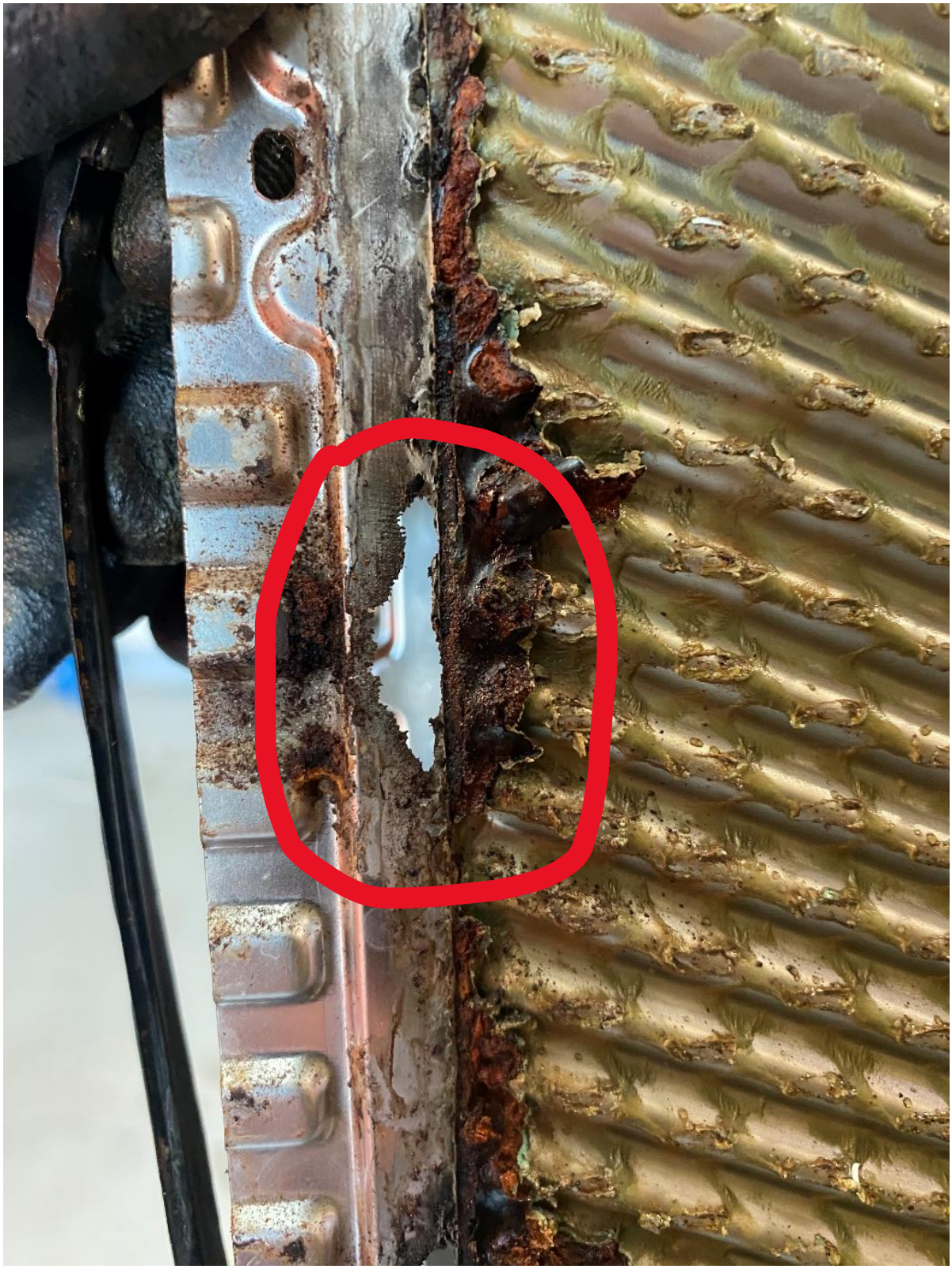

Photo 3 Showing corrosion hole under the gasket in the gasket groove on the long edge of the heat transfer plate.

In this case the building manager is fortunate that they have a proactive mechanical contractor taking responsibility for the mechanical maintenance of the building. Whilst there has been some minor leakage from the heat exchanger as shown in Photo 1, it is clear from Photo 3 that it was only a matter of time before it turned into a catastrophic leak. In this case the cooling circuit removed heat from numerous data rooms, but the

good news was that there was a backup heat exchanger, the bad news is that it was in the same condition.

Actions Taken

Both stainless-steel plate packs were replaced with genuine Sondex 0.6 mm titanium plates and NBR gaskets by Delta T Technologies (WA).

The cost of the genuine titanium plate pack was comparable with the cost of an aftermarket titanium plate pack and was delivered in a timely manner despite the complications arising from the Covid 19 pandemic.

The first plate pack (failed non-genuine pack) was swapped out on a Tuesday, the higher-pressure side was reinstated while the flange on the lower pressure side was loosened to check for any internal leakage (spools could not be removed for pressure testing and isolations were not considered reliable at the pressures required for testing).

The second plate pack was fitted on the Thursday of the same week with the entire job completed by mid-afternoon.

Potential Causes

The heat exchangers are set up in a duty standby arrangement resulting in extended period without water flow.

The failure was clearly corrosion, there are numerous corrosion mechanisms but given the circumstances it is thought to be Crevice Corrosion.

Crevice corrosion results from reduced oxygen levels in the crevice and in the presence of chlorides the moisture in the crevice will become acidic.

The reduction of oxygen levels in the crevice results in the breakdown of the passive film and promotes anodic dissolution.

Crevices can be created between scale and plate material or between plate and gasket. Several conditions are required to promote crevice corrosion:

1. A crevice which allows moisture entry but small enough to prevent free flow. The geometry of the crevice will influence its susceptibility to attack and the speed of progress. The narrower and deeper (relative to its width) a crevice is the worse attack will be. Metal to flexible plastic crevices tend to be narrower than rigid metal to metal gaps so metal to plastic joints can provide more aggressive crevices.
2. The environment will influence the occurrence and rate of corrosion. The more aggressive the environment the higher the corrosion rate. Inadequate bleed off on a cooling tower will result in elevated chloride levels when untreated water is used.
3. Temperature also influences the occurrence and rate of corrosion. Table one shows laboratory measurements of critical temperatures needed to cause pitting on an open surface (CPT) and crevice (CCT) attack of a metal plate beneath a PTFE washer in a 10% ferric chloride solution.

   The CCT is at least 20 degrees C lower than the temperature required to cause pitting corrosion in this aggressive liquid. (Ferric chloride solution is an aggressive corrodent and is used because it is similar to the liquid in a pit when it is actively corroding.)

TABLE 1: CRITICAL TEMPERATURES REQUIRED TO CAUSE PITTING					
ALLOY	**304**	**316**	**904L**	**DUPLEX 2205**	**SUPER DUPLEX 2507**
CCTºC	<-10	-10	12	13	38
CPT°C	3	10	42	33	78

(Australian Stainless Steel Development Association, n.d.)

More information on crevice corrosion can be found at:

https://www.assda.asn.au/technical-info/surface-finishes/crevices-and-corrosion#

https://www.materials.sandvik/en-au/materials-center/corrosion/wet-corrosion/crevice-corrosion/

https://www.ssina.com/education/corrosion/pitting-and-crevice-corrosion/

Recommendations

The situation described in the above report has now been identified in two further buildings.

In these cases, the heat exchangers were manufactured by Alfa Laval, so the problem is not isolated to a particular manufacturer but is a function of water quality, maintenance regimes, water treatment strategies and heat exchanger operating strategies.

Historically plate heat exchangers have had little attention unless there is a serious leak. Servicing will identify the issues described above and will assist in the reduction of catastrophic failure incidents.

Many new buildings have large plate heat exchangers where parts are not available ex stock and even after-market parts can take 2-3 weeks to manufacture, usually in China and air freight costs can be prohibitive.

One of the lessons learnt from this installation is the benefits or making decisions in a timely manner. Given the risk of imminent catastrophic failure just prior to summer and the effect this would have on the building's occupants, it was decided to air freight the plate pack which added $30,000 to the total cost of the works.

All the above ignores the commercial value in servicing/cleaning a plate heat exchanger.

An inefficient plate heat exchanger results in higher power and maintenance costs resulting from chillers and pumps running longer than necessary.

DTTWA represents a number of OEM heat exchanger and other manufacturers:

- **SPX – Authorised Service Partner**
- **Sondex – Western Australian state agent.**
- **Tranter – Australian representative.**
- **Alfa Laval – Authorised Service Partner**
- **Represents Inkorr for the supply of a wide range of high temperature/highly corrosion resistant products and equipment.**
- **Australian distributor for Delta Products Group specialising in Delta T Descaler**

If you have any questions about the above or would like any advice or costs associated with the servicing, cleaning in place or replacement of a heat exchanger, please do not hesitate to contact:

Delta T Technologies (WA) Pty Ltd

Eric Brogle

9 Hopetoun Place, Welshpool, Western Australia 6106

Tel: (08) 9353 5484 | Mob: 0447604480

Email: ericb@deltatwa.com.au or

Email: sales@deltatwa.com.au

www.deltatwa.com.au

References

Australian Stainless Steel Development Association, n.d. “Crevices and Corrosion” Accessed February 3, 2021. https://www.assda.asn.au/technical-info/surface-finishes/crevices-and-corrosion#