PARAGON
Airheater Technologies

Date: October 12, 2006

Location: [redacted]

Equipment: Unit 3 - Air Preheaters

OEM Contract Number: [redacted]

Customer PO No.: [redacted]

Invoice No.: [redacted]

Contact: [redacted]

Phone: [redacted]

Purpose of Visit:

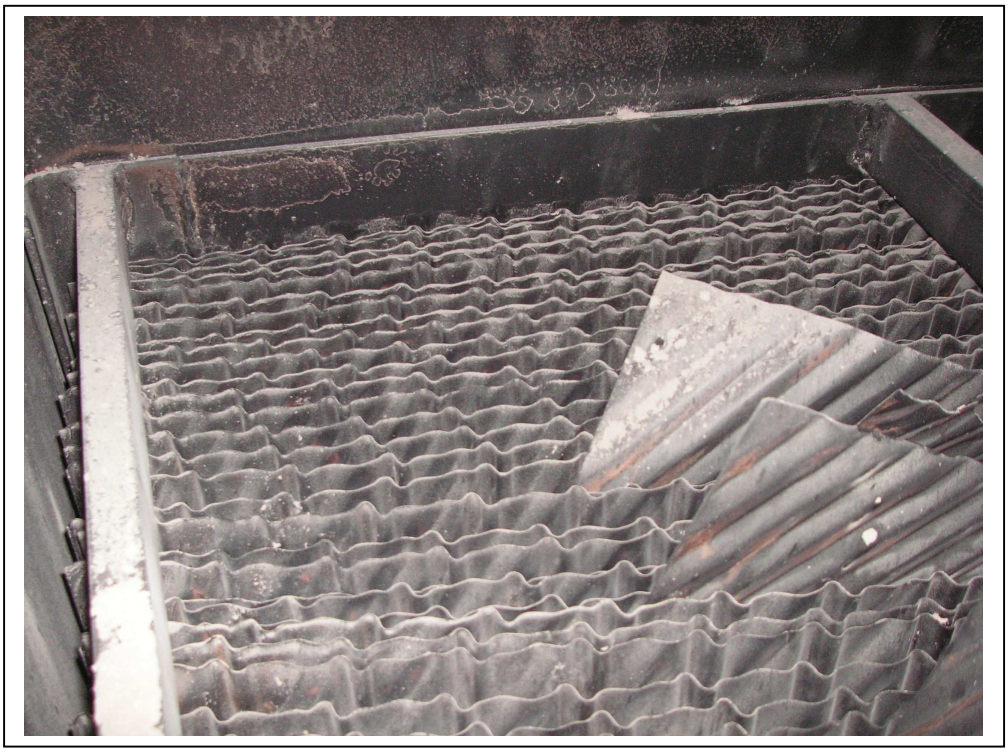
The purpose of this visit was to complete an inspection of the Ljungstrőm air preheaters on unit 3. The rotors were not rotated during the inspection.

Equipment: Two size 30.0-VI-62" Modular Ljungström Air Preheaters

Observations:

Baskets - Element:

- The element in these air preheaters is DX in the hot and intermediate layers and NF-6 in the cold end layer.
- The element is the original element installed in the rotors when the unit was new in 1983.
- The hot end element is loose packed DX element. It is breaking up in a manner that is typical of DX element. The undulated sheets are breaking up into small pieces and are coming out of the rotor. The notched and undulated sheets are also failing, but at a slower rate. Three to six inches of depth of the undulated sheets typically have been lost. The inner baskets, A and B baskets are in much better shape than the outer baskets.
- The intermediate layer could not be directly inspected. There did appear to be element damage to the element sheets that could be observed through the damaged hot layer.
- The cold end element sheets are being eroded on the cold face of the basket. This erosion is more severe in the outer baskets. There is ash build up in the baskets. There is erosion damage to the basket end plates, basket bars and spider bars. Spider bars have been cut in two in places.



Hot end element damage

Cold end element pluggage, basket bar erosion and grating erosion

Rotor Seals:

- The hot end post seals were in good condition. The hot end radial seals have made heavy contact with the sector plates. The contact is most severe with the outboard seals. The radial seals seem to be the original design with no bent in the seal leaf. The contact forced the seals to be bent over the top edges of the diaphragms. The by-pass seals eroded through both layers of seals at the gas side of the gas to air sector plates. Attachment bolts were also eroded.
- The cold end seals are in good condition with the exception of several inboard diaphragm seals. These seals had holes corroded through the seals at the post. There was some relatively minor erosion damage to the by-pass seals at the gas side of the gas to air sector plates. Radial seal bolts were eroded or missing on several outboard seals.
- Only one axial seal was inspected because the rotor was not turned during the inspection. The axial seal was in good condition.

Rotor Structure:

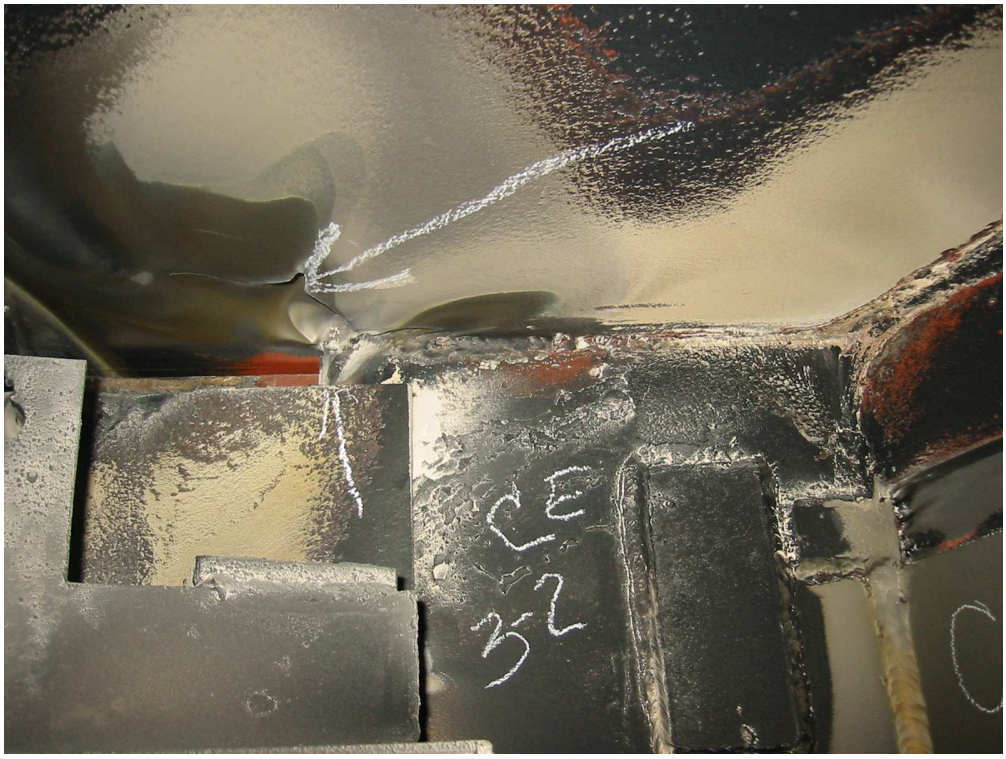
- The rotors are in relatively good condition. There is erosion damage to the cold end grating which supports the cold end element. The erosion damage, on the top surface of the grating bars, is up to 1" deep.
- The hot end floating T-bar was missing a clip on 3-1. This should be replaced.

Sector plates, static seals and spool seals:

- The hot end sector plates are in very good condition. There is a slight amount of erosion damage to the surface of the cold end gas to air sector plates on the outboard gas side of the plates.
- There are gaps in the hot end static seal assemblies at the inboard and outboard ends.
- The static seal at the support for the leakage control system sensor are bottomed out.
- There is erosion damage to the cold end spool near the gas to air sector plate.

Static seal gap – outboard end

Static seal bottomed out against the sensor support



Cold end spool erosion damage

Cold end spool erosion damage

Leakage Control System:

- The gear box on the gas to air hot end sector plate on the 3-1 heater was being replaced during the outage.
- There was a problem with the air to gas drive on the 3-2 heater.

Housing structure:

- The hot end pipe bracing in the gas inlet ducts have some erosion damage.
- The beam assemblies in the gas inlet duct that are part of the intermediate pressure high volume washing device are damaged from erosion.
- There are several missing bolts in the air inlet duct, just above the steam coils.
- There are holes in the gas outlet ducts below the rotors.

Hot end pipe brace erosion damage

Bearings:

- The oil levels in the support and guide bearings were between the marks on the dip sticks.
- There is ash build up on the dip stick line on the 3-1 guide bearing.

Soot blowers:

- There are retractable soot blowers on the hot and cold ends of these air preheaters.
- The hot end blowers are located on the center line of the gas inlet duct. There is a significant amount of erosion damage to the lance assembly. The damage is thinning of the top side of the lance piping. The lance has no holes.
- The cold end blowers are located approximately 15 degrees from the gas to air sector plate. These blowers have been repaired in the past. There are three nozzles located in the cold end lance. The distance between the outer and middle nozzles is 67". The distance between the inner and middle nozzles is 37". The distance between the limit switches that govern the travel of the lance is 67". The nozzle throats are eroded.

Discussion:

The element failure is typical of DX element, although most DX element fails much quicker. Twenty plus years of service for DX element is extremely good. DX element typically fails as a result of soot blowing. The undulated sheets break into small pieces which fail or blown out of the rotor. With the undulated sheets gone, the remaining notched sheets are much looser which makes them more susceptible to soot blower damage. DX element was replaced with DL element very shortly after it was introduced. DL element has the same undulations and notches as DX. Half of the notches on the DX notched sheet were moved to the undulated sheet to create DL. Adding the notches provided additional stiffness to the undulated sheet to increase its life. DL element will provide the same thermal performance and pressure drop as DX element. The hot end layer of element should be replaced using DL element.

The hot intermediate layer of element has been subjected to the same soot blowing that has damaged the hot end layer. I assume that it is in similar condition. The hot end seals and hot end layer of element would need to be removed to replace this layer. To minimize future costs, the intermediate element should be replaced when the hot end layer is replaced.

The damage to the cold end element is erosion of the element sheets by the soot blower. The areas of the element sheets that are shielded from the direct impact of the soot blowing jet are not eroded as much as the sheets that are protected. The basket bar damage seems to be below the flow passages in the cold end element. Some sections of the rotor are subjected to a greater amount of ash. These areas of greater ash concentration will produce greater damage. The cold end layer of element should be replaced.

The hot end radial seals wear was caused by contact with a hot end sector plate. The heaviest wear is on the outboard seal tab. When a drive for the leakage control system fails with the unit on line, the sector plate is locked in a position close to the rotor. When the unit is brought off line, the thermal deformation of the rotor is relieved and the rotor moves toward the sector plate resulting in seal contact. The damage to the by-pass seals

at the sector plates is a result of ash being purged from the rotor and forced back into the gas duct. The hot end radial and bypass seals should be replaced.

The inboard cold end diaphragm seals and missing or damaged bolts should be replaced. The cold end by-pass seals at the edge of the gas to air sector plate should be replaced.

The cause of the erosion damage to the grating bars is similar to that of the basket bars. Since the original cold end element lasted 20 plus years, the grating should be replaced.

The T-bar assembly uses clips to hold the segments in alignment. Misalignment of the segments can result in damage to the by-pass seals. The missing clips should be replaced.

Gaps between the static seal and sector plate allow for excess air to gas leakage. The static seals should be repaired.

The static seal bottoming out against the sensor support restrict the movement of the sector plate. This is a possible cause for the leakage control system gear box failure. The static seal should be modified to ensure that there is unrestricted movement of the sector plate.

There erosion damage to the cold end spool is caused by entrained ash being blown back into the gas duct. If this erosion penetrates the spool plate, the erosion will accelerate and generate higher air to gas leakage. The erosion area should be repaired.

The erosion damage in the gas inlet duct is fairly typical. The pipe braces should be replaced and shielded. Loss of a brace will allow the housing to deform and result in abnormal by-pass seals wear. If the intermediate pressure high volume washing device is used, the beam should be repaired or replaced. Holes in the air inlet and gas outlet ducts should be repaired.

Ash build up on the dip stick line can cause the oil in the line to bake out in the area of the build up. This can create a dam in the line and provide a false oil level indication. This type of problem has resulted in a guide bearing failure. The ash should be removed from the line.

Soot blowers can damage the element very easily. The cold end blower has a travel of 67”. The spacing between the two inner nozzles is 37”. This results in a section of the rotor being covered twice during a blowing cycle. It also results in the inner 30” of the rotor not being covered. This may partially explain why there is a difference in the amount of damage to the element sheets. The nozzles are eroded by the soot blowing media. An eroded nozzle will produce a jet that is not parallel to the element sheets, damaging the element. The soot blower lance should be replaced or repaired.

The hot end soot blower lances are thinning from ash erosion. These should be protected before holes are eroded through the lance tubes.

Recommendations:

1. The hot end layer of element should be replaced using DL element.
2. The intermediate layer of element should be replaced using DL element.
3. The cold end layer of element should be replaced.
4. The hot end radial and bypass seals should be replaced.
5. The inboard cold end diaphragm seals and missing or damaged bolts should be replaced. The cold end by-pass seals at the edge of the gas to air sector plate should be replaced.
6. The grating should be replaced.
7. The hot end floating T-bar clip on 3-1 should be replaced.
8. The static seals should be repaired at the inboard and outboard ends.
9. The static seal should be modified to ensure that there is unrestricted movement of the sector plate.
10. The erosion damage to the cold end spool should be repaired.
11. The pipe braces should be replaced and shielded.
12. The intermediate pressure high volume washing device support beam should be repaired or replaced if it is used.
13. Holes in the air inlet and gas outlet ducts should be repaired.
14. The ash should be removed from the guide bearing dip stick oil line.
15. The cold end soot blower lance should be replaced or repaired.
16. The hot end soot blower lance should be protected from erosion damage.

Pictures of the damage were taken. They will be forwarded on a CD.

If there are any questions, please contact me.

Technical Service Manager – East: Gary C. Goetschius