Metso

Get the most out of your equipment

Rotary kiln maintenance

The Metso advantage

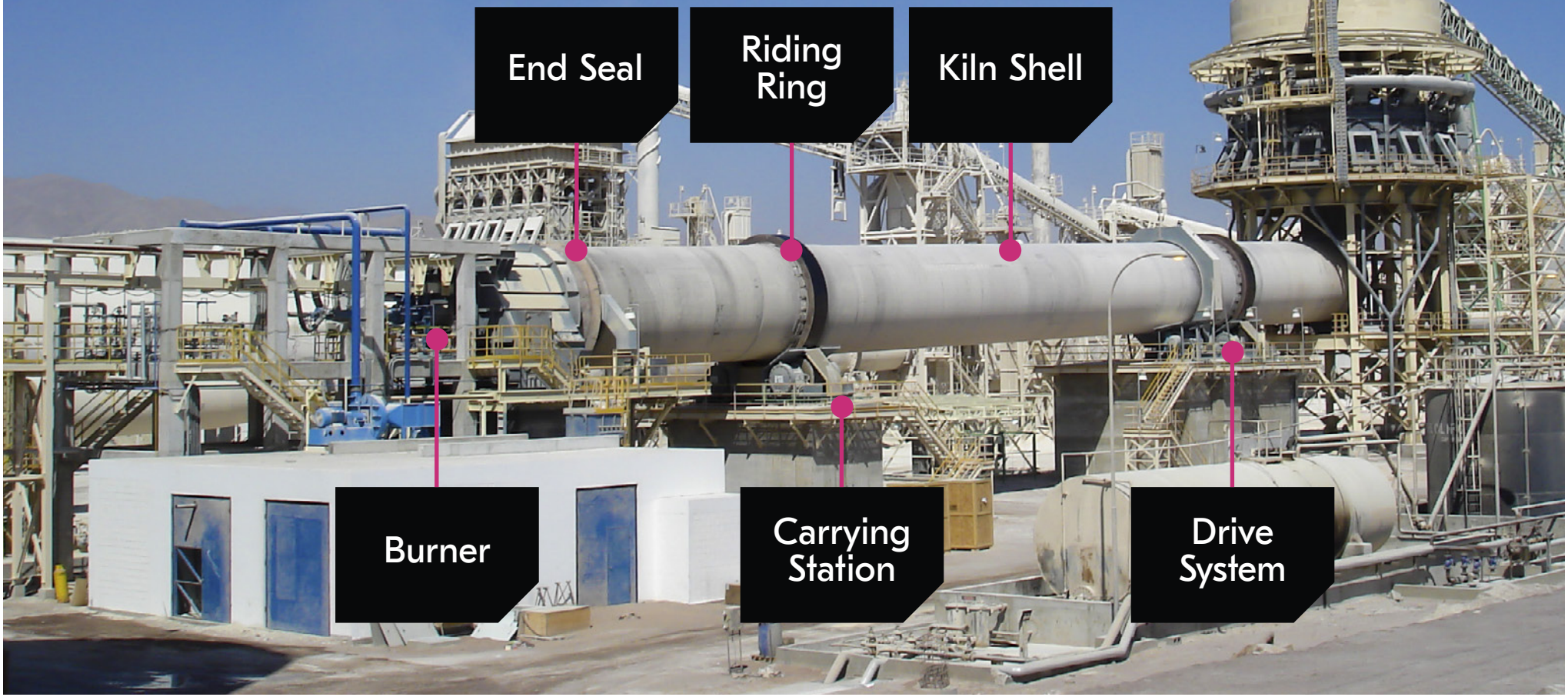
Not everyone approaches opportunities or faces the same problem the exact same way. But with over 100 years of designing and servicing rotary kilns, our experts have seen it all. We are happy to share that experience with you, whether it is through a conversation, site visit, or full mechanical analysis.
We are here to support you.

Section 1

Kiln Anatomy 101 – Get to know your kiln

Get to know your kiln

Rotary kilns have many moving parts and as the kiln ages, these parts can start to move very differently. Whether you're a kiln expert or a newcomer, it's always important to review the basics, starting with the key components that make up your kiln. To help you best maximize efficiency, availability, and longevity of your assets, this section provides guidance on what to look for in order to evaluate the operation of core components.



Kiln Anatomy 101 –

Riding Ring

What it is

Commonly referred to as a tire, the riding ring is located at every carrying station. It wraps the kiln shell, providing radial stiffness and a contact area for kiln rotation.

What to watch for

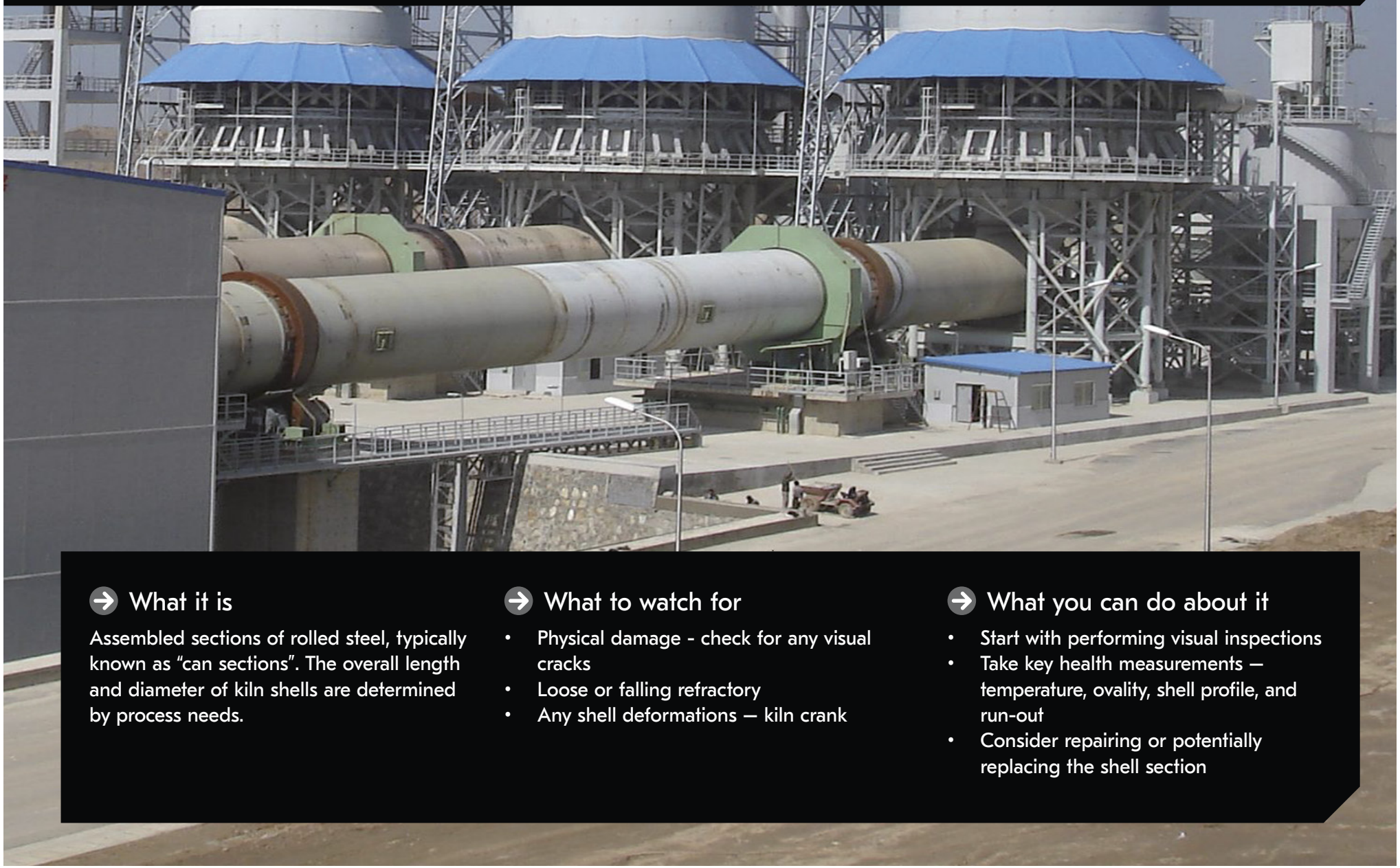
- Visual wear patterns - check for shoulders, tapers, convex or rolled edges, flat spotting, or grooving
- Physical damage - check for indentations, cracks or spalling
- Contact wear - check the interface of retaining components or thrust face to the side of the tire

What you can do about it

- Start with performing visual inspections
- Take key health measurements – creep, temperature, diameter, tire axial runout
- Consider tire grinding, alignment, or potentially replacing the riding ring

Kiln Anatomy 101 –

Kiln Shell



What it is

Assembled sections of rolled steel, typically known as “can sections”. The overall length and diameter of kiln shells are determined by process needs.

What to watch for

- Physical damage - check for any visual cracks
- Loose or falling refractory
- Any shell deformations – kiln crank

What you can do about it

- Start with performing visual inspections
- Take key health measurements – temperature, ovality, shell profile, and run-out
- Consider repairing or potentially replacing the shell section

Kiln Anatomy 101 –

Carrying Station

What it is

Located at load piers, the carrying station includes the base frame and all support mechanisms (bearing assemblies, trunnions, etc.).

What to watch for

- Overheating
- Contamination
- Excessive vibrations and noises
- Leaking oil
- Visual wear patterns on the roller - check for shoulders, tapers, concave or rolled edges, flat spotting, grooving

What you can do about it

- Start with performing visual inspections
- Take key health measurements – temperature, differential roller shaft deflection
- Lubrication/oil testing and analysis
- Perform trust adjustments
- Consider repairing or potentially replacing the component

Kiln Anatomy 101 –

End Seal

What it is

Located at the point of transfer between the rotating element and the stationary hood or duct. Kiln seals are used to minimize drawing excess air and expulsion of kiln gases.

What to watch for

- Excessive run-out of the kiln shell
- Overheating of the seal
- Damaged or inverted seals
- Dust or gas escaping from seal
- Wear and tear of the seal components

What you can do about it

- Start with performing visual inspections
- Take key health measurements – temperature, shell run-out
- Replace individual leaf seals or the complete assembly if worn out
- Switch materials or upgrade to double or triple leaves

Kiln Anatomy 101 –

Drive System

What it is

The drive system enables the rotary kiln to rotate. It is comprised of the main gear, a drive pinion, and a motor/reducer assembly.

What to watch for

- Gear and pinion backlash
- Radial and axial alignment of the bull gear
- Excessive vibration
- Visual wear patterns - steps, tapers, offset, contact pattern
- Proper lubrication

What you can do about it

- Start with performing visual inspections
- Take key health measurements – temperature, axial/radial alignment, backlash
- Consider continuous monitoring, realignment, weld repairs, component replacement or upgrade

Kiln Anatomy 101 –

Burner

What it is

The burner provides the heat required within the process to dry or carry out a chemical reaction in the product within the kiln or dryer. Heat is generated by burning fuels which can be gas, liquid or solid in the presence of oxygen normally provided by an air supply.

What to watch for

- High emissions
- Internal damage to kiln or damage
- Inefficient system performance
- Reliable and current safety systems

What you can do about it

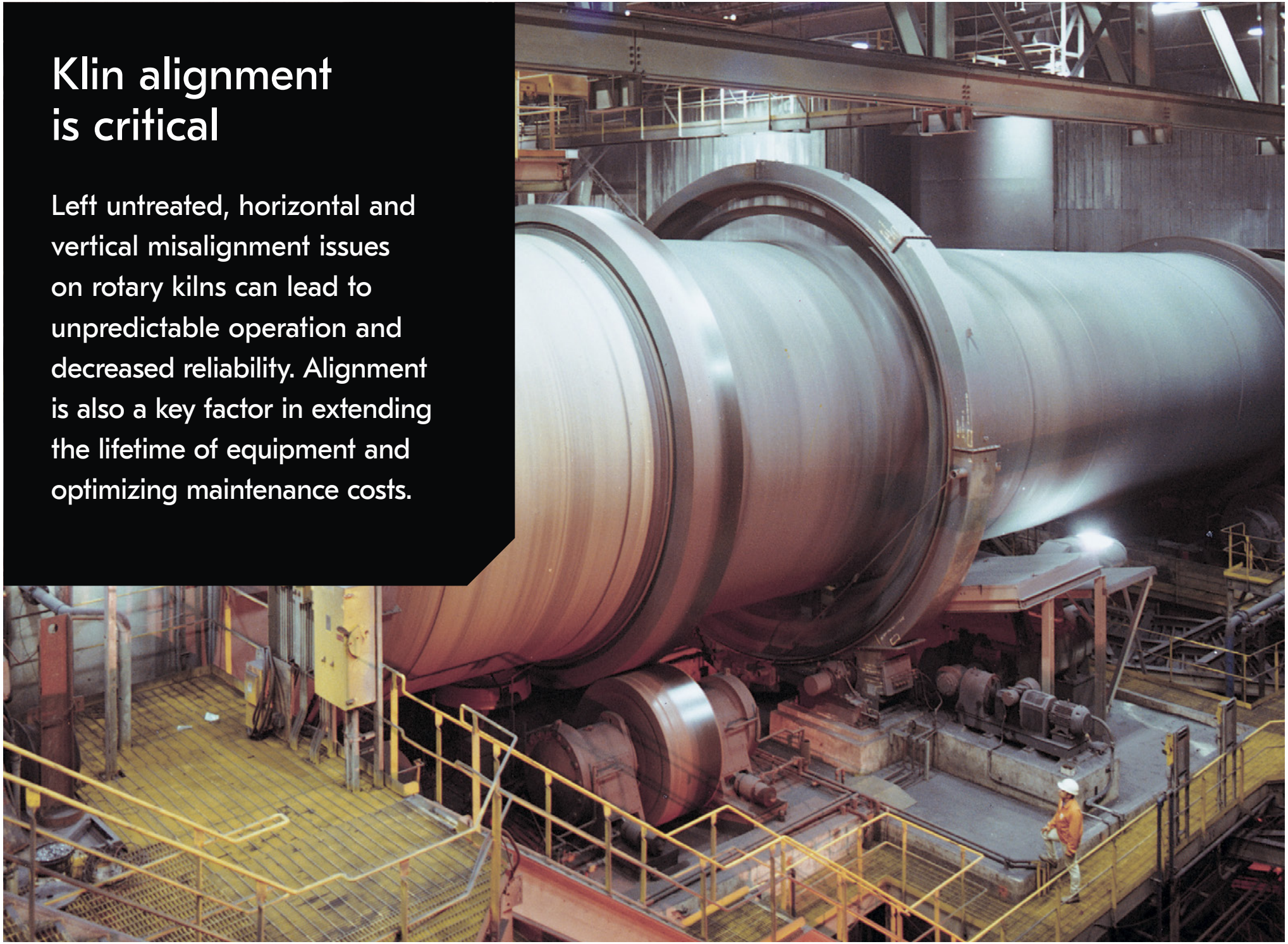
- Kiln/dryer survey and audit
- Burner tuning/optimization
- Burner upgrade
- Safety system upgrade

Section 2

Health Check – Key maintenance activities & KPIs

Klin alignment is critical

Left untreated, horizontal and vertical misalignment issues on rotary kilns can lead to unpredictable operation and decreased reliability. Alignment is also a key factor in extending the lifetime of equipment and optimizing maintenance costs.



Health Check –

Kiln alignment is critical

Why alignment is so important | Alignment methods | Evaluating your options

Why is alignment so important?

Alignment of the shell or drum between the support piers, gear to pinion, and tires to support rollers, is necessary for all rotary units. By maintaining alignment of the key components, the following benefits can be obtained:

- Equalization or optimization of loads on support piers
- Reduced power consumption
- Lower component wear rates, e.g. riding rings, support rollers, gear and pinion, thrust roller, bearings, etc.
- Reduced stress and wear on refractory
- Reduced risk of shell damage by refractory failure
- Reduced risk of unplanned stoppage

Health Check –

Kiln alignment is critical

Why alignment is so important | **Alignment methods** | Evaluating your options

Hot alignment and mechanical analysis

Hot alignment allows adjustment of the kiln to the optimum level without interrupting production for multi-pier, refractory-lined kilns. Using the latest technology, the analysis typically includes items such as: shell profile and run-out, ovality measurement, differential roller shaft deflections, gear and tire axial run-out, as well as roller and tire diameter measurements. Corrections to alignment are made on the run. Hot kiln alignments are also beneficial in determining the shell axis prior to shutdowns where major work is planned.

Cold alignment

Cold alignment is executed during a shutdown period to correctly realign the kiln in order to benefit production and safeguard your equipment. This is typically carried out on smaller units such as coolers, dryers, and carbon regeneration kilns, with or without refractory lining, and running spherical roller bearings.

Health Check –

Kiln alignment is critical

Because OEMs and repair companies apply different methods to calculate kiln misalignment, you might find it challenging to evaluate the service proposals you receive from suppliers performing their version of a hot-kiln alignment. When looking for support in kiln alignment, there are a few considerations to evaluate:

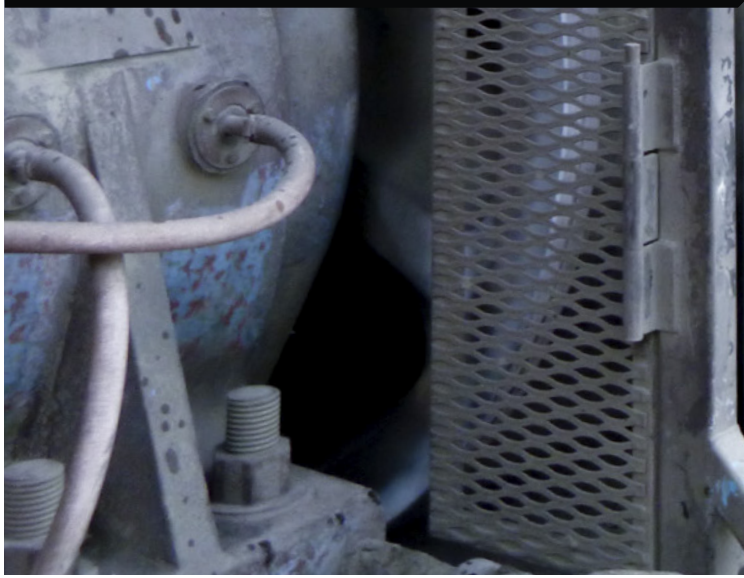
What is included in the alignment?
An Alignment Analysis of the unit is often combined with a Mechanical Survey in order to identify, diagnose, and correct any issues before they develop into major problems. Metso Alignment Analysis contains a range of measurements using different tools to ensure all key parameters are analyzed.

How experienced are the service providers?
The use of accurate and proven procedures, performed by experienced and qualified personnel should be of paramount importance to the operator. Metso has crews with many hundreds of hours of experience on all makes and types of rotary equipment.

Is the latest technology being employed?
Proper diagnostics tools and methods should be utilized. For example, some rely on measurements of the riding ring and the associated tire slip or creep. However, given that the tire surface can be irregular due to wear and is often contaminated with lubricant and dust, basing kiln alignment on tire measurements alone is of questionable accuracy. Metso uses state-of-the-art high frequency laser equipment to capture data with a high degree of accuracy, calculating the position of the kiln shell rotational axis at each support. Calculations include allowance for flexure, shape distortion, and eccentricity of the shell.

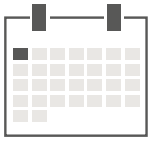
Routine maintenance

Performing regular inspections and maintenance are vital for kiln operators. They can prevent breakdowns and eliminate the related safety concerns, inconvenience, and costly repairs. Overall, good maintenance habits go a long way towards keeping your kiln healthy and minimizing operating expenses.



Health Check –

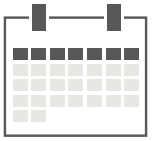
Routine maintenance makes the difference



Daily
Kiln Maintenance

A walk-by inspection should be performed daily.

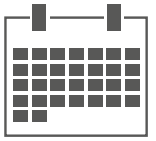
- Check lubrication levels for the carrying roller
- Check lubrication levels for the gears
- Verify kiln shell axial position
- Ensure cooling water flow for the carrying roller
- Verify the burner's fuel and air connections for leaks
- Visually check the flame shape



Weekly
Kiln Maintenance

These inspections should be performed weekly, in addition to the daily checks.

- Measure kiln tire creep
- Note major component wear
- Check the kiln drive amperages for fluctuations
- Check kiln seals and shell run-out on feed and discharge ends
- Check drive bolt tightness – visually check for loose bolts
- Verify the kiln shell temperature profile for fluctuations in operating temperatures
- Survey general pilot and burner settings including operating pressures and flow rates



Monthly
Kiln Maintenance

These inspections should be performed monthly, in addition to the daily and weekly checks.

- Check the auxiliary drive motor to ensure it is available in an emergency situation
- Check the pitch line separation between the drive gear and pinion for changes in the gear mesh
- Inspect gear reducer oil levels and all drive bearings for high operating temperatures
- Perform vibration analysis of the gear and pinion, gear reducer, and drive system bearings

*Not a comprehensive list. Please follow your OEM operating manual. Metso would be happy to provide more details and guidance.

Health Check –

Routine maintenance makes the difference

5 quick tips for effective maintenance:

1. Put together a detailed maintenance plan
2. Record all information and activities in a log
3. Be proactive with maintenance – it always pays off
4. Kiln issues can be complex. When it comes to major repairs, it's good to get a second opinion
5. Kilns are one piece of your process – it is important to take a step back and evaluate holistically

*Not a comprehensive list. Please follow your OEM operating manual. Metso would be happy to provide more details and guidance.

Factors to watch

Similar to visiting a physician for an annual physical exam, the health of your rotary kiln should be followed and examined regularly as well. Keep an eye on the following core areas and key indicators.

Health Check –

Factors to watch

Kiln shell ovality | Kiln tire creep | Shell profile and run-out | Gear axial & radial run-out

Shell flex or ovality occurs at each pier. This condition is marked by a radial irregularity or deviation from the circular shape at the horizontal axis, and an assumed equal and opposite deviation at the vertical axis.

Causes of kiln shell ovality:

- Undersize or worn tires
- Shell thickness and clearance between tire bore and shell outside diameter, also known as creep or diametrical clearance
- Misalignment causing excessive loads on support rollers

Effects of kiln shell flex:

- Refractory crushing and failure
- Shell plate cracking (typically at a weld)

*Not a comprehensive list. Please follow your OEM operating manual. Metso would be happy to provide more details and guidance.

Health Check –

Factors to watch

Kiln shell ovality | **Kiln tire creep** | Shell profile and run-out | Gear axial & radial run-out

Tire migration, also known as tire creep, is the difference in the circumferential distance travelled between the tire and shell in one revolution i.e. the amount that the tire lags or "creeps" behind the shell.

Causes of kiln tire creep:

- Wearing of kiln components that reduces the diametrical clearance between the tire and shell
- Thermal differential between the tire and shell

Effects of excessive kiln tire creep:

- Increased ovality (refractory crushing, failure, and shell cracking)
- Component wear (filler bars, tire blocks, and tire bore)

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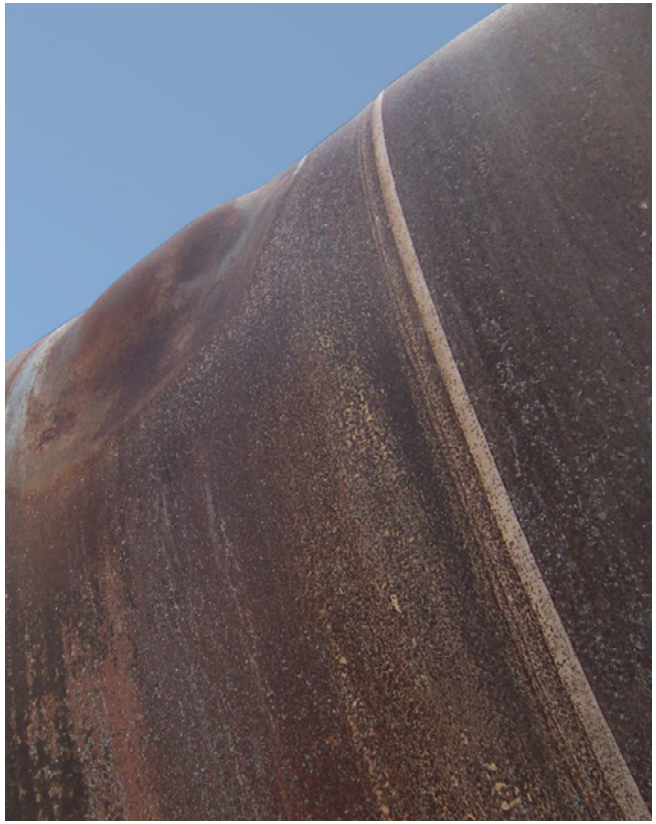
Health Check –

Factors to watch

Kiln shell ovality | Kiln tire creep | **Shell profile and run-out** | Gear axial & radial run-out



Shell profile (or out-of-roundness) is a permanent deformation of the kiln shell. This is normally referred to as shell blisters, shell warp-age, shell twisting, or coke bottling.

Kiln shell run-out (or eccentricity), is the inaccuracy of kiln shell rotation about its true center. It is the radial offset about the true center of rotation of the kiln. This situation is commonly referred to as kiln shell crank, dog leg, or a banana in the kiln shell.

Causes of shell out-of-roundness and run-out:

- Overheating of kiln and components
- Loss of refractory
- Damage to the kiln shell
- Emergency shutdown, where properly cooling and slowing the kiln was not possible

Effects of shell out-of-roundness and run-out:

- Physical distortions of both the refractory condition inside the rotary kiln and the integrity of the kiln shell
- Higher drive amps and excessive loading on carrying mechanisms
- High differential roller shaft deflection
- High ovality on the kiln shell

*Not a comprehensive list. Please follow your OEM operating manual. Metso would be happy to provide more details and guidance.

Health Check –

Factors to watch

Kiln shell ovality | Kiln tire creep | Shell profile and run-out | **Gear axial & radial run-out**

Gear axial runout and radial runout refer to the misalignment of the main gear as it rotates. Radial run-out is checked to ensure proper alignment between the gear and the pinion, while the axial runout is important to ensure proper face contact between the gear and pinion.

Causes of gear axial runout and radial run-out:

- Improper installation
- Eccentricity of the kiln shell (shell runout)
- Shell deformation (shell profile)
- Kiln misalignment

Effects of gear axial runout and radial run-out:

- Heavy tooth wear and damage
- Insufficient/excessive root clearance
- Excessive vibrations

*Not a comprehensive list. Please follow your OEM operating manual. Metso would be happy to provide more details and guidance.

Health Check –

Factors to watch

A few extras

In addition to the key factors previously listed, here are a few more indicators to track that will help ensure that your rotary kiln is functioning optimally:

Differential roller shaft deflection:
Amount of bending that occurs in the carrying roller shaft

Tire axial run-out (wobble):
Misalignment in the axial position of the tire as it rotates

Kiln float:
The axial forces of a rotary kiln must be balanced. Thrust balancing (kiln float/training the kiln) is performed to evaluate the position of the carrying roller shafts and the direction which the kiln is thrusting

*Not a comprehensive list. Please follow your OEM operating manual. Metso would be happy to provide more details and guidance.

Section 3

See a specialist – Getting help for your kiln

See a specialist –

Help with your kiln

You can rely on our expertise

Keeping your kiln healthy and running at its best can be a big job. Luckily, OEM partners like Metso can help you so you don't need to take care of everything by yourself. Metso offers end-to-end services for rotary kilns, as well as for full pyro processing systems. Our services also cover the many heritage brands that are part of Metso, and we also service non-Metso equipment. With more than 100 years of experience covering numerous applications and business areas, you can count on Metso to keep your kiln turning.

Metso is home to many heritage kiln brands:

- Allis-Chalmers
- Allis Mineral Systems
- Svedala
- Boliden Allis
- Kennedy Van Saun (KVS)
- MPSI/Hardinge
- Stansteel

*We also service non-Metso equipment.

Metso has experience in many application areas:

- Iron ore
- Cement
- Lime
- Pulp & paper
- Coke
- Lithium
- Alumina
- Waste incineration

See a specialist –

Metso Kiln Services

Spare parts supply

OEM parts are available for a variety of brands, all held to stringent quality standards

- Reliable original parts that work with no fuss
- Tried, tested, and available

Upgrades, retrofits, and repairs

A range of possibilities, from small tyre crack repairs to a shell section replacement to a complete overhaul

- Extend the life of your equipment
- Achieve performance improvements: profitability, uptime, safety

Inspection and alignment services

Regular maintenance is a core practice that should not be overlooked

- A variety of standardized inspection packages
- Comprehensive alignment and mechanical analysis services can be performed during normal operation

Training and seminars

An extensive array of training programs designed for real-world operations

- We specialize in hands-on training for operators and maintenance personnel
- We also offer on-site training and regional seminars

Metso Kiln Services – Customer cases

Getting to the root cause of issues

An Australian mill uses mechanical insight to put a repair plan in place.

Kiln shell in need of maintenance

An American paper mill in urgent need of support before their planned shutdown.

Tight timeline for kiln service work

A challenging project in the USA, completed ahead of schedule.

Customer case –

Getting to the root cause

Customer challenge

The ageing, 3-pier, 70 m long kiln at an Australian paper mill was suffering a range of issues that were severely impacting availability and thermal efficiency. Numerous issues were visible to the eye; however, the root cause had not been determined and therefore a real repair plan had not been put in place.

Results

A comprehensive mechanical inspection and detailed alignment brought the true cause of numerous issues to light. With this information in hand, the customer opted to work with Metso to implement interim repairs right away, followed by major refurbishments. Repairs and upgrades to the refractory lining, discharge seal, and a shell replacement resulted in a significant reduction in fuel consumption, improved kiln mechanical reliability and a distinct reduction in unplanned stoppages for mechanical issues.

Metso solution

After a visual inspection, it was clear that the biggest issue impacting kiln availability was the breaking of tangent plates, with the resulting wear on the gear and pinion. These types of issues can be caused by numerous issues such as poor welding procedures, material quality, lubrication, as well as many others. The operator had tried multiple repair methods for the tangent plates over the previous two years, to little result, except an unfortunate waste of time and money. This is a very typical scenario especially among large mechanical installations, where a lack of resources affects the ability to do a true root cause analysis.

At that point, the kiln was subjected to the Metso Hot Kiln Alignment and Mechanical Inspection program to identify the major causes of the various issues. Metso then worked with the client to develop the most cost-effective solution. One of the main problems identified was that high run-out of the kiln shell was the real cause of the high wear on the gear and pinion and continual breakage of tangent plates.

Then, using a shell profile analysis, which is part of Metso's standard package, the most critical areas of kiln shell deformation were identified and recommended for replacement. Further detailed measurements indicated that the wear on the gear teeth was close to the limit and gear/pinion replacement was also advised.

Customer case –

Kiln shell in need of maintenance

Customer challenge

A paper mill in South Carolina, USA was facing issues with one of their kilns. A section of the kiln's shell was in need of urgent attention as it was losing refractory due to overheating. Multiple blisters had also formed near one of the riding rings. Ahead of its annual planned shutdown, the decision was made to address the maintenance issues.

Results

All the repair and replacement work was completed on schedule by Metso and its team of Metso preferred contractors, including the final realignment of the kiln. After the work was completed, the plant was able to return to full production and the likelihood of unplanned downtime in the future was minimized.

Metso solution

Metso was responsible for removing and installing a 29' section of the 375' long kiln as well as aligning riding rings and installing new retaining blocks on piers 1 and 3. This complex task involved using heavy duty cranes, kiln support saddles and kiln joint hardware, as well as a Metso Field Services team to carry out the actual on-site work along with the plant's staff.

Metso also replaced two tube coolers and replaced the leaf seals on the discharge end of the cooler housing. In addition, repairs were done on the tube cooler leaf seal wear plate, as the wear plate had two spots on it where there were gaps between the sections. These gaps could potentially catch the leaf seals as they turned and either pop them out of the flange or tear them off completely.

Recommendations were also provided in regards to preventive maintenance steps that could be put in place for the riding ring retaining blocks and other components.

Customer case –

Tight timeline for kiln service work

Customer challenge

A plant in Washington, USA needed major maintenance work on one of its kilns and had an extremely tight timeline for the project to be completed.

Results

This was an extremely challenging project with many logistical and access constraints. Metso was able to complete the complicated project 10 hours ahead of schedule. The team successfully changed out the components and also provided many recommendations in terms of preventive maintenance to help avoid future surprises and unplanned stoppages.

Metso solution

The Metso solution involved installing a new thrust riding ring shell section, a thrust riding ring, and a thrust riding ring full floating filler bar assembly, as well as reversing the gear with new tangent plates and pinion.

The project also came with the additional challenges involved in safely manipulating the large and heavy components needed for the change-out. In addition to changing out the designated components, Metso was also able to point out several potential future issues that could be problematic if they were not addressed.

Many recommendations were provided in terms of preventive maintenance. In particular, a Hot Kiln Alignment and Mechanical Survey, which included an ovality study, was recommended to determine the proper elevation, spacing, and orientation of all carrying rollers and riding rings. Other recommendations were to put in place weekly lubrication of the bore of the riding rings and also to plan for the resurfacing work needed on one of the pier's carrying rollers, as it was showing signs of poor contact with the riding ring.

Summary

- Know your kiln — When you know about the anatomy of your kiln, you will also know what to watch out for.
- Check your kiln — Regular inspections and maintenance help to ensure that your kiln stays in the best of health.
- **Speak to a specialist — Experts like Metso know how to help you with your kiln, whatever your application.**

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Metso