WHITEPAPER

ENHANCING OPERATIONAL RESILIENCE IN THE PULP AND PAPER INDUSTRY

Global Solutions, Local Service.

CONTENTS

ABSTRACT

The Pulp and Paper industry faces unique challenges related to equipment longevity, mean time between failures (MTBF) extension, minimal downtime, and protective coatings suitable for harsh industrial pressures.

This paper explores common industry issues and presents potential solutions to ensure equipment longevity, plant productivity, and reduced maintenance costs.

1.0 INTRODUCTION

The Pulp and Paper industry has come a long way since the early days when paper production was primarily a product of manual labour. Many processes are machine-run, meaning equipment longevity and extending MTBF are critical to a healthy bottom line. Selecting the best equipment, components, and coatings based on identifiable KPIs is vital.

These KPIs are primarily concerned with lowering costs with equipment and parts that last. With many years in the industry and clients using our products, Chesterton® is uniquely positioned to assist with plant productivity and longevity. Several challenges faced throughout the Pulp and Paper industry will be explored, along with considerations of how to rectify each.

2.0 BEARING PROTECTION AND BEARING HEALTH

Achieving optimal bearing life has been a historical headache for engineers and maintenance departments, especially within the Pulp and Paper industry. Constant harsh conditions create the perfect storm that directly impacts the lifespan of bearings. From unexpected breakdowns to reduced capacity, improving bearing life is always challenging. Here, we will investigate three key questions:

- Why do bearings fail?
- What are the root causes of bearing failure?
- What mechanisms can we use for bearing protection?

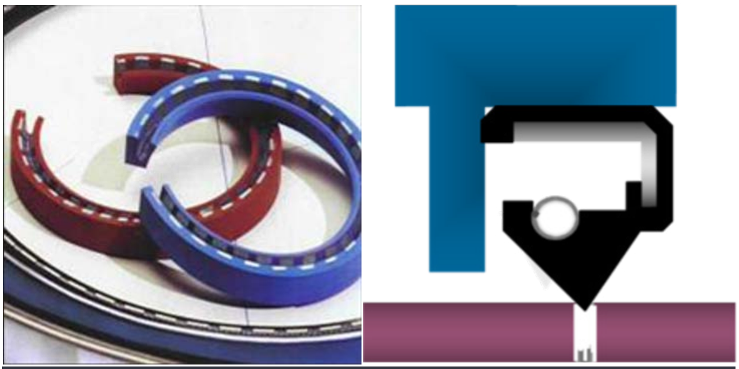

Figure 1. Conventional Lip Seal and shaft wear due to use of a Lip Seal.

2.1 Why do Bearings Fail?

In the Pulp and Paper industry, bearings face challenging conditions, significantly reducing their lifespan compared to lab conditions. Factors like water, dust, heavy loads, vibrations, contaminants, and human error contribute to premature failure. Conventional lip-sealing systems featuring elastomeric lip seals provide an initial defence, but their effectiveness diminishes after approximately 3,000 hours of operation. Beyond this point, liquid from the environment infiltrates the bearing housing, washing away the second line of defence – grease. This exposure to corrosion, accelerated by heat, load, and the environment, leads to bearing failure.

2.2 Root Causes of Bearing Failure

The primary causes of bearing failure are the inadequacies of the lip-sealing system and water ingress compromising the grease. Addressing these issues is key to extending the MTBF and achieving a lifespan closer to the manufacturer's claims.

2.3 Protective Mechanisms

Introducing the Polymer Labyrinth Seal (PLS) as a protective mechanism offers a significant improvement over conventional seals. The PLS, with its split construction, provides robust and long-lasting protection.

2.4 The Lubrication Challenge

Tailored greasing approaches positively impact bearing lifespan, considering individual lubrication needs based on varying loads, exposures, and environments. Automated grease and oil dispensers emerge as innovative solutions to tackle lubrication challenges, ensuring precise lubrication regardless of operational challenges like contaminated areas or staff shortages. With most operations working around the clock and assets in hazardous or hard-to-reach locations, this is tricky to solve. Contaminated areas, constant interruptions, staff shortages, etc, mean that lubrication often becomes a casualty of outside influences, leading to the following:

- Over and under lubrication: Over lubrication raises pressure, increasing friction and temperature. Underlubrication causes the lubricant to become ineffective, leading to bearing starvation.
- Sticking to a strict timescale: Lubricating because it's 'on the to-do list' rather than necessity often leads to over-zealous greasing and associated problems.

Figure 2. Bearing failure

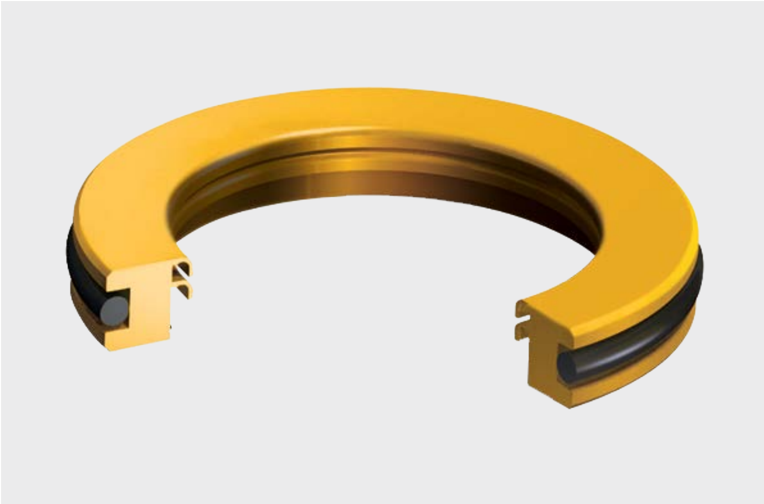

Figure 3. Chesterton 30K lip seal lip geometry design reduces shaft friction. The latest materials go further by removing heat from the contact points

Automatic grease and oil dispensers are the answer. This innovative solution solves many challenges, providing a precise amount of industrial grease or oil exactly when needed. Such automated systems add a valuable dimension to the process, ensuring reliable bearing lubrication, no matter the situation.

2.5 Water Washout-Resistant Grease?

Lubrication is critical in optimising optimal equipment performance, especially when water exposure poses a constant challenge. This emphasises the significance of washout-resistant grease, a quality exemplified by Chesterton 615 HTG. In conditions marked by temperature variations, water exposure, corrosion challenges, and heavy loads, washout-resistant grease becomes indispensable for sustained equipment reliability.

Chesterton 615 HTG is a high-performance grease tailored for such demanding environments. Offering corrosion inhibition, high temperature resistance, robust, intense pressure capabilities, and exceptional water washout resistance. It is a reliable solution to fortify your equipment against challenging conditions.

Key features of Chesterton 615 High-Temperature Greases include:

- NSF Registered, H2 – 615 HTG #2
- Outstanding extreme pressure and temperature characteristics
- Superior water resistance, excellent corrosion protection
- Exceptional shear resistance
- QBT™ Quiet Bearing Technology.

To illustrate the practical application of this solution, consider a scenario where a client faced vertical bearing failure in a hydra pulper due to harsh conditions such as water and chemicals. Limited access to the bearing nipple raised safety concerns, resulting in frequent equipment failures.

Figure 4. Chesterton Split Polymer Labyrinth Seal

Figure 5. Chesterton Lubri-Cup™ EM Series

In response, Chesterton specialists recommended the Chesterton LubriCup EM Series with 615 HTG#2. The clientreported heightened productivity and reliability a year later without bearing failures.

Figure 6. Chesterton 615 High-Temperature Grease

3.0 UNCONTROLLED WATER LEAKAGES

This chapter underscores the drawbacks of high flush water rates, commonly used to overcome the limitations of gland packing and mechanical seals. While costly and inefficient, this practice often leads to water leakage into bearing housings, dilution of pumped products, and negative environmental impacts. This can also lead to wasting energy in the process. The reluctance to adopt more effective sealing systems is attributed to factors such as unawareness of available solutions, perceived time and cost to upgrade, and resistance to change based on historical practices.

3.1 Overcoming Challenges: Effective Sealing Systems

The solution lies in adopting more efficient sealing systems backed by proven solutions designed, tested, and implemented successfully. Despite the availability of these advancements, adoption remains limited, primarily due to factors such as lack of awareness, misconceptions about the time and cost of upgrades, and resistance to change based on historical practices. However, when we look at ways to improve excessive water leakage and more energy efficient sealing solutions, we find that the latest solutions can overcome both issues within the Pulp and Paper industry. For example, historically, swapping the packing for a mechanical seal has been the answer to reducing energy consumption and excessive flushing leakage in gland or mechanically packed equipment. But does this still hold today?

3.2 Mechanical Packing

In the past, a common strategy to reduce energy consumption in gland or mechanically packed equipment was to replace traditional packing with a mechanical seal. However, as material technology and installation techniques have advanced, this conventional approach may no longer be optimal. Crafted from raw fibres, traditional packing created an effective sealant by forming a tortuous path for pressurised liquids. The effectiveness of the seal depended on manufacturing methods, materials, and installation quality, influencing how it sealed against stationary stuffing box walls and moving equipment shafts. Tightening gland follower nuts to prevent leakage is not the solution; it intensifies friction on the shaft, leading to premature wear and increased power demand to move the shaft. Modern solutions address these challenges:

- Heat-resistant fibres: Premium carbon yarns resist pressure and temperature, reducing shaft friction and power demand.
- High-resilience aramid fibres: Combined with specific braiding, they result in high-performance DualPac packing, requiring fewer adjustments, simplifying inventory, minimising shaft scoring, and lowering power consumption.

Automated gland adjustment systems, utilising air pressure control, eliminate human errors associated with overtightening, reducing excessive drag and wasted power. Proper packing installation is crucial, and mislocated lantern rings can increase friction and energy needs.

Examining the distribution of gland load transfer to radial load reveals inefficiencies in conventional flushed packing systems, particularly after the first three rings (Figure 7). The final two rings, closest to the process fluid, provide no sealing performance and may actively cause sleeve damage and lantern ring misalignment (Figure 8).

Moving to a three-ring/lantern ring configuration improves sealing reduces flush water usage and improves energy efficiencies.

The introduction of environmental controllers, such as the EnviroSeal SpiralTracTM, as a replacement for the lantern ring further reduces the need for excessive flush water and lowers the level of solids reaching the packing. (Figure 9) The latest packing technology offers installation flexibility, adapting to diverse application requirements. (Figure 10,11)

The overall result is improved packing life and increased MTBF. This strategic shift from conventional methods to advanced fibre technology, incorporating new braids, special weaving techniques, environmental controller devices, and different installation methods, position industries for enhanced reliability, efficiency, and longevity in their equipment operations.

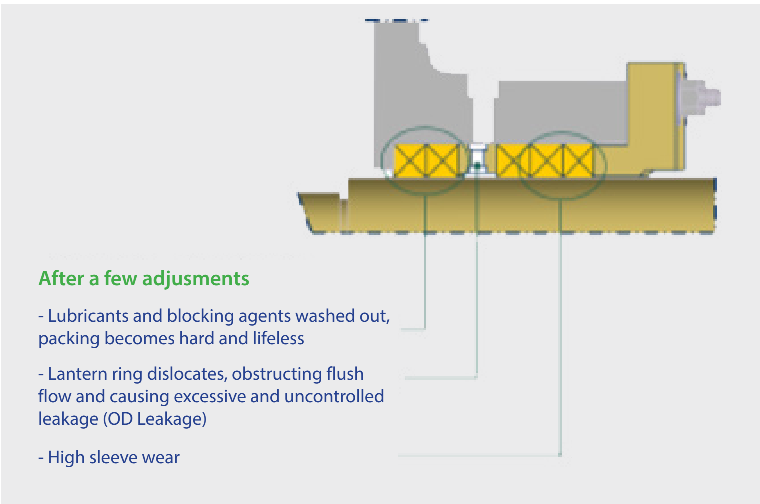

Figure 7. Conventional flushed packing system after a few adjustments

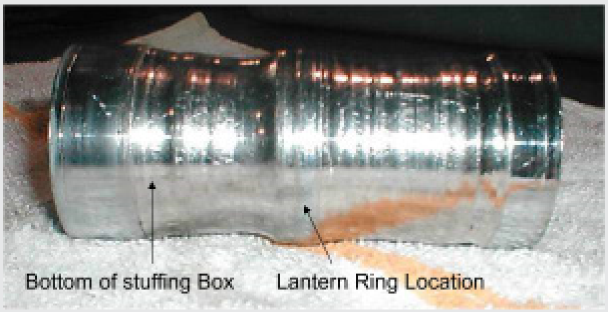

Figure 8. Damaged sleeve

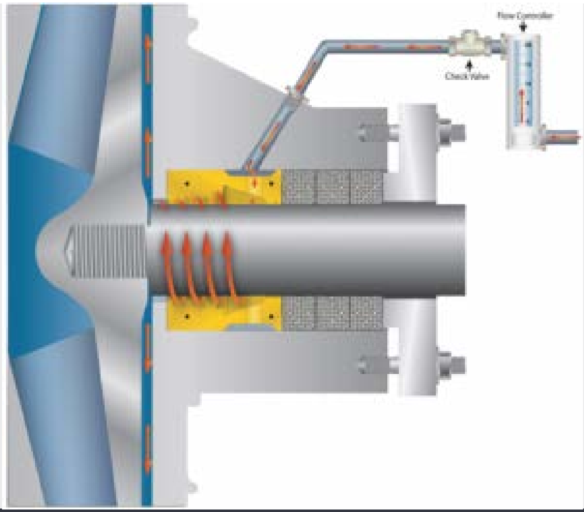

Figure 9. Using an environmental controller can further reduce flush water needs

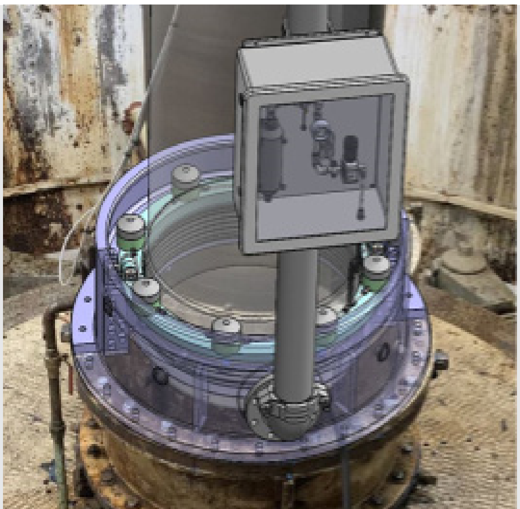

Figure 10. Chesterton AMPS™ (Automated Mechanical Packing System)

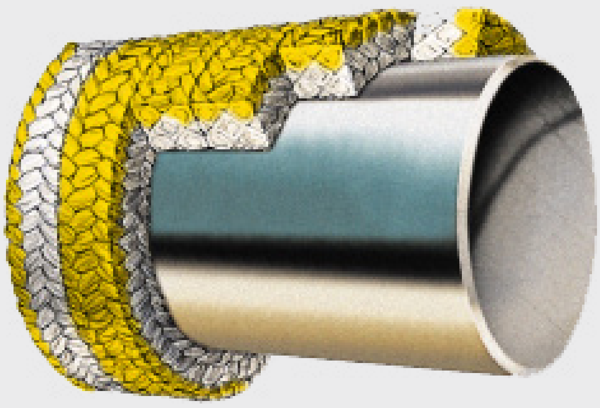

Figure 11. The latest packing technology can be installed in several different ways depending on the application requirements

3.3 Mechanical Seals

The use of mechanical seals in rotating equipment is rising due to their lower power consumption. To optimise energy usage and ensure effective operation, users should adhere to the following guidelines:

Balanced Mechanical Seal Face:

- Lower closing force reduces the turning power needed to overcome closing friction.
- A hard face in-line configuration with a balance feature is suitable for slurry applications.

Run One Softer Face Material Against a Harder Face Material:

- A softer face, being self-lubricating, generates less friction and can even be used for slurry applications with a reliable environmental controller.

Mechanical Seal Environment Control:

- Seal support systems may waste power through:
- Flushing a single mechanical seal (or compression packing) involving injecting external cold fluid for cooling.
- Cooling systems that are used with single mechanical seals, impacting the thermal efficiency of pumping systems.
- Dual mechanical seal cooling requirements which lead to thermal energy loss due to the design.

Examining energy scenarios in two condensate pump cases:

Scenario 1
Using cooled recirculation, this system involves moving liquid to a heat exchanger and re-flushing it to the seal chamber. The fluid isolation by the close clearance neck or throat bush causes a mismatch in the amount of stuffing box liquid that needs reheating, resulting in an annual energy loss of approx. US$819.

Scenario 2
The pump is sealed with a unique geometry mechanical seal that eliminates the need for externally cooled recirculation, making it the most efficient pump operation method without compromising reliability.

In conclusion, advancements in technology, materials, and design experience drive innovations that reduce energy demands. Small adjustments to lip seals, packing, and mechanical seals can translate into significant savings in power consumption and reduced water leakage.

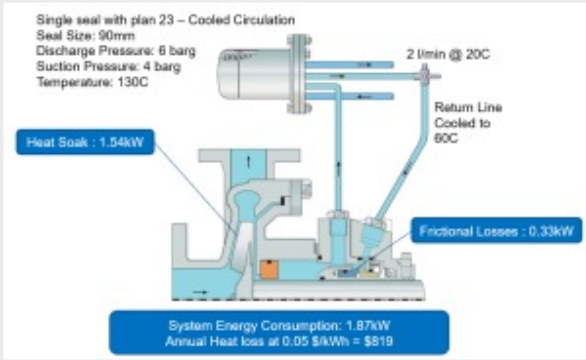

Figure 12. Pump sealed with a mechanical seal that uses cooled recirculation

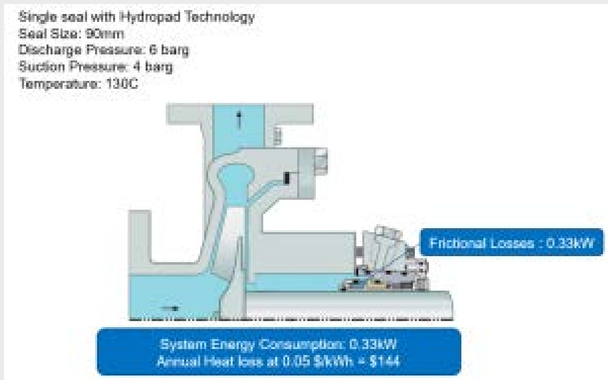

Figure 13. The pump is sealed with a single mechanical seal with a special design

4.0 EQUIPMENT CORROSION AND ABRASION

Corrosion and abrasion pose persistent challenges in the Pulp and Paper industry, affecting plant equipment and hindering seamless operations. Companies must adopt corrosion control processes for various aspects, including production, finishing, flooring, and containment, to ensure productivity. Addressing these aspects reduces the risk of contaminated paper, damaged machinery, regulatory violations, and potential health and safety risks for workers, contributing significantly to the company's overall performance.

Where are Corrosion and Abrasion Most Likely to Occur?

In Pulp and Paper production, numerous aspects expose materials and machinery to these issues, creating extreme environments with high impact and wear. Digesters, evaporators, recovery boilers, bleaching apparatus, paper-making machines, rollers, and chemical storage tanks are particularly susceptible. Corrosion can manifest in pipework, floor and wall surfaces, and any mechanisms operating in such environments.

4.1 Types of Corrosion Commonly Found in Pulp and Paper Mills

Acid Attack:

- It occurs in areas with acids, often in containment and dose mixing stations.
- Leads to concrete etching, cement paste breakdown, and aggregate exposure.

Crevice Corrosion:

- Non-uniform corrosion in small areas is common in engineered and mechanical equipment.
- Depends on factors like alloy resistance, crevice geometry, and pH levels.

Galvanic Corrosion:

- It is caused by dissimilar metals meeting in a common electrolyte.
- Less noble metal sacrifices itself to protect the more noble cathode.

Graphitic Corrosion:

- Seen in cast iron and ductile iron in acidic soils or waters.
- A weakened matrix of graphite and iron oxides results in structural issues.

Mechanical Abrasion:

- Vulnerable equipment includes de-barkers and paper rollers.
- Without protection, abrasion and erosion are inevitable.

Stress Corrosion Cracking:

- Results from material and mechanical stresses combined with environmental factors.
- It can lead to unpredictable and dangerous fractures.

Uniform Corrosion:

- Occurs in alkaline solutions and molten salts.
- Affects an entire exposed surface uniformly.

Pitting Corrosion:

- Occurs when the passivated oxide layer on a metallic surface is disturbed.
- It can lead to leaks and structural failure.

Microbiologically Influenced Corrosion (MIC):

- Common in water-exposed areas.
- Compromises mild steel and ductile iron.

4.2 Prevent Corrosion with Chesterton Solutions

In the ongoing battle against corrosion, Chesterton's ARC Industrial Coatings, exemplified by the ARC S1HB, stand as stalwart defenders, providing robust protection against the triad of abrasion, erosion, and chemical attacks. Specifically formulated with a proven track record, these coatings are meticulously engineered to fortify critical equipment and structures, particularly in environments that present formidable challenges.

The ARC S1HB distinguishes itself as a low VOC barrier coating, boasting high-build characteristics and edge-retentive properties. These features ensure comprehensive coverage, extending protection over hard angles and sharp edges where vulnerability often lurks. In practical terms, this means an extra layer of defense precisely where it's needed most.

A case study in Malaysia underscores the triumph of Chesterton coatings in the face of extreme wear. This real-world application demonstrates the sustained durability and resilience that Chesterton's ARC S1HB brings to the forefront, showcasing its ability to endure and perform admirably even in the harshest operational conditions (Figure 15).

This success story serves as a testament to the reliability and efficacy of Chesterton's ARC Industrial Coatings in safeguarding assets against the relentless forces of corrosion and wear.

Figure 14. ARC S1HB High Build Coating

Figure 15. New coating, Chesterton combination of ARC S1HB and after six months of use, the coating is still in good condition.

5.0 CONCLUSION

This white paper provides a comprehensive overview of challenges faced by the Pulp and Paper industry, offering practical solutions and innovative technologies.

By merging technical expertise with real-world applications, stakeholders can achieve enhanced operational resilience, reduced costs, and sustainable productivity.

ACKNOWLEDGEMENTS

Author, Jorge Mellado has worked for Mechanical Seal companies for the last 29 years. Jorge supports Chesterton Distributors as the Sales and Business Development Manager in Australia, New Zealand, and New Caledonia. Author, Michael Wachinger is the Senior Regional Manager for SEA/ANZ at A.W Chesterton with more than 16 years working with mechanical seal solutions.

For more information on preventative and repair options, consult **A.W. Chesterton®** at **www.chesterton.com** or **chestertoncustomseal.com.au.** or send your enquiry to: **enquiries_apac@chesterton.com** and speak to one of our experts to discover the right sealing solution for your business today.
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