CASE STUDY

LKAB | Sweden

David Brown Santasalo

ADI SEGMENTED GIRTH GEARS: A REVOLUTION IN DURABILITY AND PERFORMANCE

In heavy industries such as mining, cement, and power generation, the reliable operation of massive kilns, mills, and drums is paramount. These colossal rotating structures rely on girth gears to transmit the immense power and torque required for their operation. However, conventional girth gears, typically made from cast or fabricated steel, are often plagued by wear and tear, leading to costly downtime and frequent maintenance.

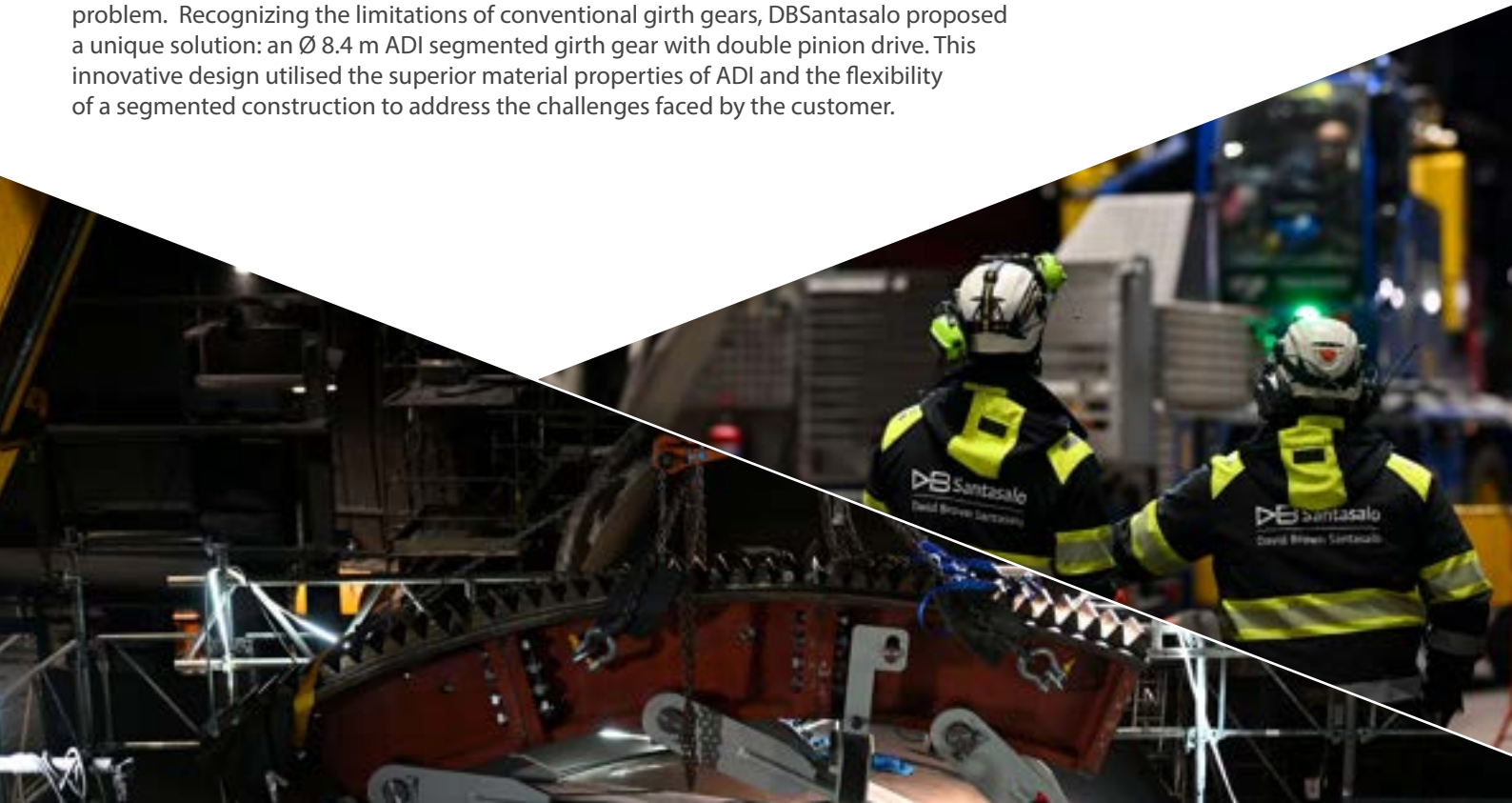
David Brown Santasalo (DBSantasalo), a global leader in industrial gearing solutions, has addressed these challenges with a groundbreaking innovation: ADI (Austempered Ductile Iron) segmented girth gears. This article explores the limitations of conventional girth gears and delves into the technical advantages of DBSantasalo's ADI segmented girth gears, highlighting a compelling case study that demonstrates their exceptional durability and performance.

Case Study: 21 Years of Wear-Free Operation in the Mining Industry

The effectiveness of DBSantasalo 's ADI girth gears is not just theoretical; it's proven in the field. DBSantasalo has a documented case study where an ADI girth gear operated on a kiln at our key customer's Iron ore mine in Svappavaara, Sweden for an astounding 21 years without showing any significant wear. This remarkable performance is a testament to the exceptional durability and longevity of ADI girth gears, providing tangible evidence of their superiority over conventional designs.

The Challenge: A mining industry kiln experienced frequent failures with conventional girth gears, leading to costly downtime and maintenance. These failures were primarily due to the harsh operating environment, characterised by high loads, abrasive materials, and extreme temperatures, which caused significant wear and tear on the conventional gears.

The Solution: In 2003, DBSantasalo was approached to provide a solution to this recurring problem. Recognizing the limitations of conventional girth gears, DBSantasalo proposed a unique solution: an Ø 8.4 m ADI segmented girth gear with double pinion drive. This innovative design utilised the superior material properties of ADI and the flexibility of a segmented construction to address the challenges faced by the customer.



Installation and Operation: The ADI segmented girth gear was delivered and installed in a short timeframe, minimising disruption to the customer's operations. The girth gear was designed to operate with a power of 320 kW at 27 rpm, meeting the specific requirements of the kiln.

Inspection and Results: In 2024, during a scheduled maintenance stop, the ADI girth gear was inspected to assess its condition and determine when it would be necessary to change the rotation direction. To the astonishment of the customer, the inspection revealed no significant wear on the gear flanks, no cracks in the structure, and no other signs of deterioration. The gearing was in perfect condition, as if it had just been delivered from the factory. The measured quality was ISO 9, meeting the quality requirement from new ADI girth gears.

Customer Response: LKAB was amazed by the exceptional performance of the ADI girth gear, especially in contrast to the frequent failures experienced with conventional gears. They were particularly impressed by the lack of wear and the overall condition of the gear after 21 years of operation in a demanding environment.

Explanation: DBSantasalo explained to the customer that ADI girth gears are renowned for their extended reliability and longevity, especially when combined with the right greasing method and lubricant. The combination of ADI's superior material properties and the segmented design, which allows for better stress distribution and easier maintenance, contributes to the exceptional performance of these gears.

THE CHALLENGES OF CONVENTIONAL GIRTH GEARS

Traditional girth gears, often manufactured from cast steel or fabricated steel, face several inherent limitations that can significantly impact their lifespan and operational efficiency.

These limitations include:

Wear and Tear: In harsh industrial environments characterised by high loads, extreme temperatures, and abrasive materials, conventional girth gears are highly susceptible to wear and tear. This wear can lead to a decline in efficiency, increased vibration, and ultimately, premature failure.

Costly Downtime: When a girth gear fails, it can result in significant downtime for the entire operation, leading to substantial financial losses. Replacing a large, single- piece girth gear is a complex and time-consuming process, further exacerbating the downtime.

Maintenance Challenges: Conventional girth gears often require frequent maintenance, including lubrication, inspection, and repair, to mitigate wear and tear and extend their service life. This maintenance can be labour-intensive and disruptive to operations.

RECOGNISING THE LIMITATIONS OF CONVENTIONAL GIRTH GEARS, **DBSANTASALO HAS PIONEERED THE USE OF ADI FOR SEGMENTED GIRTH GEARS.**

THE DBSANTASALO SOLUTION: ADI SEGMENTED GIRTH GEARS

Recognising the limitations of conventional girth gears, DBSantasalo has pioneered the use of ADI for segmented girth gears. ADI is an advanced material with exceptional strength, wear resistance and fatigue properties, making it ideally suited for demanding girth gear applications. The combination of ADI with a segmented design offers several key advantages:

Unmatched Durability: The superior material properties of ADI, including its high tensile strength, hardness, and ductility, ensure exceptional wear resistance and long-term performance, even in the harshest conditions. This translates to reduced maintenance requirements, extended service life, and improved overall reliability, minimising downtime and maximising productivity.

Enhanced Efficiency: The precise engineering and smooth operation of DBSantasalo's ADI segmented girth gears minimise energy loss and optimise power transmission, contributing to increased efficiency and lower operating costs. The segmented design also allows for tighter tolerances and improved load distribution, further enhancing efficiency.

Simplified Maintenance: The segmented design of DBSantasalo's girth gears allows for easy replacement of individual segments, minimising downtime and reducing maintenance costs. If a segment becomes worn or damaged, it can be replaced quickly and easily without the need to replace the entire girth gear, minimising disruption to operations.

Easier Installation: The segmented construction of DBSantasalo's girth gears facilitates easier transportation and installation compared to large, single-piece rings, reducing installation time and complexity. This modular design also allows for greater flexibility in installation, especially in confined spaces or challenging environments.

TECHNICAL DEEP DIVE: ADI MATERIAL PROPERTIES

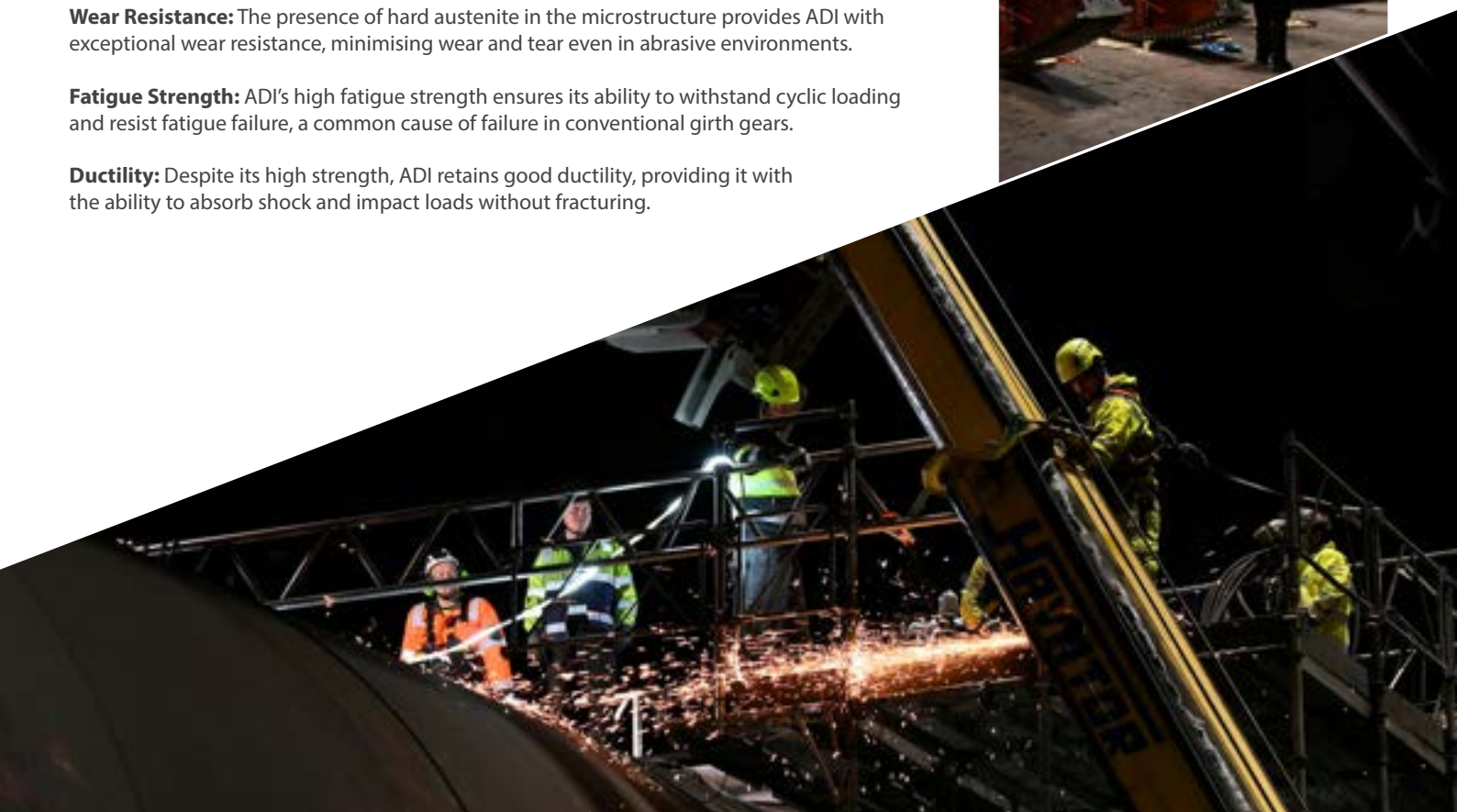
The exceptional performance of DBSantasalo's ADI segmented girth gears is attributed to the unique properties of ADI. Austempering, a specialised heat treatment process, transforms ductile iron into a material with a distinctive microstructure consisting of acicular ferrite and high-carbon austenite. This microstructure imparts ADI with a remarkable combination of properties:

High Strength: ADI exhibits high tensile strength and yield strength, enabling it to withstand the extreme loads and stresses encountered in heavy-duty girth gear applications.

Wear Resistance: The presence of hard austenite in the microstructure provides ADI with exceptional wear resistance, minimising wear and tear even in abrasive environments.

Fatigue Strength: ADI's high fatigue strength ensures its ability to withstand cyclic loading and resist fatigue failure, a common cause of failure in conventional girth gears.

Ductility: Despite its high strength, ADI retains good ductility, providing it with the ability to absorb shock and impact loads without fracturing.



"We appreciate that the resource (Erik.L) was on-site in good time for the inspection of the ring gear, which facilitated the planning. The checklist was very helpful and contributed to a structured and efficient establishment for DBSantasalo's establishment in Svappavaara. *The team on-site throughout the project demonstrated great engagement and competence. The timelines were well-adapted, and we were positively surprised that the disassembly was completed faster than expected."* - **Filip Flygare, Project Manager.**

"There was clear communication on all decisions and steps during the work, which made our collaboration easier. The follow-up on these was thorough and ensured that no issues were left unresolved during or after the production start. Quick and effective decisions allowed us to resume the reassembly of the ring gear at short notice." - **Jeanette Berggren, Construction Manager.**

"Throughout the project, from the breakdown to production, we received great help with the complex technical aspects and practical operational questions on-site."
- Malin Johansson, Construction Manager.

CONCLUSION

DBSantasalo 's ADI segmented girth gears represent a significant advancement in girth gear technology. Their unmatched durability, enhanced efficiency, simplified maintenance, and ease of installation make them the ideal choice for heavy-duty applications across various industries.

By choosing DBSantasalo, you're not just choosing a product; you're choosing a partner committed to providing innovative and reliable solutions that optimise your operations and contribute to your long-term success.

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