KOYO INSIDE Q3 - 2020

Inside the steel industry: how bearings survive under very harsh conditions

Introduction

The steel industry is characterized by processes operating under very harsh environmental conditions. After the initial foundry process, during which the molten metal is poured into steel blocks, the next stage requires the steel plates to be extruded and flattened into long extended strips in rolling mills. These strips may be still hot from earlier stages of the process (in a hot strip mill) or reduced to room temperature in the later stages of the process (as in a cold strip mill). In either case, the equipment involved needs to withstand various extreme conditions like severe temperature fluctuations and the intrusion of dust, steam, water and several other pollutants

Figure 1: Steel foundry

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Figure 2: Rolls of steel plates finally coming out of a Roll Mill facility

The bearings are suffering

Roller bearings operating under severe conditions like high speed rotation under heavy load are still expected to offer high precision and reliability despite such harsh production environments.
JTEKT's Koyo Bearing division has many decades of experience in designing, developing, testing and homologating roller bearings for the

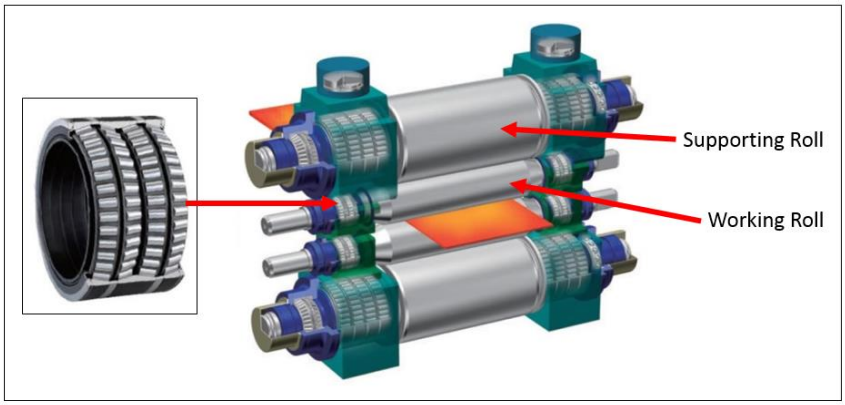

Figure 3: 4-High Roll Mill with work rolls supported by 4-row TRBs

metal processing industries. Koyo is currently one of the major global suppliers of these types of bearings for steel mills. Typical applications are the support of the *work rolls* (4-row tapered roller bearing) as well as the *back-up rolls* (4-row cylindrical roller bearings and 2-row tapered roller bearings).

JTEKT/Koyo - a major manufacturer of bearings for the steel processing industry

As a major supplier in this field, Koyo has the right expertise to diagnose and tackle specific problems that arise during daily operation. In the Koyo Large Size Bearing Technology Development Center in Kokubu, Japan, engineers use dedicated testing machines for bearings for steel production equipment to provide input for simulations of the most common steel production methods. With this experience potential problems can be anticipated in new steel production lines or quickly solved in existing steel mills. In some cases a complete redesign of the bearing, or one of its components is required. One such specific case is described below.

Figure 4: Bearing testing machine for steel production equipment

Case study: Preventing the curious water ingress into a 4-row TRB in a steel strip rolling mill

A steel mill customer was experiencing water ingress in roll neck bearings (see figure 6). During inspection, a 1.5 mm deep groove was observed on the inner ring of the bearing along the seal lip contact surface. The customer requested a root cause analysis of the water ingress and groove followed by a countermeasure against it.

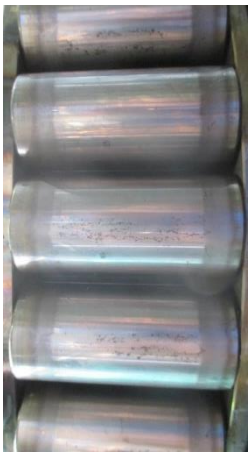

Figure 5: Visible corrosion staining on the rollers

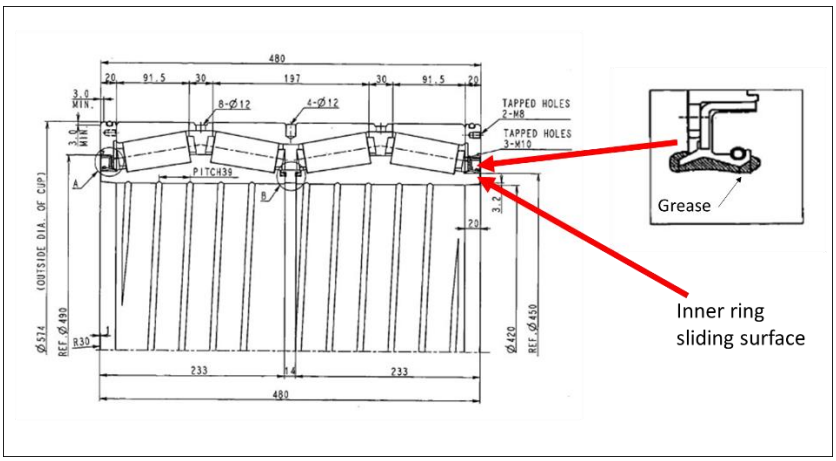

Figure 6: 4-row TRB with oil seal

Analysis of the phenomenon

After investigation by a Koyo expert it was determined that the groove was caused by scale build-up between the seal lip and the inner ring of the bearing. The combination of scale, water and grease created an unwelcome 'lapping compound' which facilitated the abrasion of the sliding surface. Because of this wear the contact with the seal lip and the inner ring reduced, which resulted in a decreasing sealing performance. The consequence was water entering inside the bearing easily.

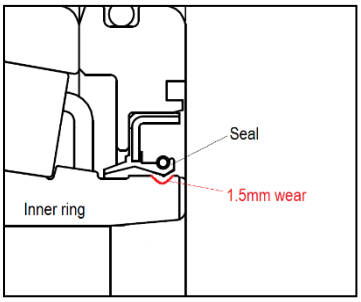

Figure 7. Detail of oil seal and sliding surface

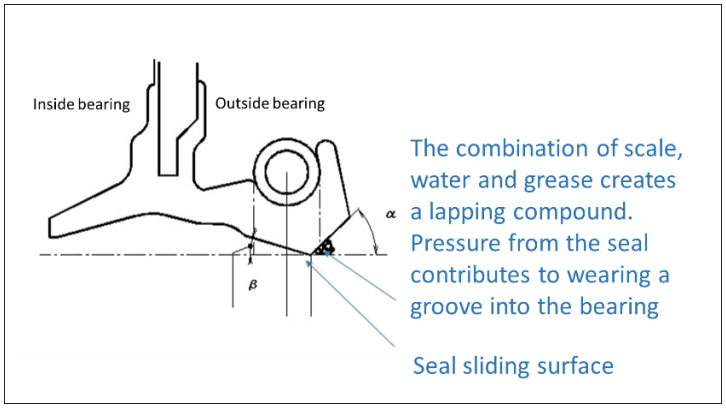

Figure 8: The oil seal showing the accumulation of dirt

The solution? A complete redesign of the seal

The countermeasure for the groove wear was a design change to the seal lip geometry to reduce the amount of scale being collected. The seal lip lower portion was also changed so that the contact area between the seal and inner ring became more stable, reducing vibration and allowing it to sit flush against the inner ring with reduced pressure, without losing sealing performance.

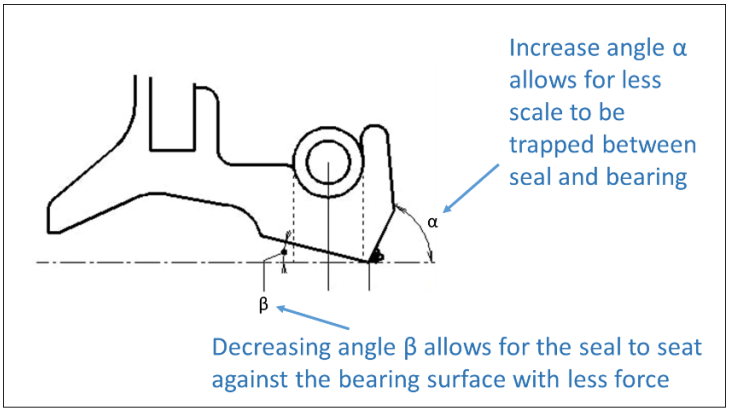

Figure 9: The redesigned oil seal showing the reduced amount of accumulated dirt

Conclusion

In retrospect the oil seal redesign looks simple and obvious as a solution, but to get there required a lot of engineering knowledge, design creativity, imagination and interaction with the end user. After testing and validation, the final improvements were successfully implemented.

For more technical details about bearings for steel mill application our engineers will be happy to support you. For technical or general information on Koyo's products, please do not hesitate to contact your local Koyo office or Koyo distributor. You can also visit our European website: www.koyo.eu.

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