

Ideal bearings for cost-optimised operation of continuous casting machines

Schaeffler offers steel manufacturers a practical and future-oriented solution with its sealed spherical and cylindrical roller bearings for continuous caster support rollers, suitable for both new and existing caster designs. The use of sealed bearings enables longer caster runtimes and lower operating costs, which contributes to more environmentally friendly steel production. The investment in sealed rolling bearings is recouped in just a few months.

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From the very beginning, operating continuous casting machines efficiently and economically have been driven by the following factors related to rolling bearings:

- Quantity of steel produced for each set of bearings
- Operational safety: unplanned failures due to cooling or lubrication system failures, blocked rolls, bearing damage, etc.
- Operating costs arising from grease consumption, coolant water treatment, system cleaning, the disposal of grease and scale residue, etc.

Due to the extreme heat, high humidity and heavy dust and scale contamination, continuous casting machines (see Figure 1) are, without a doubt, a severe test for rolling bearings in strand guides. To compound the matter, the slow speeds of the strand guide rolls inhibit effective distribution of lubricant within the bearings and the mechanical forces exert tremendous stresses within the bending area of the machine. Therefore, bearings designed specifically for these adverse conditions are absolutely essential to cost-effectiveness and reliability of the casting process.

The past 20 years have seen steel producers use a variety of operating strategies for rolling bearing maintenance. While some companies overhaul lines of rolls and replace bearings after a fixed period, say every million tonnes of steel produced, others rely on one-time reconditioning of the bearings. Still others will push the limits of the rolling-bearing arrangement and produce far in excess of one million tonnes of steel with a single bearing set.

The greater the quantity of steel produced, the higher is the risk of unplanned failure and therefore, the demands placed on the bearing solution are high. In some circumstances, this necessitates use of specialised ▶



Fig 1 Typical caster application of Schaeffler bearings



QR code of animated steel plant



Ⓒ Fig 2 FAG spherical roller bearings of series 240 and 241



Ⓒ Fig 3 The CoCaB-CRB with proven internal design and new, patented seal

coatings, high quality and expensive lubricants, and above all, larger quantities of lubricants. This, along with shorter maintenance intervals, drives up operating costs. It is difficult to generalise in favour of one or another operating strategy so steel producers should compare and contrast the various bearing and seal concepts to optimise their solution based on durability and/or operating costs.

Schaeffler offers both open and sealed cylindrical and spherical roller bearings from its continuous casting bearings (CoCaB) product portfolio for the bearings used in strand guide rolls. In the following, the article is focused on these bearings.

Besides that, the upper segments use INA needle roller bearings whereas for applications using driven rolls, split FAG cylindrical and spherical roller bearings are available. Special FAG bearing housings with water cooling complete the CoCaB product portfolio.

STANDARD SOLUTION WITH AN OUTER SEAL

Open rolling bearings in combination with additional housing seals (outer seals) continue to be popular. The lubricant feeds through the bearing outer ring by a central system and lubricates the bearing and outer seal from which a portion escapes forming a bead of grease as a barrier against coolant water and scale. Due to the very slow speeds, the system requires large quantities of lubricating grease to ensure both that the bearing is sufficiently lubricated and that the protective bead of residual grease remains intact. This solution results in the highest costs due to the amount of required lubricant, water and scale treatment, and grease disposal.

BEARINGS WITH INTEGRATED SEAL AND OUTER SEAL

Bearings with integrated seals represent an alternative to the standard solution and are ideally suited to the rough operating conditions during continuous casting. They are greased at manufacture and are maintenance-free while in operation. Schaeffler offers FAG spherical roller bearings of series 240 and 241 from the CoCaB product portfolio and feature a robust sheet steel cage and integrated seals made of Fluorelastomer (FKM) on both sides. They can directly substitute for open bearings on a one-to-one basis, having the same outer dimensions. An example is shown in *Figure 2*.

The new, sealed FAG cylindrical roller bearings from the CoCaB product portfolio serve as floating bearings. Compared to the open versions, they have the same outer dimensions and are equipped with FKM seals. Schaeffler designs the dimensionally stabilised bearing rings and the FKM seals for the high operating temperatures in continuous casting machines (see *Figure 3*).

Both types of bearings are factory filled with a high quality

Schaeffler Arcanol grease. With both types of bearings, the seal concept allows for an additional reservoir of grease at both sides of the rollers. The seal design precisely considers the clearances and tilting of the bearings to guarantee the sealing effect under all operating conditions.

INTERNAL BEARING GEOMETRY SPECIFICALLY DESIGNED FOR CONTINUOUS CASTING MACHINES

Many of the floating bearing solutions on the market entail a compromise between variability of axial displacement, load-carrying capacity and compensation of angular misalignment and do not optimally meet the requirements in continuous casting machines. Thanks to the special profiling of the bearing elements, the CoCaB-CRB combines the advantages of a full-complement cylindrical roller bearing and a spherical roller bearing, namely high radial load-carrying capacity, forceless axial displacement, and compensation of angular misalignment. The profiling, specifically designed for the heavy loads, prevents edge stresses on the rollers and is designed to allow the cylindrical roller bearings to compensate for angular misalignment of up to eight angular minutes under heavy loads.

The expansion of the shafts is easily and unconstrained compensated with the CoCaB-CRB since it is still a cylindrical roller bearing type. The same load conditions are guaranteed in all axial positions, making axial presetting of the bearing unnecessary.

OPERATING STRATEGY

For-life lubricated rolling bearings in strand guide rolls offer steel manufacturers two options: operation with or without re-lubrication of the outer seals.

With re-lubrication In this option only the outer seal is lubricated and the escaping grease forms an additional barrier against dust and scale. Following a transition from open to sealed bearings, low-cost grease is sufficient since it serves primarily to keep abrasive contamination and water away from the outer sealing lip and not as a bearing lubricant. This also leads to reduced grease consumption. Significant savings are achieved with this concept due to the bearings' demonstrably long life as shown in field tests, reduced lubrication consumption, and low disposal costs. This solution is easily implemented and highly flexible with regard to outer seal design.

Without re-lubrication With this option the aim is to eliminate re-lubrication altogether. While the dry-running outer seals required for this are not yet widely used, they have been successfully used for several years. They need to withstand the wear caused by abrasive particles for a sufficiently long time and are more expensive than seals ▶

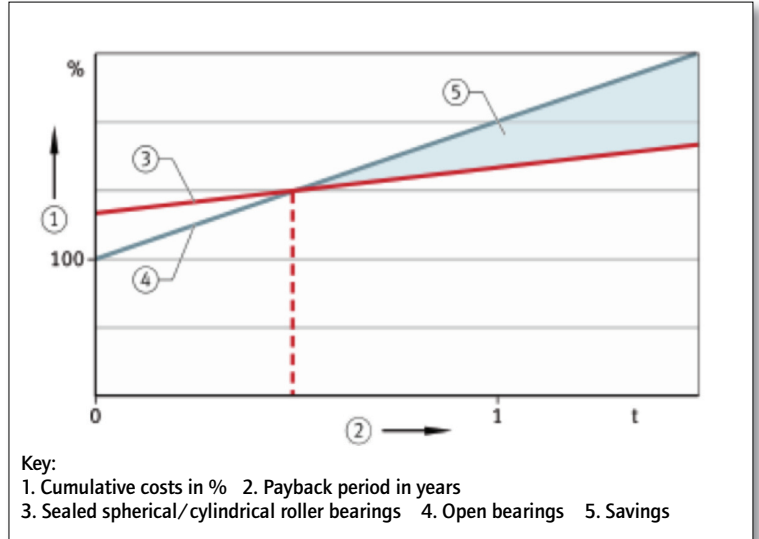


Fig 4 Cost comparison of open and sealed strand guide bearings with re-lubrication of the outer seal



Fig 5 Reconditioning of bearings



QR Code - a video of reconditioning

that are lubricated with grease. They do, however, make it possible to operate the bearing arrangement completely without re-lubrication when combined with bearings that have been lubricated for life. Durability testing has shown that Schaeffler sealed spherical and cylindrical roller bearings installed in strand guide rolls produced 1.2 million tonnes of steel with no re-lubrication required.

There are numerous advantages to this solution:

- The coolant water is no longer contaminated with grease, making it less expensive to treat
- The costs for disposing of the mixture of grease, dust, water, and scale are avoided
- New continuous casting machines do not require investment in a lubrication system for the guide rolls
- The risk of failure from leaking screw connections, clogged lines, empty lubricant reservoirs, etc. is eliminated

Payback A comparison between open and sealed bearings shows the projected savings (see Figure 4). The costs are based on an open bearing with an outer seal and a bearing with an integrated seal and an outer seal with re-lubrication. Also considered are costs needed for the separation of grease from the cooling circuit and its disposal. Due to lower operating costs and the longer life expectancy of sealed bearings, their higher capital cost is amortised within just a few months.

RECONDITIONING OF ROLLING BEARINGS

During guide roll maintenance, most steel manufacturers replace the existing rolling bearings with new ones. It is, however, quite possible to recondition these used rolling bearings. Common practise shows that one-time reconditioned bearings attain the same runtime performance as new ones. To recondition the bearings, they are dismantled and cleaned, the raceways are examined and polished if necessary, the ovality of the rings is measured, and the internal clearance is checked after reassembly (see Figure 5). Moreover, the new load zone is marked on the outer ring, and the reconditioned bearing is remounted with the outer ring positioned accordingly in the housing.

Many system operators' safety concerns sometimes predispose them to overlook the cost-saving options that are available. Reconditioned bearings have a more favourable price, shorter lead times and a lower environmental impact than new bearings. Schaeffler not only offers reconditioning of bearings from its own production but also for third-party products.

OUTLOOK AND MARKET ASSESSMENT

Due to their importance for environmental sustainability, the issues of grease reduction and disposal are also gaining

political significance and increasing disposal costs in the short to medium term are anticipated. However, Schaeffler offers steel manufacturers a practical and future-oriented solution with its sealed spherical and cylindrical roller bearings of identical installation size. Both new and existing casters can very easily be fitted with these bearings.

In addition to sustainability benefits, the use of sealed bearings also enables longer runtimes and lower operating costs with the investment in sealed rolling bearings being recuperated in just a few months. **MS**

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