

# SPLIT SOLUTIONS

**Ryan Fernandes and Fabiana Maggico, The Timken Co.**, explore how a split bearing solution for bucket elevators can reduce repair time.

## Introduction

Modern cement plants convey countless tonnes of material using bucket elevators every day. These machines are essential to keeping operations in all parts of the world productive and profitable.

Bearing replacement is a common issue for owners of large rotating machines, such as bucket elevators, and can often result in significant maintenance spending and lost production time. Due to the sheer scale of bucket elevators, bearing replacement is anything but routine, requiring fully

trained personnel, specialised equipment (such as cranes, hoists, and scaffolding), and a disciplined approach to proper procedure to ensure the task can be performed safely.

The Timken Co. has engineered bearings for heavy-duty industries for over a century, understanding the rigours of the cement plant and the huge pressure engineers and maintenance professionals are under to increase efficiency. In fact, cement plants are among the harshest



environments for bearings, with the constant threat of contamination and condensation.

While it is easy to assume that similar types of bearings offer comparable performance, the truth is that designs can be dramatically different. For example, some are specially intended to create new advantages in challenging applications, as is the case with bucket elevators: even eliminating days



Spending quickly goes up when bucket elevators go down, due to bearing issues.



Have no fears when trapped bearings fail – a split housing and bearing design offers many advantages in locations that are hard to access.

#### **A lower cost of ownership**

While it is easy to cite many examples where the use of split roller bearings resulted in savings, the reality is that savings can be seen in almost any trapped application. Depending on the application, downtime for the replacement of split bearings can be a small fraction of that required for solid bearings and can keep critical equipment running.

of costly downtime by making routine maintenance much simpler.

#### **A solid reason to switch**

All bucket elevators use housed units to protect the bearing while it is operating, with most of these units being a split design (where the top half of the housing can be easily removed to inspect the bearing, which is typically a solid spherical roller bearing). Still, the shaft must be lifted, and, in most cases, auxiliary equipment must be moved when swapping out the bearing, meaning a crane is required. Normally, crane rental for a bucket elevator repair is three days, with one day to mobilise the crane onsite, one day to carry out the replacement, and one day to demobilise the crane.

There is, however, a novel approach that is saving one European cement plant considerable time and money when it comes to keeping bucket elevators up and running. In this operation, buckets attached by two chains carry crushed limestone 35 m to the top of a preheater tower, with the shaft itself supporting up to 14 t of weight. When the drive-side head pulley bearing fails, it takes three working days to remove and replace it. This is because the bearing is trapped between the bucket elevator drive pulley and gearbox/motor assembly. The maintenance costs include up to 72 hours of lost production time and the expense of renting a 30 t crane.

Recently, a site visit carried out by a Timken service engineer resulted in the suggestion to change the original spherical bearing to a split cylindrical roller bearing. This promised to not only improve the life of the bearing, but would also reduce the time required to change it. At the same time, the design would also provide a more effective seal arrangement, for added protection against the harmful debris that causes bearing damage.

#### **Saving with split bearings**

Split roller bearings have been used to simplify installation and disassembly in difficult applications for decades. These bearings are distinguished by a split-to-the-shaft design. This design helps plants and other industrial facilities to avoid production losses by enabling an up to 90% reduction in fitting time. This is compared to conventional split-block solutions where the housing, but not the bearing, is split.

Split roller bearings offer greater convenience because they can be fitted without requiring access to the shaft ends. Rather, the bearing can be built around the shaft. This saves a great deal of time because there is no need to remove other drive components (the shaft is supported by a jack, while the bearing and housing are mounted around it).

#### **Smarter clips**

While meeting with the cement plant's maintenance team, the Timken service engineer also stressed

that split roller bearings should be quick and easy to assemble; however, some designs incorporate a non-retained clip that clamps the two cage halves together. As many maintenance professionals have experienced, these clips are prone to falling out during assembly and can be easily lost (or are often dropped from the top of a bucket elevator), halting repair work and further delaying production.

To remedy this, Timken has developed a split cylindrical roller bearing solution, with an innovative clip that is fixed to the cage. This retained clip firmly attaches to one half of the cage (via spiral pins) and is easily fastened to the other half with no risk of losing the clip. The design also speeds up installation by effectively allowing technicians a 'free hand,' as there is no separate small piece to fumble with, particularly in tight working quarters.

### Stronger cages

Timken also took time to discuss with the cement plant how precision-machined, bored-pocket brass cages offer the best results and outperform pressed steel, cast aluminium, and moulded polyamide materials in split roller bearing applications.

The service engineer explained that, while steel is suitable for a vast majority of bearing applications, brass offers greater rigidity, strength, and resistance to shock loads, as well as better lubricity between cage and rolling elements. Unlike other materials, which can seize without warning, brass wear is gradual, making it ideal for condition monitoring and other preventative measures to alert plant maintenance.

Furthermore, by fully machining brass cages as Timken does, it is possible to deliver improved bearing reliability by ensuring the accurate guidance of the rolling elements. Compared to their steel, aluminium, or polyamide counterparts, CNC bored pocket brass cages are a better option to prevent roller skewing. This is a condition that can lead to edge loading on the bearing raceway, reducing the life of the bearing.

### No need for re-engineering

Despite the benefits that split roller bearings can bring to applications such as bucket elevators, in the event that expensive re-engineering is required, many plant managers remain wary of specifying them in place of conventional SAF, SN, and SD housings. A common problem when replacing standard units with split roller bearings is that the support pedestal base to shaft centreline is usually higher on a split roller bearing, meaning that machinery must be modified before the new bearing can be installed.

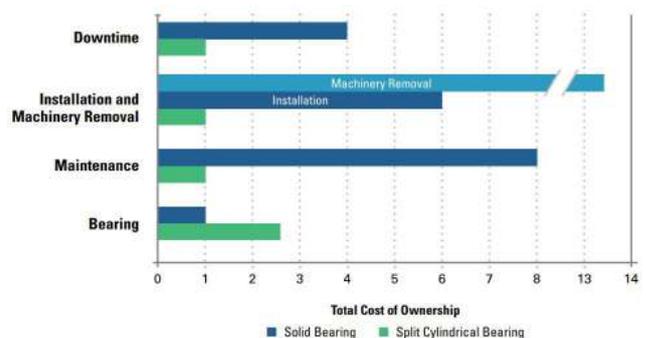
Noting this difficulty, Timken designed its split cylindrical roller bearing housed units as a direct, drop-in replacement option for SAF/SN/SD housings.

### All seals are not the same

Any bearing, housing, and support unit that is not suitably sealed against its surrounding environment is unlikely to achieve its full potential, either in terms of performance or life span. The prevention of contaminants is paramount and should be considered as early as possible in the selection process.

When specifying bearings, Timken advises customers to choose a product that offers multiple sealing options, which will allow the bearing to run at higher speeds and temperatures in hostile operating conditions. For instance, many customers prefer a Kevlar Packing Seal, which is ideal for harsh environments with fine particle contamination. An Aluminum Triple Labyrinth arrangement, meanwhile, is a non-contact seal for maximum bearing speed in high-speed fans or motors.

It is notable that seals must stay aligned with the shaft in order to keep contamination out, but this is often not the case with standard spherical roller bearings. For this reason, Timken's split cylindrical roller bearings offer inherent sealing advantages over traditional designs. This is because no matter which type of seal is used, it will always remain concentric to the shaft.



Compared to solid bearings in trapped positions, split bearings can deliver big savings.

This saves customers the time to retrofit, allowing plant personnel to remain focused on production.

Furthermore, when replacing units in the field, Timken discovered that the customer only received the benefit of the split bearing once the housing was in place. This was because the shaft and adjacent equipment needed to be lifted and disassembled in order for the new bearing to be installed.

In response, Timken developed a split angled housing that has a height lower than the shaft, meaning the housing can be slid under the shaft before the bearing and cartridge are built up. This



Using a split roller bearing in the head pulley position allows the shaft to remain in place while repairs are made, meaning bucket elevators can resume operations in hours rather than days.



Timken developed a special angled housing that slides under the shaft, eliminating up to two days of equipment teardown.

In cement plants, the benefits of using split roller bearing housed units in bucket elevators include the following:

- No need to remove the motor and gearbox (requiring two working days).
- No need for a crane (requiring rental for three days).
- Drive remains in place (split bearing assembly installed around the shaft).
- Minimal downtime (repairs made in one day).

design allows for the easy replacement of standard housed units, as the bolt hole, bolt spacing, shaft centre to base height, and shaft diameter all line up with SAF/SN/SD requirements.

### Greater support

Timken emphasised to its customer how the benefits of reduced maintenance time are only relevant as long as split roller bearings offer equivalent or greater reliability compared to conventional options. If a bearing is unable to survive in an industrial environment, it will not deliver improved efficiency and cost savings. Importantly, both the bearing housing and support pedestal design must be able to cope with the mechanical stresses applied in the application, as well as any environmental hazards, such as abrasive materials or extreme temperatures.

To overcome this issue, Timken engineers studied the shape of the casting that made up the support pedestal halves, finding that incorporating stiffening ribs on the support pedestal casting cap significantly increased rigidity and provided extra robustness in harsh conditions. This stronger design, featuring double webs and thick sections of ASTM 48A – Grade 35 cast iron, makes the split housings strong and durable, in turn promoting longer bearing life.

### Concrete results

The cement plant in Europe was pleased with the quick response that Timken provided and approved the recommendation to change its bucket elevator bearings to a split cylindrical design that offers a lower cost of ownership. Months later, the plant is considering upgrading bearing solutions for other severe-duty machines in the coming year.

For cement manufacturers, it is proof that smarter, stronger solutions often come from component suppliers with a deep knowledge of the inner workings of critical equipment. In this instance, it was just the lift the plant was looking for. [🌐](#)

### About the author

Ryan Fernandes is a Senior Application Engineer for the Timken Co. He focuses on bearings and housed units for equipment applications in the cement and aggregates industries. His expertise includes bearing system analysis and optimisation, as well as damage analysis for mill equipment and gearboxes, crushers, vibratory screens, fans, and materials handling.

Fabiana Maggico is Manager of Global Marketing for the heavy industry markets. This includes mining, metals, cement, aggregates, pulp, and paper. Before moving to the UK from Brazil, she held several positions in the company, including sales manager and account manager for industrial distribution. Before joining Timken, she received a bachelor's degree in mechanical engineering.