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INCREASING LIFE TIME OF LINEAR BEARING IN HOT SAW

J.VijayLeshwanth[1],B.Yugeshkumar[2],T.Dhineshkumar[3] ,R.Venkatraman[4]
[123]UG Scholar,[4]Assistant Professor, Department of Mechanical Engineering
Knowledge Institute of Technology, Salem, Tamil Nadu, India.

***Abstract* --With continuous heat exposed to linear bearing at all times, the deterioration period becomes narrow. The major factors affecting the life time of the bearing such as, heating load, uneven load during machining times, quenching medium and bearing rail moments. In this paper, an attempt is made to increase the lifetime of the linear bearing by increasing the lubrication soaking time and introducing bellen cover. The introduction of these two methods showed significant increase in lifetime of linear bearing. In future furthermore development may be developed depending on its feasibility.**

I. INTRODUCTION

Arslan have carried out an investigation of rolling element vibrations caused by local defects at higher speed. The model is prepared by assuming the races as a springs and balls as mass. Obtained results showed that it was possible to identify the defected element of ball bearing by studying ball vibrations using the simulation model. McFadden have studied two-point defect model. In this paper, the original model is extended to describe the vibration produced by multiple point defects, thereby enabling large defects to be modeled by treating them as the sum of a number of point defects. The influence of multiple defects is explained by the reinforcement and cancellation of spectral lines because of differing phase angles. A comparison of predicted and measured spectra for a bearing with two point defects confirms satisfactory performance of the model.Tandon have compared some of the vibration parameters used for detection of the defects in rolling element bearings. Overall RMS, ceptrum, crest factor and peak of acceleration signal of bearing with defects of different sizes are compared with those of healthy bearings.

The results of measurement indicate that, except crest factor, all the parameters have detected the defects in the bearings. The defect detectability of overall power is best followed by peak and RMS measurement.White has given emphasis on vibration signature characteristics by study of load distribution function. Formation of load zone depends upon diametral clearance and load distribution factor. When defect is out of load zone, it does not give response to the sensor. Many other techniques have also been attempted for defect detection.Sawalhi present an algorithm to enhance the surveillance and diagnostic capability of SK as an analysis tool for rolling element bearings, by combining it with the use of AR-based linear prediction filtering and MED. The use of the MED along with SK analysis also greatly improves the results of envelope analysis for making a complete diagnosis of the fault and trending its progression.

1. BEARING PROBLEM STUDY

A linear-motion bearing or linear slide is a bearing designed to provide free motion in one direction. There are many different types of linear motion bearings. Motorized linear slides such as machine slides, XY tables, roller tables and some dovetail slides are bearings moved by drive mechanisms. XY Tables, linear stages, machine slides and other advanced slides use linear motion bearings to provide movement along both X and Y multiple axis.

1.1. ROLLING ELEMENT BEARING:

A rolling-element bearing is generally composed of a sleeve-like outer ring and several rows of balls retained by cages. The cages were originally machined from solid metal and were quickly replaced by stampings. It features smooth motion, low friction, high rigidity and long life. They are economical, and easy to maintain and replace. Rolling-element bearings can only run on hardened steel or stainless steel shafting (raceways).

Rolling-element bearings are more rigid than plain bearings.

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- Rolling-element bearings do not handle contamination well and require seals.
- Rolling-element bearings require lubrication.

Rolling-element bearings are manufactured in two forms:

1. ball bearing slides and
2. roller slides.

1.2. ROUND RAIL BEARING SYSTEM:

The two major types of linear guides are

1.round rail bushing bearings and

2.profile rail bearings.

FIG.1.1: ROUND RAIL BEARING SYSTEM

The self-aligning-in-all-directions design of round rail bearings is forgiving of poor parallelism and variations in rail height. In end-supported applications, the axis of motion of round rail guides is established entirely by fixing the two ends of the shaft.So round linear bearings are capable of spanning gaps up to 24 times the shaft diameter, making them useful in a range of applications such as pick-and-place modules and gantry systems.

1.3. PROFILE RAIL BEARING SYSTEMS:

Profile or square rail systems offer higher accuracy, higher rigidity, higher load-life capacity, and are also very compact. Their key advantage is derived from ball conforming grooves on both inner and outer races that increases load capacity relative to standard round rail guides.Profile rail guides can provide positioning accuracy from 0.0002 inch to 0.001 inch over 10 feet. Square rails can be preloaded from 3% to 13% of rated dynamic load to further reduce deflection. An aspect of concern for profile rail bearings are that mounting surfaces must be precise thus they are more difficult to install.

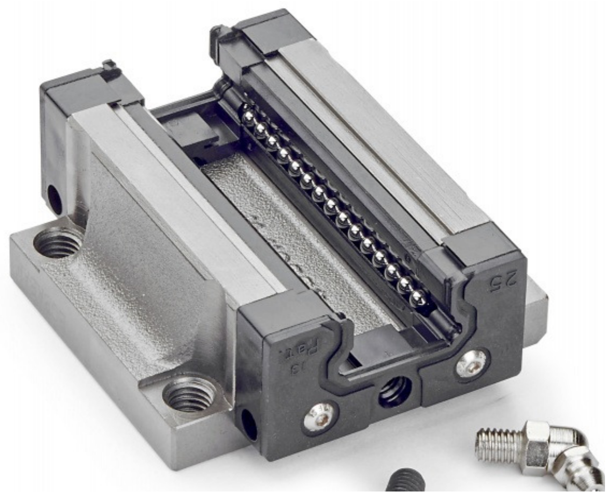

FIG.1.2. PROFILE RAIL BEARING SYSTEM

Profile rail designs are especially sensitive to flatness errors that can cause binding. Surfaces must be carefully prepared or the parts may need to be shimmed and adjusted during installation. One common rail alignment method is to mount one rail on a qualified surface against one qualified reference edge, and float

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the second rail into place while moving the carriages.Three other alignment methods, in order of increasing complexity and accuracy, are to establish relative position of the rails by using gauges blocks, both reference edges, or a positioning laser. An even higher rigidity or load-life capacity option is a linear Profile Rail roller guide bearing wherein cylindrical rollers run between flat races. Interestingly, there is also a Round Rail bearing using concavex rollers running on a cylindrical inner race that offer up to 20 times that load capacity of conventional linear ball bearings. Round Rail linear roller bearings handle up to 35 tons per bearing and speeds up to 100 feet per second. Their optimized contact ellipse maximizes the load capacity of an anti-friction linear bearing. Round Rail bearings can carry loads up to 70,000 lbs per bearing at a 10 million inch rated travel life.

1.4. BALL BEARING SLIDES:

Also called "ball slides," ball bearing slides are the most common type of linear slide. Ball bearing slides offer smooth precision motion along a single-axis linear design, aided by ball bearings housed in the linear base, with self-lubrication properties that increase reliability. Ball bearing slide applications include delicate instrumentation, robotic assembly, cabinetry, high-end appliances and clean room environments, which primarily serve the manufacturing industry but also the furniture, electronics and construction industries. For example, a widely used ball bearing slide in the furniture industry is a ball bearing drawer slide.

Commonly constructed from materials such as aluminum, hardened cold rolled steel and galvanized steel, ball bearing slides consist of two linear rows of ball bearings contained by four rods and located on differing sides of the base, which support the carriage for smooth linear movement along the ball bearings. This low-friction linear movement can be powered by either a drive mechanism, inertia or by hand. Ball bearing slides tend to have a lower load capacity for their size compared to other linear slides because the balls are less resistant to wear and abrasions. In addition, ball bearing slides are limited by the need to fit into housing or drive systems.

1.5. ROLLER SLIDES:

Also known as crossed roller slides, roller slides are non-motorized linear slides that provide low-friction linear movement for equipment powered by inertia or by hand. Roller slides are based on linear roller bearings, which are frequently criss-crossed to provide heavier load capabilities and better movement control. Serving industries such as manufacturing, photonics, medical and telecommunications, roller slides are versatile and can be adjusted to meet numerous applications which typically include clean rooms, vacuum environments, material handling and automation machinery.

The rollers crisscross each other at a 90° angle and move between the four semi-flat and parallel rods that surround the rollers. The rollers are between "V" grooved bearing races, one being on the top carriage and the other on the base. The travel of the carriage ends when it meets the end cap, a limiting component. Typically, carriages are constructed from aluminum and the rods and rollers are constructed from steel, while the end caps are constructed from stainless steel.

1.6. PLAIN BEARING:

Plain bearings are very similar in design to rolling-element bearings, except they slide without the use of ball bearings. If they are cylindrical in shape, they are often called bushings. Bushings can be metal or plastic, or even air.

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- Plain bearings can run on hardened steel or stainless steel shafting (raceways), or can be run on hard-anodized aluminum or soft steel or aluminum. For plastic bushings, the specific type of polymer/fluoro-polymer will determine what hardness is allowed.
- Plain bearings are less rigid than rolling-element bearings.
- Plain bearings handle contamination well and often do not need seals/scrapers.
- Plain bearings generally handle a wider temperature range than rolling-element bearings
- Plain bearings (plastic versions) do not require oil or lubrication (often it can be used to increase performance characteristics)

1.7. DOVETAIL SLIDES:

Dovetail slides, or dovetail way slides are typically constructed from cast iron, but can also be constructed from hard-coat aluminum, acetal or stainless steel. Like any bearing, a dovetail slide is composed of a stationary linear base and a moving carriage.

A Dovetail carriage has a v-shaped, or dovetail-shaped protruding channel which locks into the linear base's correspondingly shaped groove. Once the dovetail carriage is fitted into its base's channel, the carriage is locked into the channel's linear axis and allows free linear movement. When a platform is attached to the carriage of a dovetail slide, a dovetail table is created, offering extended load carrying capabilities.

Dovetail slides can be motorized, mechanical or electromechanical. Electric dovetail slides are driven by a number of different devices, such as ball screws, belts and cables, which are powered by functional motors such as stepper motors, linear motors and handwheels. Dovetail slides are direct contact systems, making them fitting for heavy load applications including CNC machines, shuttle devices, special machines and work holding devices. Mainly used in the manufacturing and laboratory science industries, dovetail slides are ideal for high-precision applications.

1.8. COMPOUND SLIDES:

Slides can be constructed with two sections or multiple sections. A slide with two sections can only extend approximately 3/4 of the total compressed slide length. A compound slide typically has three sections: fixed, floating intermediate member, and the section attached to the equipment. A compound slide can extend at least as far as the compressed slide length and typically a bit more. In the case of rack slides, this allows the equipment to extend completely out of the rack allowing access for service or connection of cables and such to the back of the equipment.

1.9. RACK SLIDES:

Rack slides are specifically intended for mounting equipment into 19-inch racks or 23-inch racks. These can be friction bearing, ball bearing, or roller bearing.In some cases, one mounting flange is formed into the rack slide with an adapter bracket attached to the other end to accommodate different depths of the rack.

The outer fixed member is attached to the rack and the inner moving member is generally screwed to the side of the mounted equipment. Rack slides are typically compound or 3-part slides allowing full extension of the mounted equipment and generally include provision for sliding the inner member completely free to allow removal of the equipment from the rack. They can also include stops to prevent accidentally pulling the equipment out of the rack without releasing the stop mechanism.

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There can be proprietary configurations which, for example, may clip to the equipment without the use of screws or can be clipped into an appropriately designed rack. But the basic geometry is the same regardless of how they are mounted.

3. OVERVIEW OF JSW

JSW acquired SISCOL in the year 2004, a sick unit at that time. Quick turnaround of the plant was achieved by expanding capacity from 0.3 Mt to 1 Mt and switching over to value added products.

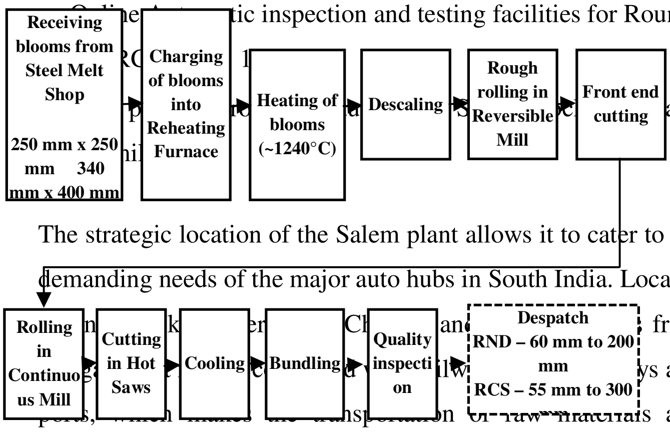
Unique features:

Complete product range

- Rounds: 5.5 to 180 mm
- RCS: 55 to 265 mm

- Flats: 60 to 101 series
- DSIR Approved R&D Centre with sophisticated modern equipments.

O...ne ... tic inspection and testing facilities for Rounds ... and



The strategic location of the Salem plant allows it to cater to the demanding needs of the major auto hubs in South India. Located ... from ... ys and ... ports, which makes the transportation of raw materials and finished products easy. This, coupled with its start-of-the-art technology and unique processes, makes Salem a steel plant that's truly a cut above the rest.

3.2. PROJECT NAME AND LOCATION:

JSW Salem works presently, operating a steel plant with the name plate capacity of 1 MTPA. The demand for special alloy steel was growing at the rate of 15% a year. In order to tap the potential market in special alloys, it planned to enhance the capacity of special alloy steel from 1 to 1.3 MTPA and expansion of power plant capacity from 67 to 97 MW. The proposed expansion of JSW, Salem works is located at M.Kallipatti&Pottaneri Village, Mecheripanchayat, MetturTaluk, Salem District of Tamil Nadu state. The nearest town Mecheri is located at a distance of 3 km in NE direction from the project site. The site lies in seismic zone-II as per seismic zone mapping of India. There is no capable fault within the study area. The site is well connected by road (SH 20) and rail and Mecheri road railway siding is existing at the back of present plant.

PROBLEM IDENTIFICATION AND RECTIFICATION

BLOOMING MILL-PROCESS FLOW DIAGRAM:

CUTTING IN HOT SAW:

- Cutting of hot rolled bars are done using a disc type metallic blade of 1600 to 1800mm diameter. This is called 'Hot Saw'.
- There are 3 Hot saws in blooming mill to cut the hot rolled bars in to customer required lengths.

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- The Hot saw blades are reconditioned once the blade teeth are worn out.

UNDESIRABLE RESULT OF THE PROBLEM:

(i).Low productivity
(ii).Increase in maintenance cost
(iii).Equipment failure

Brainstorming points:

- ✓ Water spillage on linear bearing
- ✓ Scale accumulation over railings.
- ✓ Continuous operation of hot saw.
- ✓ Over loading.
- ✓ High temperature.
- ✓ Usage of cracked blade
- ✓ Rail damage.
- ✓ Burr accumulation in rails.
- ✓ Improper Inspection.

POSSIBLE SUGGESTION TO IMPROVE LINEAR BEARING LIFE TIME:

- ✓ Proper lubrication (Increase the frequency of lubrication)
- ✓ Provide cover over to keep away from water, spark, burr and etc.,
- ✓ Avoid uneven bloom load(but it's not practically possible)
- ✓ Proper inspection over the certain period of time
- ✓ To take correct action against scale accumulation
- ✓ To take proper preventive maintenance activities will increase the life time of linear bearing.

IMAGE REPRESENTATION:

- ✓ Bearing without grease hose

Bearing with grease hose

CONCLUSION

II. The solutions provided to increase the lifetime of linear bearing in hot saw machine is to provide proper lubrication with periodic inspection so that proper preventive maintenance activities can be carried out. By adopting proper methods to avoid scale accumulations lead to increase in life time of the bearing. The above suggestions are provided based on the study carried out in the company.

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