



## RECONDITIONING OF BUSHES IN WIRE ROD MILL

<sup>1</sup>Mr.P.Shoukat Ali Khan, <sup>2</sup> P. Sreenivasulu

<sup>1</sup> PG Scholar (Advanced Manufacturing Systems), <sup>2</sup> Asst. Professor

<sup>1,2</sup> Mechanical Engineering Department,

<sup>1,2</sup> Sree Krishnadevaraya Engineering College, Gooty, Anantapur, India

### Abstract:

Steel has always been the backbone of nation's economy. Rashtriya Ispat Nigam Limited – Visakhapatnam Steel Plant (RINL-VSP) popularly known as “ Vizag Steel ” the “Pride of Steel”, a leading Central PSU under the Ministry of Steel is the first shore based Integrated Steel plant in the country. At VSP there is emphasis on total automation, seamless integration and efficient up gradation, which result in wide range of long and structural products to meet stringent demands of discerning customers within India and abroad. VSP has become the first integrated Steel Plant in the country to be certified to all the three international standards for quality (ISO-9001), for Environment Management (ISO-14001) & for Occupational Health & Safety (OHSAS-18001).

The bush is a stationary element in the bearing assembly. The bearing bushing is to be considered as the radial bearing proper. It is designed in the form of a babbitt–metal lined steel shell. The babbitt metal is a one type of soft metal used in bush is to perform operations with most effective. Reasonably long eye bolts are screwed into the tapped holes provided in the flange faces of the bushing.

So many bushes at both drive side and operation side are get damaged because the wear out takes place on the inside babbitt metal layer. The damaged bushes are send to the scrap area.

The main objective of this project is to reduce the inventory cost by reconditioning of bushes in wire rod mill. In this research work, the damaged bushes are reconditioned by using metal coating (Two wire electric arc spraying )method.

**Keywords-** RINL ,bush, babbitt, metal coating, Two-wire electric arc spraying.

### I. INTRODUCTION:

The bush is a stationary element in the bearing assembly. It is designed in the form of a babbitt–metal lined steel shell. The babbitt metal is a one type of soft metal used in bush is to perform operations with most effective. Reasonably long eye bolts are screwed into the tapped holes provided in the flange faces of the bushing. Bending and deformation of the eye bolts are counteracted by means of a “spreader” or “separator “ type element provided with V-notches on either side being located between the two bolts. After the bushing has been properly cleaned and provided with an oil film, it is slowly lowered into the roll chock bore without any under forces being applied. The structure of the bush is same at both drive side and operation side.

The bushes are classified into three types based on the size of the rollers. They are

1. 21” inch bushes
2. 16” inch bushes
3. 12” inch bushes



Figure 1.1 : Bush

## II. LITERATURE SURVEY:

Wear is among the most serious of issues to deal with when contacting surfaces in machine parts are in relative motion , such as bushes & bearings.

Surface coating technology has gained growing interest in recent years. Among various surface coating techniques, thermal spraying has been recognized as one of the most feasible and cost-effective solutions to protect against wear and corrosion.

By the reference of some journals and suggestions from the senior engineers in the plant , I found the solutions for this problems.

## III. FAILURES OF SLEEVES:

The failures of the bushes in wire rod mill as follows.

- Insufficient lubrication
- Babbit metal wear out
- Scratches
- Improper handling

### INSUFFICIENT LUBRICATION :

- Lubrication is the process or technique of using a lubricant to reduce friction or wear in a contact between two surfaces. Lubricants can be solids, liquids or gases. The purpose of lubrication system is to supply the lubricating oil between the moving parts to reduce friction and provide the cooling effect, carry away the deposits formed due to wear and tear.
- The Servo steel 680 is used as a lubricant for rolling operations in wire rod mill. Insufficient oil causes the failures like friction and wear of the parts in the bearing assembly. If the wear rate of the parts in bearing assembly increases it causes the over flow of the lubricant oil.

### BABBIT METAL WEAR OUT :

- Babbit metal wear out is a major problem of bearing assembly in wire rod mill. While performing the operations the sleeve is continuously rotating in the bush through motor shaft in the mill. The lubricant is supplied in between the sleeve and bush in the bearing assembly while rotating.
- If there is any problem occurs in the supply of lubrication in between the sleeve and bush while rotating, it causes more friction in between the sleeve and bush. Later on the babbitt layer which is coated on inside of the bush is wear out because the babbitt metal is a soften metal. Sometimes the load conditions are also effects the failures of the bush in the mill.



Figure 3.1 : wear out of the babbitt material

**SCRATCHES :**

The scratches are formed on inner side of the bush while performing the operations. The sleeve neck is wear out while friction takes place in between the sleeve and lock nut. The sleeve neck metal is wear out in the form of small discontinuous chips. These chips are entered into the inner side of the bush through the lubricants. If the chips are enter into the inside of the bush, the inner side of the bush is a soft metal so a scratches are formed on the inner side of the bush.



**Figure 3.2:** Scratches on inner side of the bush

**IMPROPER HANDLING :**

While assembly, the bush is inserted in a chock bore by worker. If the bush is not positioned exactly in the chock bore ,the worker is hammering on it. This causes the damage of the babbitt layer. Do not rotate the bush inside the chock bore. Before assembly the parts should cleaned by using oil and maintain proper handling to reduce the failures of the parts.



**Figure 3.3 :** Bushes at scrap area

**IV. FAILURE ANALYSIS OF SLEEVES & BUSHES :**

While assemble of the parts in bearing house we maintain some clearances in between the parts to reduce the failures. In the bearing assembly we are maintain some standard values for the clearance between the sleeves and bushes. If the clearance is increased beyond the standard values it should be replaced with new one. If the clearance in between the sleeves and bushes is within the standard values it would be negligible and it is acceptable to reuse.

**STANDARD DIMENSIONS ( IN MM ) OF THE SLEEVE & BUSH :**

SIZE	SLEEVE – OD	BUSH – ID	BUSH - OD	MAX.CLEARANCE
21”	413	413.35	442	0.9
16”	314	314.35	340	0.7
12”	238	238.25	259	0.5

Table 6.1- Standard dimensions of sleeves &bushes

If a problem is occurs like oil leakage or oil overflow in the chocks while running the mill , then the mill is stopped and replaced it by alternative systems. The failure chocks are send to the bearing shop to repaired it.

In the bearing shop, the workers are disassembled the chock parts and verify the parts if there is any structural damage is occur. If there is no structural damage of the parts , then the worker checks the all dimensions and clearances of the parts.

**PRACTICAL EXAMPLES :**

- ❖ Clearance = Bush inner diameter – sleeve outer diameter



**1. FOR 12” SIZE :**

SIZE	SLEEVE – OD	BUSH – ID	BUSH - OD	CLEARANCE	RESULT
12”	237.97	238.25	258.97	0.28	ACCEPTABLE

$$\text{Clearance} = 238.25 - 237.97 = 0.28$$

SIZE	SLEEVE – OD	BUSH – ID	BUSH - OD	CLEARANCE	RESULT
12”	237.95	238.51	258.95	0.56	REJECTED

(Allowable clearance is up to 0.5)

$$\text{Clearance} = 238.51 - 237.95 = 0.56$$

**2. FOR 16” SIZE :**

SIZE	SLEEVE – OD	BUSH – ID	BUSH - OD	CLEARANCE	RESULT
16”	313.95	314.61	339.95	0.66	ACCEPTABLE

$$\text{Clearance} = 314.61 - 313.95 = 0.66$$

SIZE	SLEEVE – OD	BUSH – ID	BUSH - OD	CLEARANCE	RESULT
16”	313.94	314.82	339.94	0.88	REJECTED

(Allowable clearance is up to 0.7)

$$\text{Clearance} = 314.82 - 313.94 = 0.88$$

**3. FOR 21” SIZE :**

SIZE	SLEEVE – OD	BUSH – ID	BUSH - OD	CLEARANCE	RESULT
21”	412.97	413.76	441.96	0.79	ACCEPTABLE

$$\text{Clearance} = 413.76 - 412.97 = 0.79$$

SIZE	SLEEVE – OD	BUSH – ID	BUSH - OD	CLEARANCE	RESULT
21”	412.96	413.91	441.96	0.95	REJECTED

( Allowable clearance is up to 0.9 )

$$\text{Clearance} = 413.91 - 412.96 = 0.95$$

**V. RECONDITIONING OF BUSHES:**

In my observation nearly 35 to 40 damaged bushes are kept aside for send to the scrap area. So I’ m concentrating on reconditioning of damaged bushes to reduce the inventory cost for the mill.

By the reference of some journals and I’ m visiting a few of small scale industries , I observed the all process in the industries and finally I get an idea to reconditioning of bushes.

I’ m using thermal spray coating methods for reconditioning of bushes in the wire rod mill.

**COATING :**

Generally the coating is defined as the process of adding a metallic compound on the base metal or parent metal. The coating methods are classified into different types based on their working principles like Hot dipping, Tin plating, Galvanizing and Siliconizing etc...

**SPRAY COATING :**

Spray coating is a coating technique where a device sprays a metallic compound through the air onto the surface. There are different types of spray coating methods are there. We are using thermal spray coating method for reconditioning of bushes. The thermal spray coating methods are classified into five types. They are

1. High velocity oxy – fuel spraying(HVOF)
2. Combustion flame spraying
3. Plasma spraying
4. Vacuum plasma spraying
5. Two-Eire electric arc spraying

From the all five methods, I’ m selecting Two-wire electric arc spraying for reconditioning of bushes because it is very less expensive.

METAL COATING



THERMAL SPRAY COATING



TWO-WIRE ELECTRIC ARC SPRAYING

### TWO – WIRE ELECTRIC ARC SPRAYING:

The Two-wire electric arc spraying method utilizes an arc point which is created between two wires which are electrically conductive. Melting will occur at the point where the wire are connect. The arc allows for heating the wires and creates deposition on the parent metal by the use of torch. A compressed air is used for spraying the coatings. This method is popular due to its cost effectiveness. The base material used for this process is either zinc or aluminum.

### VI. PROCEDURE:

- First clean the bush and degrease the area which is to be coated.
- Check the dimensions of the bush which is to be repaired.
- Undercut the damaged the area by blasting with angular steel grit to a maximum depth (0.2 to 0.5), after masking the sides which are not to be coated.
- The blasting ensures that roughen the surface and provides good bonding for the coating.
- Preheat the part about 600C by using blower.
- Arrange the bush on lathe and apply a bond coat of nickel aluminide as a base metal while bush is rotating on lathe.



**Figure 6.1 :** Layout of Two wire electric arc spraying

- The babbitt wires are arranged at a hole in the center of the tip on torch.
- The molten babbitt material is blown with compressed air force , which causes the interlocking with surface irregularities.
- During spraying, the temperature would not exceed 900C. If necessary, interrupt the spraying and keep the part to cool down up to 600C and repeat the process until we get the required thickness.
- Measure the dimensions of the bush while performing the operations and we maintain over thickness of 0.5 to 1 mm for machining operations on it.
- By spraying metal on the parent metal there is an increase in porosity, compressive strength and hardness.
- After completion of the process, remove the bush from lathe and measure the dimensions.



**Figure 6.2 :** Material coated bush on lathe

- The excessive thickness of the bush is removed by using grinding operation on it, until we get the required size and good surface finish.

**PRECAUTIONS:**

- A welder should wear gloves, high-top boots, safety glasses and face mask.
- Maintain the compressed air.
- Do not touch the bush after a grit basting.
- Cover the area of part which is not to be coated.

**VII. COST ANALYSIS:**

Cost is a major factor in all industries. Every industry will try to reduce the production cost and improve the profits for it. By reconditioning of sleeves and bushes to reduce the inventory cost for the wire rod mill as well as plant. The cost analysis for reconditioning of bushes are as follows.

The cost for the new bushes are as follows.

BUSH SIZE	COST
12"	90,000
16"	1,10,000
21"	1,25,000

**Table 7.1 :**Cost of new bushes

**VIII. RECONDITIONING COST:**

- For reconditioning of bushes we are using Nickel aluminide and babbitt metal wires.
- The cost for the wires are as follows.
  - Nickel aluminide – 1 KG - RS.1600
  - Babbitt metal – 1 KG - RS.1300
- The cost analysis for reconditioning of bushes are as follows.

BUSH SIZE	METAL FOR 1 BUSH / IN KG	RECONDITIONING COST
12"	1 - 2	1700 - 3000
16"	2 - 3	3100 – 4400
21"	3 - 4	4500 – 5700

**Table 8.1 :** Reconditioning cost of bushes

**NOTE :**

- The reconditioning cost includes the metal cost, machining cost and power cost.

**IX. RESULT :**

The reconditioning of bushes to be done by using Two wire electric arc spraying method (using Babbitt wire rods as electrode). The sprayed bush to be machined on lathe for getting the required shape and size as per the dimensions.

The cost comparisons for the new bush and reconditioned bush as follows.

SIZE	NEW BUSH COST	RECONDITIONED COST
12"	90,000	1,700 – 3,000
16"	1,10,000	3,100 – 4,400
21"	1,25,000	4,500 – 5,700

**Table 9.1 :** Comparison of cost for new bush & reconditioned bush

## X. CONCLUSION :

A thin layer of tin-babbit deposited by two wire electric arc spraying on the surface of bush can significantly change the properties of special steel in corrosion and improve the performance.

The reconditioned bush is assembled in bearing house and placed at stand 11 in the wire rod mill on 1-03-2019 and replaced it on 29-03-2019. The functioning of the bush is good and the clearance between the bush & sleeve is very less . Finally the bush is again placed in bearing house.

By the reconditioning of damaged bushes, we can reduce the inventory cost for the wire rod mill (replacement of new bush). The cost savings for the mill by reconditioning as follows.

SIZE	COST SAVINGS (Approximately) for 1 Bush
12"	87,000
16"	1,05,600
21"	1,19,300

**Table 10.1 :** Saving cost for the bushes

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