RECONDITIONING OF ROLL NECK SLEEVES IN WIRE ROD MILL OF VSP

[1]Mr.E.Naresh Goud, [2]Prof.M.L.S.Deva Kumar
[1] M.Tech (Advanced Manufacturing Systems), [2] Professor
[1,2] Mechanical Engineering Department,
[1,2] Jawaharlal Nehru Technological University, Anantapur, India

Abstract:

Steel has always been the backbone of nation's economy. From an annual production of 13million ton in 1900, global steel production raised to 300 million ton in 1950 and to 842 million ton in 2000. India produces 30 million ton per annum from 9 major plants. The major steel plants contribute 19 million tones and the rest is contributed by secondary sector. Visakhapatnam Steel Plant is one of the 6 integrated steel plants contributing 6.3 million ton of liquid steel per annum. It is the only steel plant in India accredited with ISO 9001, ISO 14001and OHSAS 18001 certificates for Quality environment and Safety aspects of the steel making activities.

A Roll neck sleeve is the rotating element of the bearing assembly in a rolling mill. It features a precision finish obtained by grinding both inside and outside with utmost precision being ensured for the outside diameter finish. The sleeve bore is tapered section, an end section aligned axially with the internally tapered section, and a cylindrical outer surface surroundings the internally tapered section. The roll neck sleeve outer surface is adapted to be rotatably journalled in a bushing component of the bearing. The Keyways are placed at the outside of the internally tapered section and exclusively in the end section to serve to rotatably fix the sleeve to the roll neck.

This Roll neck sleeves and bushes are get failures because of the reasons a Corrosion on the raceway is generated due to the clearance between the roll neck and the sleeve, insufficient grease or oil between the inner ring bore surface and the roll neck surface (When creep occurs between the inner ring and the roll neck, because of loose fit of them), Wear, Dislocation, Inappropriate handling, Cracks on the inner bore.

The main objective of this project is to reduce the inventory cost by reconditioning of sleeves in wire rod mill.

In this research work, the damaged sleeves are reconditioned by using Arc welding method. SA 80 E is used as a electrode for arc welding. The welded sleeves are machined on lathe for getting the required size.

***Key*words- steel, roll neck sleeve, reconditioning, arc welding, SA 80E.**

I. INTRODUCTION:

The neck sleeve is the rotating element of the bearing assembly. It features a precision- finish obtained by grinding both inside and outside with utmost precision being ensured for the outside diameter finish.

The sleeve bore is tapered and corresponds exactly to the taper of the roll neck. The sleeve bore is tapered section, an end section aligned axially with the internally tapered section, and a cylindrical outer surface surroundings the internally tapered section. The roll neck sleeves are made up of a Special type of steels.

The roll neck sleeves outer surface is adapted to be rotatably journalled in a busing component of the bearing. The keyways are placed at the outside of the internally tapered section and exclusively in the end section to serve to rotatably fix the sleeve to the roll neck.

Basically the rollers are having two ends. One is operation side and another is Drive side. The design of the sleeves at both ends of the rollers is different. The drive side of the roller is connected to the motor for rotating.

The rollers used in wire rod mill are classified into three types based on their size.

1. 21" inch Rollers
2. 16" inch Rollers
3. 12" inch Rollers

The design specifications of the rollers as follows.

SIZE	MAX.DIAMETER	MIN.DIAMETER
21"	610	515
16"	490	430

12”	390	325

Table.1: Specifications of rollers

The sleeves used in wire rod mill are basically classified into two types based on their assemble side.

1. Drive side
2. Operation side

1. DRIVE SIDE :

The design of the drive side sleeve is to be different the Operation side sleeve. The sleeve has internally tapered section and the outer surface is to be flat. A key way is placed on the inside of the sleeve for assemble it over the rollers for rotating purpose.

The drive side sleeves are classified into three types based on the size of the rollers.

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

Fig.1: Drive side sleeve

The dimensions of the sleeves are as follows.

SIZE	SLEEVE OD (MM)
21”	413
16”	314
12”	238

Table.2: Dimensions of sleeves

2. OPERATION SIDE:

The design of the operation side sleeve is to be different the drive side sleeve. There is no key ways are placed in sleeve bore. The operation side sleeves are also classified into three types based on the size as mentioned in the drive side sleeves. A Thrust bearing is placed on the sleeve neck for rotating the roller in operations.

Fig.2: Operation side sleeve

The main difference between the drive side and operation side sleeves are as follows.

- Operation side sleeves are having a thrust bearing assembly but there is no bearing assembly in drive side system.

- Design and Structure of the two types of sleeves are different.

II. LITERATURE SURVEY:

A lot of studies have been carried out by many researchers in the domain of welding technology. The main objective of all welding processes is to obtain high quality weldment with perfect weld bead-geometry and excellent mechanical properties with minimum distortion. Shielded metal arc welding was the predominant form of fusion welding until the beginning of the 1980s.

As per the definitions by the American Welding Society (AWS), it is comprehended that welding is a location- specific coalescence of metals or non – metals. A weld is the end product of welding process.

Some researchers like Onoro (21) studied 9-12Cr steels in welded materials that required good mechanical properties and corrosion resistance at high temperature.

III. FAILURES OF SLEEVES:

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

- Insufficient lubrication (servo steel 680)
- Misalignment
- Inappropriate handling
- Cracks on the inner bore
- Friction between sleeve neck & lock nut
- Due to load conditions
- Corrosion on the raceway is generated due to the clearance between the roll neck and the sleeve
- Due to the Vibrations

FRICTION BETWEEN THE SLEEVE & LOCK NUT:

After assemble the chock on roller a lock nut is placed at the end of the chock to avoid movements of the sleeve as well as chock. The lock nut edge is meshed with the sleeve neck in assembly of the rollers.

The lock nut is screwed onto the corresponding threaded ring after the thread flights have been coated with molycote in order to prevent the thread from seizing when being tightened. At first, the lock nut is tightened by hand to the maximum amount such tightening is possible end, thereupon final tightening is carried out by using a lock nut wrench.

After assemble the chocks at both ends of the rollers, it is shipped to the wire rod mill for the operations. The drive side roller is connected to the motor shaft in the mill. The lubricant and water coolant connections to the stand is assembled.

Fig.3: Wear out on sleeve neck

While performing the operations the sleeve is rotated through the roller at both ends. While rotating a friction takes place between the sleeve neck and lock nut. Therefore sleeve neck is wear out due to the cause of friction. This is main problem occurring in the mill continuously.

"The sleeve neck is wear our nearly 4 to 12 mm depth and 6-11 mm thick (taken from the all previous damaged parts)"

MISALINGMENT:

Misalignment of the parts in bearing assembly is more effects the lifetime of the parts. To follow a step by step procedure while assemble the parts. The sleeve is placed exactly on a keyway which is placed on the roll neck. If there is any misalignment between the sleeve and roller it cause to get a chance of slip while rotating. The parts used in bearing assembly should be perfect and maintain clean.

INAPPROPRIATE HANDLING:

While assembly, the chocks are placed on a rollers by using cranes. The movements of the chock is controlled by the crane for positioning it. Inappropriate handling of the parts will causes the damages of the parts.

Fig.4: Failure of sleeve at operation side

CORROSION:

Corrosion is the irreversible damage or destruction of living tissue or material due to a chemical or electrochemical reaction. Corrosion is the breakdown of materials due to chemical reactions. It is usually oxidation with air molecules and often in the presence of water. Corrosion also occurs when an acidic or basic material touches another material.

Fig.5: Corrosion on sleeve

The sleeves are get failures because of the corrosion is formed on it. The reasons for the corrosion is , we are using water as a coolant and oil is used as a lubricant. The lubricant(oil) is supplied to the inside of the bearing assembly and the coolant |(water) is supplied to the rollers as well as outside of the bearing assembly. Whenever the sleeve neck is wear out, the water is enters into the inside of the bearing assembly then a corrosion is formed.

DUE TO LOADS & VIBRATIONS:

The sleeves are get failures because of the loads and vibrations are very less in the wire rod mill.

IV. RECONDITIONING OF SLEEVES:

I'm concentrating on reconditioning of drive side sleeves only because there are so many drive side sleeves are damaged while I m observing. The major damages of the sleeves are wear out on the sleeve neck. Nearly 45 damaged sleeves are kept aside in the mill. My aim is to reconditioning of it with less cost.

Fig.6: Collection of damaged sleeves

- I choose welding methods to reconditioning of sleeves.

WELDING:

Welding is a fabrication process that joins materials, usually metals or thermoplastics by using high heat to melt the parts together and allowing them to cool causing fusion. Welding is distinct from lower temperature metal- joining techniques such as brazing and soldering , which do not melt the base metal.

In addition to melting the base metal , a filler material is typically added to the joint to form a pool of molten material that cools to form a joint that, based on weld configuration (butt ,full penetration, fillet, etc..) can be stronger than the base material . welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

One beauty of welding in comparison to other processes of joining metals is that by this process we can have more than 100% strength of joint and it is very easy process. I m selecting the Arc welding method for reconditioning of sleeves.

Welding Method ⇒ **Arc welding**

ARC WELDING:

Arc welding is a welding process that is use to join metal to metal by using electricity to create enough heat to melt metal, and the melted metals when cool result in a binding of the metals. It is a type of welding that uses a welding power supply to create an electric arc between the electrode and the base material to melt the metals at the point of contact. Arc welders can use either direct current (DC) or alternating current (AC). We can use either consumable electrodes or non consumable electrodes for the arc welding process.

- The electrode used for arc welding is SA 80 E to reconditioning of sleeves.

ELECTRODE ⇒ **SA 80 E**

V. PROCEDURE:

- Setup the all equipments like work lead, electrode lead, power source and electrode holder as shown in the below figure.

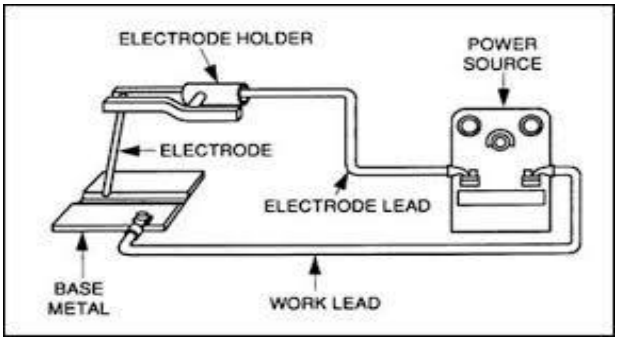

Fig.7: Layout of arc welding

- Place the base metal (sleeve) at dry place and electrode holder should be insulated.
- Take the correct size electrode and placed it in electrode holders.
- Once check the all connections and switch on the main power supply.
- A tremendous heat is liberated and the temperature of the arc is of the order of 36000C.
- The electrode is melted by the heat of the arc and deposited into the this small pool in the molten state.
- The molten metal in the pool is agitated by the action of the arc, and thus the parent and electrode metals are thoroughly mixed.

Fig.8: Partial welding on sleeve neck

- The electrode (SA 80 E) which we are using is a flux coated electrodes. The flux coated electrodes are used which on melting form a protective gas shield around the electrode tip and molten weld pool.
- On cooling the flux is solidifies to form a slag on the surface of the weld, which is subsequently chipped away.

Fig.9: Completion of welding on sleeve neck

- Continue this process until we get the required dimensions.

PRECAUTIONS:

- A welder should wear welding jackets made of leather, leather leggings, leather welding gloves, high-top boots and safety glasses.
- Flammable materials like matches, combs, fountain pens etc…should be removed from pockets.
- Before starting arc, inspect the all connections.

The welded sleeve needs the machining operations for getting the required shape and size. We are using turning operations for machining of the welded sleeve on lathe machine. We are doing this process in Area repair shop, it contains lathe machines.

VI. LATHE MACHINE:

A lathe machine is a machine tool which is used to remove the materials from the work piece to give a desired shape and size. The various metal removing operations performed by the lathe are facing, turning, knurling and threading.

The main parts of the lathe machine are bed, lead screw, head stock, tail stock, carriage, tool post and compound rest. A lathe operates on the principle of a rotating work piece and a fixed cutting tool.

PROCEDURE:

- Place the welded sleeve in between the two rigid & strong supports called centers in lathe chuck by using crane.

- We are using 4 jaw independent chuck on lathe so after placing the sleeve in chuck and adjust the jaws by a chance wrench.
- The sleeve is having a inner bore so we can arrange one round plate which is equal to the diameter of sleeve bore to support it while rotating.

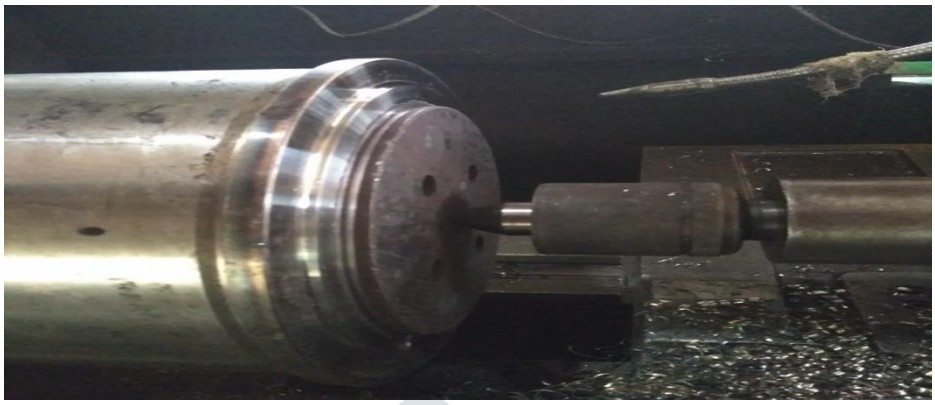

Fig.10: Machining of sleeve on lathe

- The tail stock is moved towards the sleeve and placed the tail stock center on the centre of welded sleeve.
- A cutting tool is inserted in the tool post for machining operations.
- Start the machine and maintain the spindle speed at the low rate.
- Specify the feed rate and depth of cut for machining of the sleeve to get the required dimensions.
- After completion of the machining process moves the tail stock away from the sleeve and check the dimensions of the sleeve by using venire calipers.
- If the dimensions of the sleeve are accurate then remove the sleeve from chuck by using cranes and placed on the ground.

Fig.11: Finished sleeve

- Finally we get the sleeve with accurate dimensions and size.

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 sleeves and bushes as follows.

FOR SLEEVES:

The costs for the new sleeves are as follows.

SLEEVE SIZE	COST
12”	2,00,000
16”	2,60,980
21”	3,05,000

Table.3: Cost of new sleeves

RECONDITIONING COST:

The SA 80 E electrodes are available in the pack of 5kgs at cost of RS. 12,000.

The number of sleeves reconditioned by using one pack of electrodes are based on the depth of the wear out are as follows.

SLEEVE SIZE	NO.OF SLEEVES	RECONDITIONING COST
12”	6-8	18,000 – 20,000
16”	4-6	18,000 – 21,000
21”	2-4	16,000 – 20,000

TABLE.4: Reconditioning cost of sleeves

VIII. RESULT:

- The reconditioning of sleeves to be done by using arc welding method (using SA 80E electrode).
- The welded sleeve to be machined on lathe for getting the required shape and size as per the dimensions.
- The cost comparisons for the new sleeve and the reconditioning sleeve as follows.

SIZE	COST	
	NEW SLEEVE	RECONDITIONED
12”	2,00,000	3,000
16”	2,60,980	4,500
21”	3,05,000	8,000

Table.5: Comparison of cost for new sleeve & reconditioned sleeve

- The reconditioned sleeve is assembled in bearing house and placed at stand 7 in the wire rod mill on 18-01-2019 , till now there is no failure occurs.

IX. CONCLUSION:

The deposition of SA 80E electrode material by Arc welding method on the surface of sleeve neck can significantly change the properties of special steel in corrosion and improve the performance.

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

SIZE	COST SAVINGS (Approximately) for 1 Sleeve
12”	1,97,000
16’	2,56,480
21”	2,97,000

Table.6: Saving cost for the sleeves

- 14 sleeves are reconditioned till now..
  - **12” - 5 (9,85,000)**
  - **16” - 8 (20,51,840)**
  - **21” - 1 (2,97,000)**

X. REFERENCES:

1. Regina M.H. Pombo Rodriguez., 2007.Aluminium Coatings Deposited by Flame Spray and by Electric Arc Spray, Surface &Coatings Technology 202, p. 172.
2. V.R.S Sa Brito., 2012. Corrosion Resistance and Characterization of Metallic Coatings Deposited by Thermal Spray on Carbon Steel, Material and Design, 41 p.282.
3. Rogerio Varavallo., Adhession of Thermally Sprayed Metallic Coating, Journal of ASTM International vol 9 No 2, p.1-10
4. I. Gedzevicius & A.V. Valiulis., 2006. Analysis of wire arc spraying process variables on coating properties Journal of Materials Processing Technology 175 p.206
5. H.D.Steffens, Z.Babiak, M.Wewel., 1990. Science Recent Developments in Arc Spraying, IEEE Transaction on Plasma Science 18, p.975.
6. A.P. Newbery & P.S. Grant,. 2006. Oxidation during electric arc spray forming of steel, Journal of Materials Processing Technology178, p.259.