Reclamation of Rack Teeth of Tilting Mechanism of Mixer of Steel Melting Shop of Bhilai Steel Plant

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ABSTRACT

Reclamation, in general, means economical sense of unused damaged waste item by value addition which otherwise would have been useless. Reclamation is the process of reclaiming some thing from loss or from a less useful condition. Economics plays a very important role in deciding to go for reclamation.

Bhilai Steel Plant is an integrated steel plant. In this plant, the production of steel is done through two routes, first one is the conventional route (ingot route) and second route is converter and continuous cast route.

The main function of Mixer in any steel melting shop is to receive hot metal (pig iron) from Blast Furnace and to supply hot metal to the Twin Hearth Furnace or Converters. The Mixer acts as a reservoir for homogenization of chemical composition and temperature of hot metal received from different Blast Furnaces.

For pouring of hot metal in to the ladle, the Mixer is tilted towards ladle. After filling one ladle, the Mixer is then tilted back for positioning of next empty ladle. So, for pouring of each ladle, Mixer is to be tilted to and fro. Hence tilting mechanism is very vital equipment of Mixer.

While inspecting, it was found that the rack teeth of tilting mechanism is worn out beyond permissible limit and it was unsafe to work i.e. tilting of Mixer for handling of hot metal. At that time, the spare rack was not available. Hence it was decided to reclaim the other rejected rack which was lying.

The estimated value of Mixer Rack is around Rs.1.75 crores.

This paper deals with the reclamation technology adopted to revive this vital assembly. This paper includes selection of welding consumable, welding parameters, preparation, preheat and post heat treatment and precautions for entire reclamation procedure.

INTRODUCTION

Mixers in any Steel Melting Shop are required for the following purposes -

1. To receive hot metal (pig iron) from Blast Furnace and to supply hot metal to the Converters or Twin Hearth Furnaces at a fairly uniform temperature and composition in required quantity.
2. Mixer acts as a buffer between Blast Furnaces and the Converters or Twin Hearth Furnaces (steel making furnaces).

PROBLEM

Due to continuous working, the rack teeth were worn out considerably and it was unsafe to work i.e. tilting of mixer for handling of hot metal.

WHY RECLAMATION

The spare rack was not available and rack teeth were worn out beyond permissible limit.

The estimated cost of Mixer Rack is about Rs. 1.75 crore.

Fig. 1

Fig. 2

TECHNICAL DATA OF RACK

No. of teeth	33
Module	65
Pitch	204.1
Pressure angle	20^0
Co-efficient of cutters tooth height	0.8
Weight	9300 Kg.
Total length	8300 mm
Material of rack	40Ni2Cr/Mo28 of IS : 1570

MECHANICAL PROPERTIES OF PARENT METAL OF RACK

Tensile strength	790 Mpa - 940 Mpa
Elongation	16 %
Hardness	229 BHN - 277 BHN

JOB PREPARATION

1. To grind the worn out area to remove fatigued material, sharp corners and edges.
2. To check the area which is to be welded with D.P. test for any possible inherent surface defects.
3. To make a template as per teeth profile.
4. Rack to arrest properly to avoid distortion.
5. A burner was prepared in house for preheating, post heating and to maintain inter pass temperature.

Fig. 3

Fig. 4

CHEMICAL COMPOSITION OF PARENT METAL OF RACK

C	Si	Mn	Ni	Cr	Mo
0.35 to 0.45	0.1 to 0.35	0.4 to 0.7	1.25 to 1.75	0.9 to 1.3	0.2 to 0.35

Fig. 5

SELECTION OF WELDING PROCESS AND CONSUMABLES

The process MMAW was selected as it is most suitable for positional welding.

Two types of electrodes were selected for reclamation of rack teeth.

1. Electrode for base run.
2. Electrode for subsequent (filler) runs.

ELECTRODE FOR BASE RUN

Low hydrogen, low heat input MS electrode was selected for base run. Low hydrogen electrode is used to overcome the problem of porosity in the weld bead as porosity is caused by bubbles of hydrogen being caught in weld metal. These electrodes are designed to eliminate hydrogen inclusion, because the flux coating has low hydrogen content.

FEATURES OF ELECTRODE (FOR BASE RUN)

1. Superb weld ability.
2. Excellent impact resistance and ductility.
3. High strength reliability.
4. Bonds easily with parent metal.

CHEMICAL COMPOSITION OF ELECTRODE FOR BASE RUN

C	Mn	P	S	Si
0.06-0.12	1.3	0.01	0.01	0.4-0.5

MECHANICAL PROPERTIES OF ELECTRODE FOR BASE RUN

Tensile strength	520Mpa
Yield stress	350Mpa
Elongation	28%

ELECTRODE FOR BUILT UP RUN

Low heat input highly alloyed electrode for anti wear size 3.15 mm was selected for subsequent run. This electrode has outstanding weldability with extra high deposit yield.

FEATURES OF ELECTRODE (FOR BUILT UP RUN)

- Excellent resistance to impact, galling and scoring.
- High work hardening rate without deformation.
- Outstanding weldability.

MECHANICAL PROPERTIES OF ELECTRODE (FOR BUILT UP RUN)

Tensile strength of the joint	600Mpa to 650Mpa
Yield stress	450Mpa
Elongation	30% to 38%
Hardness as deposited	200 BHN to 220 BHN
Work hardened	280 BHN to 320 BHN

CHEMICAL COMPOSITION OF ELECTRODE (FOR BUILT UP RUN)

C	Mn	P	S	Si	Cr	Ni	Mo
0.12	6.5	0.02	0.02	1.02	19.94	10.5	1.4

WELDING PROCEDURE FOR RECLAMATION

As total 16 nos. teeth were worn out, hence these teeth were selected for reclamation. Sequence welding technique was adopted for proper heat distribution. For that, in first batch, teeth no. 1, 4, 9 and 13 were taken for welding. For second batch, teeth no. 2, 6, 10 and 14, for third batch, teeth no. 3, 7, 11, and 15 and for last batch, teeth no. 4, 8, 12 and 16 were taken for welding.

The welding procedure in detail is as given below –

1. To clean the weld area.
2. To bake the electrodes.
3. To preheat the base metal to 150°C to 200°C.
4. To deposit stringer beads.

5. To remove slag between passes.
6. Skip and staggered welding technique may be used for heat distribution.
7. To peen deposit.
8. To cool naturally.
9. To grind tooth profile as per template to the finish size.
10. To check with D.P. test for any possible surface crack.

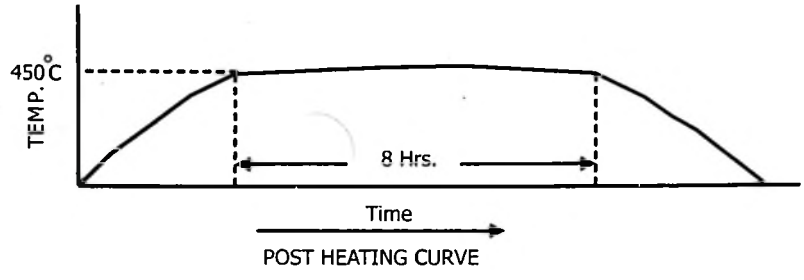
POST HEAT TREATMENT

After completion of welding, post heat treatment should be done to relieve internal stresses. For that, HAZ should be heated up to 400°C to 450°C for 8 hours and then allowed slow cooling.

PRECAUTION

- To ensure that the electrodes are dry, to re-dry the electrodes at 200°C to 300°C for one hour.
- To maintain inter pass temperature between 150° C to 200°C.
- To weld in flat position, wherever possible.

11. After each run, surface should be cleaned thoroughly to eliminate slag inclusion, blow holes etc.
12. To cover the job to allow slow cooling.
13. The heat input should be as low as possible.
14. Intermittent welding must be used to prevent local heat build up.



POST HEATING CURVE

Fig. 6

15. As the area is inclined, hence, welding has to be done with welding electrode holding at 90° to the surface for better penetration.

TECHNO-ECONOMICS

Reclamation cost of Mixer Rack was around Rs.8.5Lakh. Where as the estimated cost of new Mixer Rack is about Rs.1.75crore.

CONCLUSION

The reclaimed rack assembly not only served the purpose to get the spare assembly in time, but the life obtained by this assembly was as good as new assembly.

The pioneering effort of the team was very successful. The success achieved here has also opened new avenues for other steel plants to revive the assembly in similar critical situation.

REFERENCES

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