e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:08/August-2022 Impact Factor- 6.752 www.irjmets.com

REVIEW PAPER FOR SCARP REDUCTION IN TMT RENIFORCED BAR

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ABSTRACT

In this work, we studied a manufacturing of random rods at a leading manufacturing company of Thermo Mechanically Treated (TMT) reinforced bars to reduce the several types of scrap like Head and End cut, Cobbles, Random rods, Melting rods and chopping. The hot billet coming from the extrusion machine is sent to the rolling mill where the TMT bars are produced; this consists of seven stages – scrap handling, Induction furnace, Continuous casting machine, Reheating Furnace, Rolling mill which contain 18 stands in which 6-Roughing stands, 6- Intermediate stands and 6-Finishing stands, shear cutting and programming logical controller (PLC). During the shear cut operation performed on the billet, a large amount of scrap was being generated. To reduce this scrap and the non-value-added activities, techniques have been applied.

Keywords: TMT Bars, Shear Cut Operation, Scrap Reduction.

I. INTRODUCTION

Induction furnace is a type of furnace for steelmaking which uses electrical energy for its operation. Induction furnace (IF) steelmaking is one of the two electrical steelmaking processes. The other process for electrical steelmaking uses an electric arc furnace (EAF). Though IFs are being used since a long time, the production of mild steel by the IF is relatively not very old phenomenon. The principle of melting in IF is that a high voltage electrical source from a primary coil induces a low voltage, high current in the metal or secondary coil. IF uses the heat produced by the eddy currents generated by a high frequency alternating field. The alternating magnetic field produced by the high frequency current induces powerful eddy currents in the charge resulting in very fast heating. After tapping of steel from a primary steelmaking furnace such as IF, BOF, EAF or EOF, molten steel for high quality or specialty applications is subjected to further refining in a number of alternative processes collectively known as ladle metallurgy. Ladle metallurgy processes are commonly performed in ladles. Tight control of ladle metallurgy is associated with producing high grades of steel in which the tolerances in chemistry and consistency are narrow.

Continuous casting (CC) is a process of producing an infinite solid strand from liquid steel by continuously solidifying it as it moves through a CC machine. It is the predominant process route in a modern steel plant which links steelmaking with hot rolling of steel. The liquid steel is solidified into a semi-finished steel product for subsequent rolling in the hot rolling mill. The basic operation of the CC machine is to convert liquid steel of a given composition into a strand of desired shape and size through a group of operations. Continuous casting is distinguished from other solidification processes by its 'steady state' appearance. That is, the liquid steel freezes against the mould walls and is withdrawn from the bottom of the mould at a rate which keeps the solid / liquid interface at a constant position with time, relative to an outside observer. Reheating furnaces are used in hot rolling mills to heat the steel stock (Billets, blooms or slabs) to the rolling temperatures of around 1200 deg C which is suitable for plastic deformation of steel and hence for rolling in the mill. Rolling is the process of plastically deforming steel by passing it between rolls. Rolling is defined as the reduction of the cross sectional area of the steel piece being rolled, or the general shaping of the steel products, through the use of the rotating rolls. It is usually the first step in the processing of steel after it is made and cast either in Ingot or continuous cast product in a steel melting shop. The initial rolling of steel is done in a hot rolling mill where billet and slabs are rolled down to various rolled products such as plate, sheet, strip, coil, billet, structures, rails, bars and rods. Steel rolling can produce a wide range of products. The width of a rolled product can vary from a few millimetres to several meters while the thickness can vary from 0.1 mm to more than 200 mm. The rolled section can be square, rectangular, round or shaped sections.

A rolling mill cooling bed is used for the uniform air cooling of the rolled materials and transports it in a phased manner from the entry side of the cooling bed to its discharge side. It transfers the bars one by one to the roller table, on which they are transported to the finishing section. It is important equipment in the hot rolling of long products in a rolling mill. A cooling bed carefully moves and cools the hot steel rolled bars after the hot rolling process. Cooling beds are to be specifically designed considering the smallest and the maximum size of the bars being rolled in a particular rolling mill. They are designed for receiving, transferring, and cooling of the rolled material. They are sized so that the product cools within a particular cycle time. The length of the cooling bed is determined by the maximum run-out bar length, optimized by the selling lengths to minimize crop losses. The width of a cooling bed is determined on the basis of mill productivity (tons/hour) and the time required for cooling. Cooling beds normally have natural air cooling. The rolled bars after their rolling in the rolling mill are generally above 700 deg C and are to be cooled to below 150 deg C for subsequent finishing process. This results into high quality profiles and throughput. The cooling bed is located in the rolling mill after the rolling of the steel material is completed. It supports and permits the hot rolled bars from the last stand of the mill to cool. Cooling bed cools the bars as well as cross transfers them towards the discharge end. In a cooling bed the temperature of the entire length of the bar is to be cooled at the same time. If not, it develops stresses in the bar. After the last stand of the rolling mill, a shear arrangement is used to cut the bar which is moving to the cooling bed. This shear is normally a dual ratio crop and dividing shear. The lengths cut are to suit the length of the cooling bed and is based on the multiples of the finished saleable lengths. The cut length optimization software adjusts the primary cut lengths to the cooling bed to minimize yield losses. The bar delivery system to the cooling bed is to enable the bars to be transported onto the cooling bed at a speed matching with the speed of the rolling in the rolling mill. There need to have a soft braking system for the bars so that the surface of the bars remains in a perfect condition despite the high delivery speed. The bars are to be transferred onto the cooling bed for which the suitable arrangement needs to be provided. The mechanical type of cooling bed is used in which rake type cooling bed has a saw tooth pattern which is why it is also known as a rake type cooling bed. The purpose of the cooling bed of a movable rake design is to uniformly air-cool the rolled bars or light sections and transport the same in a phased manner from the entry of the cooling bed to discharge side. The rolled bar as it enters the cooling bed slides onto the first notch on the rakes. The initial notches provide continuous support for the bar on a casting called a grid casting. Long plates with notches set at some distance apart, support the bar after it moves beyond the grid castings. The bar moves across the cooling bed by the movement of alternative plates moving in a cycle of lift, move, and retract, by the action of eccentric cams. Repeating of this cycle moves the bars as they are delivered from the mill. The front ends of the bars and light sections are also levelled at the discharge side and a fixed number of cooled rolled bars are sent for final length cutting by cold shear for subsequent bundling or piling. Cooling beds can also use a chain transfer as the traversing method. In the shearing process, metal is separated by applying a great force enough to cause the material to fail. The shearing force is applied by two blades, one above and the other below the material (upper blade and lower blade). These blades are positioned at an angle relative to each other. These two blades are forced past each other with the space between them determined by a required offset. Normally, one of the blades remains stationary. The shearing blades used in the shearing process typically have a square edge rather than a knife-edge and are available in different materials, such as high carbon steel, low alloy steel, and tool steel etc. Shears which are used in rolling mills before the cooling bed are called hot shears while the shears which are used after the cooling bed are cold shears. Hot shears cut desired length and as well as cut front and tail ends of the rolling stock. These shears also cut the bar being rolled in case of cobble in the rolling mill. Hot shears are designed to cut the rolling stock at the rolling temperature. Cold shears are used to cut the rolled product in to desired saleable lengths. The type of shears normally used in rolling mills are (i) crop and cobble shear, (ii) cooling bed dividing shear, The crop and cobble shear is used in hot rolling mills is to crop front end, tail end, as well as to segment cutting in case of eventualities. These shears are usually of start/stop type and are driven either with flywheel mounted pneumatic clutch/brake or with direct DC (direct current) motor driven. These shears are controlled through PLC (programmable logic control) system and provide very close tolerance of the cut length. The cooling bed dividing shear is used to cut cooling bed lengths. This shear is generally installed before entry to cooling bed. The cooling bed shear is generally stop/start and continuous operating type and is driven by the direct DC motor drive. This shear is also normally controlled through PLC system and hence very close tolerance of cut length is achieved. Flying shears are those shears which cur the material while it is moving in the rolling mill at the rolling speed. Flying shears are used for cutting applications, where endless material to be cut to length, cannot be stopped during the cutting process and the cut is required to be effected 'on the fly'. The mechanical construction provides a shear system mounted on a carriage, which follows the material with synchronous speed while cutting is in progress, and then returns to a home position to wait for the next cut. The flying shear control is based on a PLC system. The system is generally designed for the special requirements of flying shears under consideration of maximum efficiency and accuracy at minimum stress for all mechanical parts. **Cold shear** are for cutting of cooling bed lengths into saleable lengths. They are installed downstream of the cooling bed exit roller table after the straightener.

II. LITRETURE REVIEW

1. Sabiya. K, M. Shilpa, S. Appaiah, Scrap Reduction in TMT Reinforced Bar Production by the Application of Lean Techniques, (IJRTE) ISSN: 2277-3878, Volume-8 Issue-2, July 2019, lean techniques are applied to the manufacturing of random rods at a leading manufacturing company of Thermo Mechanically Treated (TMT) reinforced bars to reduce the scrap. The hot billet coming from the extrusion machine is sent to the rolling mill machine where the TMT bars are produced; this consists of three stages – roughing mill, shear cutting, and programming logical controller. During the shear cut operation performed on the billet,a large amount of scrap was being generated. The work had been carried out by collecting the data and analyzing it, different methodology is used for different scrap generation.The overall scrap generation was 6% which is more than any industry. Eliminating this non value adding activity the rate ofscrap production was reduced. Based on this concept the overall percentage of scrap production was reduced to 4% which is important for any leading company in the steel sector. This concept of wastage elimination is the MUDA concept of lean technique.

2. Tejas Chaudhari and Niyati Raut, Waste Elimination by Lean Manufacturing, (IJISET) Vol. 4 Issue 5, May 2017 ISSN (Online) 2348 – 7968, Lean manufacturing is the systematic elimination of waste. Lean is focused at cutting non-value-added activities from production. This Paper details the use of lean manufacturing Techniques in reducing waste in Nut Bolt Manufacturing Company. This Study Shows the reduction in Through-Put Time is achieved to increases the productivity. Lean manufacturing appears to hold considerable promise for addressing a range of simultaneous and product quality, low cost and reductions in lead times. This Case Study addresses the application of lean manufacturing concepts to the continuous production sector with a focus on the Pump manufacturing industry.

3. Jorge Madias, Split Ends during Long Products Rolling, Billet Quality or Rolling Process, during the continuous process in rolling mill, in the long products end splitting (alligatoring defect) and central bursting occurs, which effect on quality and productivity of the product and the different aspects of defects are represented. This phenomenon may occur in the roughing passes of the roughing mil, particularly in open mills. Steel grades affected include free cutting steel, rebar and wire rod and shapes. Although out of the scope of this paper, this problem is also known in flat rolling of steel and aluminium.

4. Alberto Simboli, Raffaella Taddeo and Anna Morgante, Value and Wastes in Manufacturing. An Overview and a New Perspective Based on Eco-Efficiency, ISSN 2076-3387, Adm. Sci. 2014, 4, 173–191; doi:10.3390/admsci4030173, Various studies have been carried out to encourage companies in including the environment in their strategic and operational decisions making. This study presents an overview on the evolutionary dynamics of manufacturing in the industrial age, and offers a discussion about the potential synergies in integrating IE approaches and tools in Lean Manufacturing, by introducing the environmental load as a further type of Muda; the systematic actions to reduce this waste can build up the basis for improving competitiveness through the eco-efficiency.

5. Agnieszka Grzelczak and Karolina Werner-Lewandowska, Eliminating Muda (Waste) in Lean Management by Working Time Standardization, Arabian J Bus Manag Review 2016 and 6:3 DOI: 10.4172/2223-5833.1000216, The purpose of this article is to present the methods mentioned and focus on the possibility of their inclusion in the concept of Lean Management, in the context of elimination of waste in the form of under-utilized potential of employees. The authors focused on just the last type of waste that is on the under-utilization of the potential of employees. However, according to the author's interpretation, thinking of "muda" is not using the available working time of employees. In the opinion of the authors, this loss is due to a lack of standardization of working time of employees In order to eliminate wasted time at the workplace, the authors suggest using the techniques of work analysis and standardization. The purpose of this article is to present the

methods mentioned and focus on the possibility of their inclusion in the concept of Lean Management, in the context of elimination of waste in the form of under-utilized potential of employees. The above approach combines the Japanese approach in terms of improvement of processes and European approach in the context of research on work.

6. Sanjay Kumar, Dr. S.S. Mantha and Dr. Arun Kumar, Scarp Reduction by using Total Quality Management Tools, International Journal of Industrial Engineering, 16(4), 364-369 2009. This case study was carried out in one of the leading Indian industries manufacturing pre-stressed concrete steel strands (PC wire). It has major applications in bridges and construction industry. During study, lot of scrap was observed. Reasons for scrap were found out by using total quality management tools (TQM).

III. SUMMARY/FINDINGS OF THE LITERATURE

In the above section extensive literature review has been carried out to understand current status of Scrap reduction in TMT reinforced bar from the literature review it appears that

1. Most of the research in this area is focused by using some techniques like lean manufacturing and MUDA method of lean technique.
2. There is no information available to reduce scarp ratio without applying any techniques or methods.

IV. STATEMENT OF PROBLEM

During shear cut operation, the billet is cut at its head and tail ends to eliminate alligatoring defect. For this, a length of 10 inches has been specified to be cut at both the end of the billet. When a sample of 30 rods was measured, it was found that in all the billets in the sample, an excess length of 6 - 12 inches was cut at both the ends. Due to excess cut, the scrap of 450ton/month is generated, which is very high. Also, the required number of bars is not being produced. After finishing mill operation, a sample of 1 meter TMT re-bar is checked for its weight, which should adhere to BIS. The billets size is 130*130 sq.mm & 9 meter long in length. Amongst these different section sizes from 6mm to 40mm diameter bars are not manufactured at required billet size. The excess cut that happens during shear cut operation coupled with the selection of wrong billet size, which becomes visible during finishing mill, leads to the generation of random bars. The overall scarp generated is 5.5 % per month.

Scope of the work: The literature mentioned above and the findings depicts that the scope of the work is confined to the following:-

1. This work aims to reduce the scrap ratio generated in reinforced TMT bars.

2. To increase the production by decreasing scarp ratio.

Objective of this work: The objective is to reduce Scrap Reduction in TMT Reinforced Bar Production

Which would the following:-

1. Reduce the scrap generated during the TMT re-bar production.

2. Determine the right size billet selection, to minimize the scrap during the cutting operation.

V. CONCLUSION

As per above study of literature's the different types of scrap produced in the TMT bar production were affecting productivity which leads to increase in cost production of TMT. Accordingly, the work had been carried out by collecting the data and analysing it, different methodology is used for different scrap generation such as lean manufacturing concepts and lean techniques methods like MUDA.

VI. REFERENCES

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