

Study of Rolling Mill Defects: A Survey Approach

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Abstract—Hot Rolling is the process of plastically deforming metal by passing it between rolls. The metal is subjected to high compressive stresses as a result of the friction between the rolls and the rolling process metal surface. This is one of the most widely used process among all the metal working process because it's higher productivity and low cost. It generates large surface area and therefore is useful for mass production of flat as well as shaped steel products. Defects on the surface of steel plates are one of the most important factors affecting the quality of steel plates. This paper presents the different types of rolling defects occurred in hot rolled steel plates.

Keywords: *Rolling, Rolling Defects, Steel plates, Production, Quality*

I. Introduction

Due to economic globalization, industry is facing severe competitors. To get success in this environment, the industry must significantly improve productivity and quality and reduce defect less product and waste during production. In addition to economic consideration requirement also strongly derive steel industry toward that direction therefore, there is an urgent need from steel industry for effective process quality control. Since the rolling operation is often the last process step of raw materials of several products, hence the scrap from defects at rolling stage is very costly and the quality control of rolling process has a vital role. Manufacturer should have maintained zero defects so that their products should not be rejected in the global market. Besides, we should also keep in mind that manufacturing should not have any negative impact on our environment. No one can rule out the global opportunities which are knocking the doors of Indian entrepreneur must have to achieve manufacturing excellence and have to carefully work upon competitive enhancement for their respective business. Any defect to major loss in terms of money and sometimes major accidents also.

II. Literature Survey

P. S. Chauhan and C. M. Agrawal B presented the "A Case Study of the Effectiveness of Rolling Process to Manufacture the Strip of Leaf Spring". Hot rolling is the key process that converts cast or semi-finished steel into finished products. Since the rolling operation is very costly, hence quality control of rolling process is essential. The raw material of leaf spring i.e. strip of SUP 11 is manufactured with hot rolling process. For proper functioning of the process and minimization of the defects in the final process which leads to minimization of defects in the final product. Different defects have been taken into consideration by using Brain

Storming, Cause and Effect diagram, Pareto analysis, problem solving session etc. to diagnose the root cause of the defect and accordingly corrective measures have been suggested [3]. Pawan Kumar Rai, Dr. Aas Mohammad, Hasan Zakir Jafri presented the "Causes & Prevention of Defects (Burr) In Sheet Metal Component". In this paper Burr formation is common sheet metal defect and Burr control / deburring is an important issue for industrialist and engineers. It is produced in all shearing & cutting operations. In sheet metal parts burr is usual but after a specified limit it takes a form of defect. This leads to rework and quality problem of part. So controlling this defect is the issue of quality as well so a study of all relevant factors is done in this paper, individually. This paper describes that what the possible causes are & how can we prevent it [4]. Heena Sharma, Dr. N.M. Suri presented the "Implementation of Quality Control Tools and Techniques in Manufacturing Industry for Process Improvement". This study is to apply Quality control tools in production process to reducing the rejection and rework by identifying where highest rejection occur at and to go give suggestions for improvement. This study is conducted from one of the Leading Manufacturing industries in Noida which manufactures Low voltage Panel board products. It has been founded that the company has many problems especially there is highly rejection and rework in the production processing lines. There is a various process parameters such as Punching, Bending, welding, grinding, Painting, Assembly and wiring process etc. which have influence of the quality of final products have to be controlled in order to reduce the wastage and also there have been observed a need of improvement by using the quality control tools [5]. Ranjan Prakash, Baidya Nath Roy presented the "Quality Improvement in Finished Cold Rolled Sheet by reducing the defect" Cold rolling improves the surface finish and holds tighter tolerances. This will certainly affect the quality of product in terms of high production, since they are critical. This will also increase the product evolution in the opened market. Better coordination among quality and production will help in achieving greater efficiency to produce high quality cold rolled sheet. Manufacturer should have maintained zero defects so that their products should not be rejected in the global market. Besides, we should also keep in mind that manufacturing should not have any negative impact on our environment. Any defect in the material may result rejection of final product that leads to major loss in terms of money and sometimes major accidents also [7]. Jozef Hrabovský, Michal Pohanka, Pil Jong Lee, Jong Hoon Kang presented the "Experimental and numerical study of Hot-Steel-Plate flatness". The analyses presented in this paper focused on the study of non-homogeneous cooling and its impact on the deformation of a steel plate. Several numerical models of steel plates were prepared. The first model computed time dependent temperature fields. Plant measurements were simulated using this model. The results obtained from the simulation agree with data obtained during the plant measurements. The second numerical model focused on the cooling process of the steel plate and the impact of thermal fields on the final deformations of the steel plate. The FE simulation of the cooling process showed the impact of the non-homogeneity in the thermal field on the final deformations. The simulations confirmed that the plate is bent towards the side with the higher cooling intensity in the initial cooling stage; however, in the later stages, the plate is bent towards the opposite side, with the lower cooling intensity [8].

III. Rolling

Rolling is a forming operation where the metal is compressed between two rotating rolls for reducing its cross-sectional area. The reduction that can be achieved with a given set of rolls which is called rolling stand. This is one of the most widely used processes among all the metal working process, because of its higher productivity and low cost [1]. Rolling would be able to produce component having constant cross section throughout its length many shapes such as plate I, T, L and channel section are possible [2]. Rolling which accounts for about 90% of all materials produced by metal working process, was first developed in the late 1500's [1]. The basic operation is flat rolling or simple rolling where the rolled products are flat, plate or sheet. Two types of rolling like hot rolling and cold rolling of the metals are affecting the process of forming. In this work the various parameters which affect

the hot rolling process are being included and analyses [6]. Hot Rolling is the process of plastically deforming metal by passing it between rolls. The metal is subjected to high compressive stresses as results of the friction between the rolls and the rolling metal surface. The initial breakdown of slab in to plates and sheets is generally done by hot rolling. The need for the project was realized a large percentage of mill capacity is lost due to production of scrap. The financial loss associated with this waste of resources necessitates the adoption of process improvements in the mill. The basic operation is flat rolling or simple rolling, where the rolled products are flat, plate or sheet (Fig. 1).

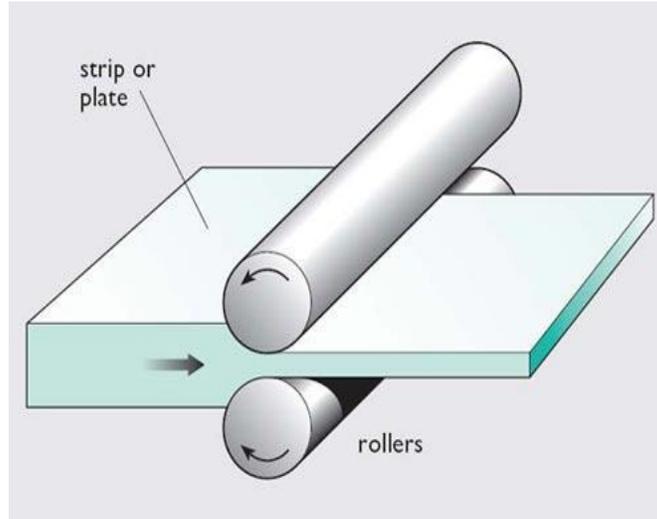


Fig. Error! No text of specified style in document. Principle of Rolling

IV. Types of Rolling Mill Defects:

The different types of the rolling mill defects are expressed in below:

A. *Edge Wave (EWV)*

If rolls are elastically deflected, the rolled plates become thin along the edge, whereas at centre the thickness is higher. Similarly, deflected rolls results in longer edges than the centre. Edges of the plate elongated more than the centre. Due to continuity of the plate, the centre is subjected to tension while edges are subjected to compression. This leads to waviness along edges.

Causes-Sudden stoppage of mill, Poor temperature of metal, Warpage due to excessive cooling and uneven elongation of the plates.

Remedy-Sufficient temperature of metal, Optimum mill scheduling.

B. Non-Trimming Allowance (NTA)

When the plates are rolled with less trimming allowance (short width), trimming cannot be done.

Causes-Nonuse of vertical stand, Rolling of half cold slabs.

Remedy- Avoid rolling of half cold slabs.

C. Short Length Slab (SLS)

Proper dimension of plate not obtained due to short length of slab at initial stage.

Causes-Deviation in dimension of slab at initial stage

Remedy- Proper cutting of slab size.

D. Thickness (THK)

If the plates could not be rolled in ordered thickness then it is called thickness variation. Lateral variation is observed on the plate surface.

Causes-Wrong draft schedule, Un soaked slabs.

Remedy- Proper soaking of slabs.

E. Mechanical Defect due to Mill (MDM)

Any significant deep impression over the slab surface will create MDM defect over the plate in the process of rolling. The deep impression may be present on the slab or is generated in the process of charging, discharging or the rolling of the slab. It appears on bottom and top surface.

Causes-Furnace charging dry skids, furnace slots, slab extractor fingers, foreign body particles, roughing & finishing balancing beam shoes.

Remedy- Regular cleaning and proper maintenance of rolling stands.

F. Short Length due to Mill (SLM)

Due to unequal cutting of plate by operator or may be tool faulty cutting short length of plate obtained.

Causes- Unequal size of slab.

Remedy-Maintain the rigidity of cutting stand

G. Equipment Diversion (ED)

Machines and set of tools are not working in proper direction of use. It deviate plates from their actual profile.

Causes- Poor maintenance of equipments.

Remedy-Proper scheduling of maintenance.

H. Width (WID)

If the plate could not roll in ordered width then it is called width variation. Over width and short width is observed on the plate surface.

Causes- Improper rolling of plate.

Remedy-Optimum mill scheduling

I. Rolling Mark (RIM)

These are surface marking, elevation or depression on the surface of plates occurring in rolling and attributable to defective roll or roller surface.

Causes-Cracks on roll surface or foreign metallic pieces welded to peripheral surface of rolls.

Remedy-Surface irregularities on the roll surface are rectified by grinding.

J. Shearing (SHEAR)

Blunt shear edges, improper blade gap may lead to poor shearing or step cutting. Plates with serve segregation may give a torn like appearance of the sheared edges. Trimming chips if stay on the plate edges may get embedded in the plate and dent the affected area on removal.

Causes-Improper horizontal and vertical gap of shear blades.

Remedy-Maintain proper gap of shear blades.

K. Roll Scale Pit (RSP)

Appear as rough pitting marks on rolled surface varying in shape, thickness and frequency from small spots to patch like surface.

Causes-Sticky scale formation due to chemical composition.

Remedy-Effective descaling from the rolling stock before rolling and processing.

L. Mechanical Defect due to Finishing (MDF)

During finishing of plate, mechanical defects like scratches, shoe mark due to rolling guide, foreign body etc. appear on rolled plate surface.

Causes- Shoe mark due to rolling guide.

Remedy-Prevention of rolling from foreign material.

M. Edge Crack (ECR)

While rolling the plates, tendency of lateral spread is opposed by transverse frictional forces resulting in inhomogeneous deformation. Edges of the plate are strained in tension leads to edge cracking.

Causes-Inhomogeneous deformation in thickness direction.

Remedy- Use of vertical edger.

N. Other (OTH)

Apart from above defects all rejected plates are categorised in this section.

Causes- Improper crown of the roll, Improper drafting schedule.

Remedy-Effective rolls cooling, good health of levelers.

V. Conclusion

The correct identification of the rolling defect at the initial stage is essential for taking remedial actions during the process, different defects occur either due to method, material, man, and equipment/machine. Defect may be occurred in plate mill during the slab casting, to follow reheat furnace. It is hereby also suggested that slab must be carefully checked for surface defect; length and their proper stock size. If any hidden defect lies within the slab, specimen should be cut down and should be investigated by Nondestructive test. Other defect which comes on product must also be taken care at rolling mill area, handling of the material and proper stacking of the product etc.

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REFERENCES

- [1] S. Kalpakjain and S.R. Schmid , Manufacturing Engineering and Technology , 4th ed. Dorling Kindersley Pvt. Ltd , pp. 340-341, 2011.
- [2] P.N.Rao, Manufacturing Technology, 2nd ed. Tata McGraw Hill, pp.240-241, 2008.
- [3] P. S. Chauhan, C. M. Agrawal. "A Case Study of the Effectiveness of Rolling Process to Manufacture the Strip of Leaf Spring." International Journal of Materials, Mechanics and Manufacturing 1, pp. 71-75, 2013.
- [4] Pawan Kumar Rai, Dr. Aas Mohammad, Hasan Zakir Jafri. "Causes & Prevention of Defects (Burr) In Sheet Metal Component." International Journal of Engineering Research and Applications, pp. 511-515, 2013.
- [5] Heena Sharma, Dr. N.M Suri. "Implementation of Quality Control Tools and Techniques in Manufacturing Industry for Process Improvement." International Research Journal of Engineering and Technology 4, no. 5, pp. 1581-1587, 2017.
- [6] Dr. Ravi Goyal, Anurag Joshi, Umesh Gurnani. "Review on Cold Rolling Mill Roll Deformation." International Journal of Science and Technology 1, pp. 83-95, 2017.
- [7] Ranjan Prakash, Baidya Nath Roy. "Quality Improvement in Finished Cold Rolled Sheet by reducing the defect." International Journal of Scientific & Engineering Research 7, no. 3, 2016.
- [8] Jozef Hrabovsky, Michal Pohanka, Pil Jong Lee, Jong Hoon Kang. "Experimental and Numerical study of hot-steel-plate Flatness." Materials and technology, pp. 17-21, 2016.