EQUIPMENT AND TECHNOLOGICAL OPTIMIZATION FOR PRODUCTIVITY IMPROVEMENT IN COLD ROLLING – AN OVERVIEW

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Abstract—Productivity improvement is a continuous process. Various advancement of technology and development of equipment have helped ‘Cold Rolling’ to evolve from basic model proposed by ‘Leonardo Da Vinci’ to the existing complex structure. This paper focuses on various new technologies and equipment developed for use in cold rolling. Productivity improvement can be done by using practices like ‘T.P.M.’ Application of advanced technologies like ‘Self Adaptive Control’ in ‘Auto Gauge Control’, Taguchi method, and Liquid Nitrogen as coolant will help in function of cold rolling. Equipment monitoring devices like ‘Online vibration’ and ‘Torque monitoring’ will help in monitoring health of cold rolling mill. Designing mills for wide application will help in increasing its utility. Use of this technique will help in improving productivity and quality of steel as well. Various process models for cold rolling mill have been studied through literature review.

Index Terms—Cold rolling mill, Productivity, Advanced technique, Equipments

I. INTRODUCTION

Rolling is a metal forming process, in which metal stock is passed through one or more pairs of roll arranged in single or multiple stand, either in one direction or two opposite to each other. Rolling is used to reduce thickness or make the thickness uniform. It is of two types Viz. Cold rolling That is carried below recrystallization temperature and Hot rolling that is carried above recrystallization temperature.

Cold rolling is used to further treat hot rolled sheet to increase its strength and its strength to weight ratio. Cold rolling provides tighter tolerance with smooth surface.

Productivity is a measure of how effectively Resources are managed to complete timely objective as stated in terms of quantity.

To considerate competitive strength in global market, many steel companies are engaged in maximizing productivity by application of modern equipment and technology, for diminishing losses and to fully use human, machine and material resources. There is always a need to maximize rolling mill utilization, to achieve profitability and significant cost associated with capital upgrades. The application of innovative rolling technology present he most attractive near term solution’s for many metal producers to improve quality and productivity.

II. LITERATURE REVIEW

[1] ChetanS.Sethia et.al. From India in their article on “ Case study on total productive maintenances in rolling mill “ states that “Total productive maintenance “ has been evolved to meet the new maintenance needs by keeping the equipment in top working condition, so as to avoid breakdown

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and delay in production. This will improve the productivity and efficiency of the equipment of the rolling mill by eliminating most of waste.”

Total Productive Maintenance is a proven tool and application of T.P.M. in cold rolling mill will have an positive impact on production and health of mill, likewise it will help in reducing unwanted breakdown.

[2] G.Plicht et.al. From Germany in an article titled “Cold rolling of metal strip using technical gases” Suggest that use of liquid nitrogen as a coolant in final or skin pass cold rolling to increase productivity by raising throughput, improving product quality and reducing rejection. Liquid nitrogen allows the rolling of thinner final strips, reduce required rolling force and improve strip flatness.

During rolling of thinner gauges the application of coolant is normal practice but has an limitation as there is increase in load in final pass, this will have an negative impact on profile of sheet, it is common observation that mostly the profile of sheet changes in final pass, also increase in load will increase the tendency of strip break in final pass, hence the use of some effective coolant like liquid nitrogen will solve the problem of increase in load and help in reducing strip breakages.


Traditional A.G.C. System is tuned once before its implementation, one standard program is run in system so as to control rolling, this stands good If conditions are identical everywhere. This is not the actual case where there is different working condition and different requirement of various product and market. Self adaptive control system will adjust independently to various working environment and will be more user friendly as compare to traditional A.G.C. System.

[4] G.Finstermann et.al. from Austria in their article “Latest equipment and technology highlights in endless cold rolling mills”, Proposes the use of modern technical solution like strip feeding and welding section, strip centering unit, guillotine shear, hydraulic gauge control, flying gauge change and on designing a mill stand capable of rolling both ultra-low carbon ultra-high carbon steel grades”. In this world of competition equipment with capacity of producing wider range of product will always be an added advantage, and added facilities like welding section, guillotine shear and flying gauge change will add to the productivity of mill.

[5] Stefan Dragomir et.al. From Romania in their article “Control process for cold rolling mill by vibration and torque” put forward two different systems to improve productivity. The first system is an online vibration monitoring system to control on-line sheet quality and mill maintenance in relation with diagnostic function. The second system is used to monitor the torque and to measure the mill parameters as well (the force, mill speed, gap between work rolls).

Any mechanical system stability and precision depends on the vibration in the system, monitoring the vibration of mill so as to keep an eye on equipment health will be helpful in maintaining gauge, and an standard operating practices of load, speed and gap between roll will help in improvement of quality and production only.

[6] Sang-ho lee et.al. from Korea in an article “Study on improved accuracy of strip profile using numerical formula model in continuous cold rolling with 6 high mills”, Developed the numerical model to improve the precision and convergence speed compared to existing numerical model.

Advanced model needed to be implemented but only point to be taken into consideration is that they need to be check up before use.
[7] Tetsuro Hashimoto et.al. from ‘ Nippon steel’ Japan in their article “Construction and operation of cold mill for stainless steel at hikari works” , Highlighted the realization of stable high speed rolling , high accuracy control function and installation of automation devices to improve productivity .

Increase in rolling speed will help to reduce the load and this will help in maintaining proper profile of the sheet.

[8] Tanehiro Kikkawa of ‘ JP Steel plant co.’ Japan writes in paper titled “New rolling method of reversing cold rolling mill “ , That in reversing cold rolling mill unrolled portion’s can be reduced using a leader strip and spot welding machine and thereby aims improvement of productivity.

Unrolled portion has been the main source of yield loss in reversible rolling mill such method will help in increasing the output and improvement of yield.

[9] Vivek Anil Vaidya from India in his article “Taguchi approach to optimize process parameters like entry tension , exit tension , rolling speed and roll bending pressure to improve productivity.

Optimizing parameter like entry and exit tension rolling speed and roll bending will bring uniformity in the product and quality.

[10] Vivek Anil Vaidya from India in his paper titled “Optimization of cold rolling mill process to improve productivity and product quality of steel – an overview” reduction of cold rolling.

Optimizing pass schedule will bring uniformity in rolling in spite of different operator and will help in smoothing of the process.

[11] Fumiyo sudo , Tetsuya Fuji in their Kawasaki steel technical report titled ”Progress in Technologival development during past 50 years at Kawasaki steel and future prospects” states that leading technologies like diagnosing and controlling system from a blast furnace, plain view pattern control in plate rolling , endless hot strip rolling , multipurpose continuous annealing , can lead to better productivity.

All the above process will provide a better input to cold rolling and as input will improve the output will automatically improve.

III. CONCLUSION

Development is a continuous process, various methods and aspects discussed in the paper are for development of equipment and technologies in cold rolling mill. These all different methods lead to one way that is productivity improvement in cold rolling.

- Planning and strictly following ‘T.P.M’ methods[1]for cold rolling discussed in paper will helps in reducing breakdown to a larger extent and will act as a boon for productivity improvement.
- Systems like online vibration monitoring and torque monitoring [7] Developed by author will helps in keeping an eye on mill working condition.
- Use of modern technical solutions like using leader strip, spot welding [4], plain view pattern control in plate rolling [2] will helps.

Some changes require less investment while some require heavy, But it will be the price paid for better and smarter cold rolling process.
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