THE INDIAN INSTITUTE OF METALS
DELHI CHAPTER

"MET-INFO"

INHOUSE PUBLICATION

ISSUE NO. 18 E-VERSION NOV / DEC 2020

K K Mehrotra-Chairman, Delhi Chapter
S C Suri-Editor-in-Chief (IIM-DC Newsletter)

For Private Circulation only

Contents of E-Version of this Issue

E - Version

Published By
The Indian Institute of Metals
Delhi Chapter
Jawahar Dhatu Bhawan
39, Tughlakabad Institutional Area
M B Road, Near Batra Hospital, New Delhi-110062
Tel: 011-21820057, 011-29955084
E-mail:iim.delhi@gmail.com
Website: iim-delhi.com

ISSUE NO. 18 E-VERSION NOV/DEC 2020

Executive Committee: 2020-21			
Name	**Designation**	**Mobile**	**Email**
Shri K K Mehrotra	Chairman	9968653355 9868112514	kishorekmehrotra@gmail.com
Shri A C R Das	Vice-Chairman	7678470803 9811330571	ajoycrdas@gmail.com
Shri N K Kakkar	Secretary	9871008505	nirmalkakkar@gmail.com
Shri N Vijayan	Treasurer	9818695690	technothermaindia@gmail.com
Dr. Ramen Datta	Joint Secretary	9958084110	dattaramen@gmail.com
Shri B D Jethra	Member	9818326878	jethra@yahoo.com
Shri S C Suri	Member	26949167 9650936736	scsuri.iimdc@gmail.com
Shri K L Mehrotra	Member	9810203544	klmehrotra48@gmail.com
Shri G I S Chauhan	Member	9717302437	gisc.delhi@gmail.com
Shri R K Vijayavergia	Member	9650155544	rkv.sail@gmail.com
Shri P N Shali	Member	9810708510	pnshali@gmail.com
Shri Deepak Jain	Member	9868640986	deepakjain@bis.org.in
Shri Manoranjan Ram	Member	9999303008	manoranjan.ram@paulwurth.com manoranjanram@yahoo.com
Dr. Mukesh Kumar	Member	9584032329	drmukeshkumar@gmail.com
Shri K R Krishnakumar	Member	9818277840	kuduvak059@gmail.com
Shri R K Narang	Member	9899298857	rknarang62@gmail.com
Dr. Rajesh Prasad	Member	9818538085	rajesh@iitd.ac.in
Shri B R Thukral	Special Invitee	9818563381	balwantthukral@gmail.com
Shri P K Chatterjee	Special Invitee	9210844819 9958228404	parijat.chatterjee@yahoo.com

Strip Flatness Control in Cold Rolling through Selective Work Roll Cooling

Abstract

In cold rolling process heat is generated due to friction and deformation at the roll bite. The generated heat is partially absorbed by the work roll through which the strip passes, causing localized, irregular and variable thermal expansion of work roll. Irregular and asymmetrical rolling loads across the work roll causes a non-uniform transverse temperature distribution. Hot zones on the roll lead to an increase in the roll diameter in those particular areas, changing the transverse profile and crowning of the roll barrel. When the heat affected roll profile (thermal profile) is transferred to the strip material, the profile and the flatness of the strip is immediately degraded. The change in strip flatness gets reflected as a deviation from the average longitudinal stress value across the strip width measured through shape-roll meter.

The thermal profile and crown is controlled by selective work roll cooling so as to minimize variable thermal expansion of work roll in transverse direction.

The paper highlights the various aspects of the state of the art selective roll cooling system, Selectospray® developed by Lechler. The Selectospray® system can be used in conjunction with any of the shape control systems currently available, the roll zoning being dimensioned to exactly match that of the shape metering roll involved.

Introduction

In the cold rolling process the most significant aspects are the generation of heat through friction and deformation in the roll bite. In a typical Cold Tandem Mill, work roll temperatures normally fall in the range of 55 – 70°C with strip recoil temperatures and inter-stand temperature rarely exceeding 160°C depending on product. Because of the current demands on rolling mills to produce much lighter exit gauges from increasingly thicker hot strip input, much greater reduction are required on individual mill stands. Such higher reductions at a nominal width result in a larger area of contact with correspondingly higher rolling forces, friction and heat generation. These high reduction schedules combined with the requirement to produce widening range of material cross-sections with a more diverse range of softer and harder materials also result in increasingly greater challenges in the control of roll temperature and the effective transfer / extraction of heat.

The heat generated is partially absorbed by the work rolls through which the strip passes. This causes localized, irregular and variable thermal expansion of the work rolls. The changing profile of the work rolls is transferred to the strip and if uncorrected this results in out of shape, non-flat sheet being produced with wavy edges and buckles.

Establishing a uniform homogenous cooling across the rolling width with a uniform and acceptable thermal distribution, without gradients, is the ultimate goal in terms of cooling to assure that the universal problem of post-cooled shape after recoil is minimized. Selective work roll cooling is an effective tool to meet the above objective. Selective work roll cooling helps in maintaining uniform, stable roll temperatures, circumferentially around the roll and transversally across the roll through precise controlled and metered cooling.

Heat Generation and Dissipation in Cold Rolling Process

The Area of Contact between the hard work roll surface and the softer steel strip surface (Fig. 1) is where friction is created, deformation occurs and heat is generated. The generated heat is transferred into both the strip and the roll in the roll bite.

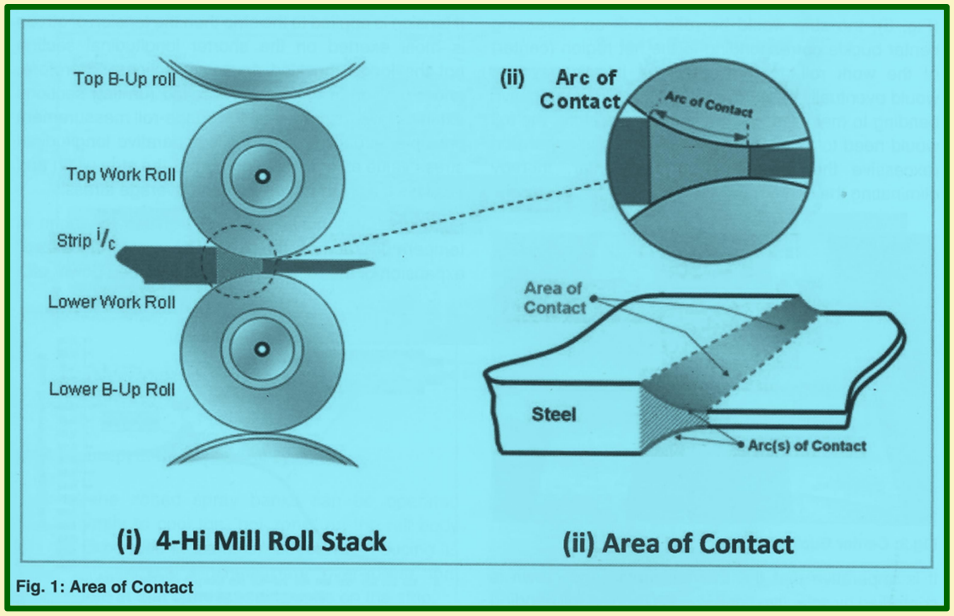


Fig. 1: Area of Contact

In the cold rolling process, where the area mass ratio is higher because the gauge is "thin", large proportion of the "strip heat" is lost to air with further losses to coolant wash-over. However, heat absorbed by the rotating roll is subject to a more complex thermal mechanism.

Heat will continuously migrate to cooler zones in and out of the roll body due to localized elevated temperatures in the area of contact (bite) and localized "chill zones" in the impingement areas of coolant sprays on the surface. This localized heat input/ output process results in a non-uniform distribution of heat (and temperature), circumferentially around the roll and transversely across the roll body (Fig. 2).

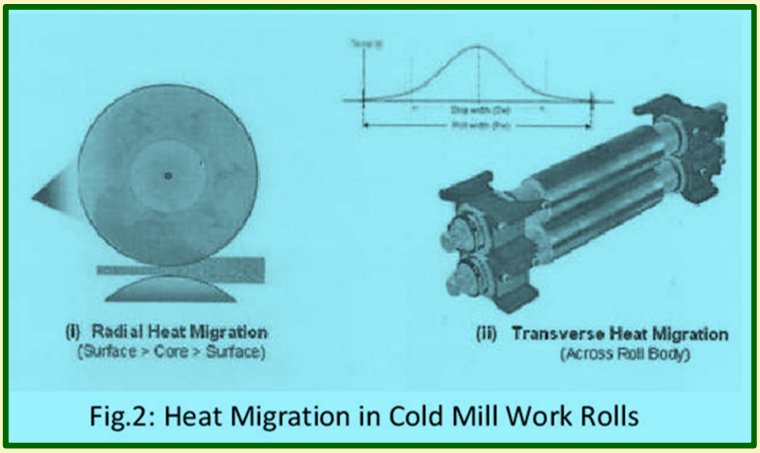


Fig.2: Heat Migration in Cold Mill Work Rolls

High reduction schedule combined with the requirement to produce a widening range of material cross sections and more varied range of softer and harder materials, results in increasingly greater challenges in control of roll temperature and the effective transfer / extraction of heat. Given the more diverse range of thermal conditions, it is important to install efficient and robust roll cooling systems that can establish both heat balance and controllable

thermal conditions around the work roll as well as across its width by controlled selective cooling and efficient heat transfer.

Strip Flatness Control and Selective Work Roll Cooling

Irregular and asymmetrical rolling loads across the work roll causes a non-uniform transverse temperature distribution. Hot zones on the roll lead to an increase in the roll diameter in those particular area, changing the transverse profile and crowing of the roll barrel. When the heat affected roll profile (thermal profile) is transferred to the strip material, the profile and the flatness of the strip is immediately degraded.

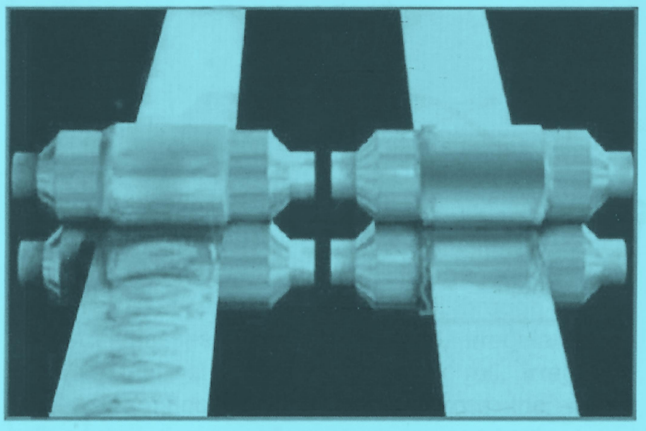


Fig.3: Center Buckled Strip

If the center of the roll is allowed to continue thermally expanding with insufficient or no coolant being applied (Fig. 3), the strip would be rolled with an increasing center buckle corresponding to the hot region (center) of the work roll. In this case, the bending system would eventually be unable to apply sufficient negative bending to maintain the strip shape. Therefore, the roll would need to be cooled to reduce thermal expansion (excessive thermal crown) in the center, thereby eliminating the center buckle (full shape in the strip).

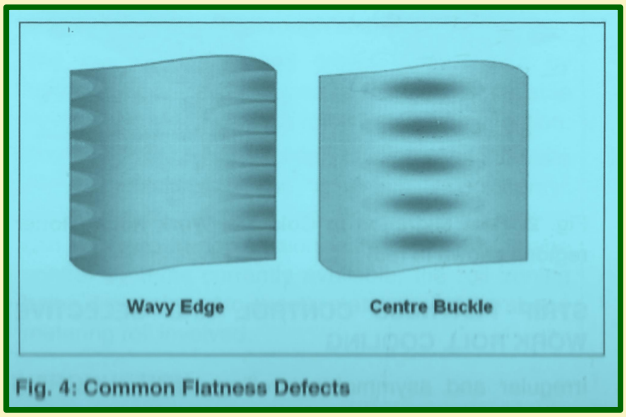


Fig. 4: Common Flatness Defects

It is imperative that the thermal profile and crown is controlled by selective cooling such that the roll bending remains “in range”.

Over-rolling the center of the strip will result in center buckle and conversely over-rolling the edges will result in waves at the edge of the strip (Fig. 4)

A localized thickness reduction on the strip produces a corresponding and proportional extension in strip length.

Physically a wave or buckle running through the length of the rolled strip results because the “un-flat” section has been reduced more (thinner) and is therefore “elongated more” and is constrained by the adjacent shorter sections.

If tension is applied to the strip then the tension or stress is most exerted on the shorter longitudinal section not the longer buckled or wavy sections. Therefore, under tension in the mill, over-rolled (un-flat) sections exhibit a lower stress, thus the shape-roll measurement principle actually records the comparative longitudinal stress value as a distribution across the strip width and displays it as a deviation from the average stress.

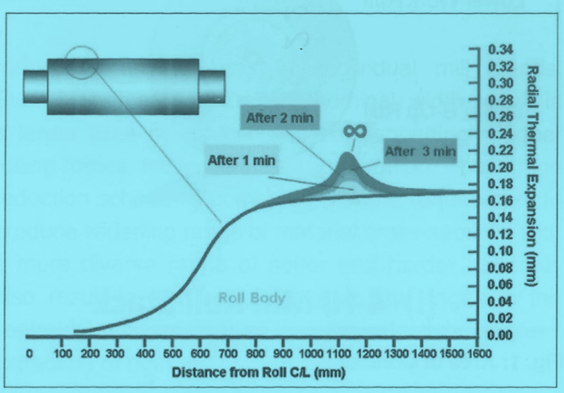


Fig. 5: Transient temperature changes in Work Roll

Fig. 5 illustrates how "localized" transient changes in temperatures across the roll body create "localized" expansion of the roll when a spray is turned down/ off.

The initial change is quite narrow and relatively fast on the roll but over time it grows in magnitude and area until a wave or buckle appears on the strip.

With such a condition evident, the relevant Shape-roll sensor would register a lower stress value in the strip corresponding to the affected (hotter) zone on the roll and initiate the coolant spray. Selective cooling – stress control systems automatically measures and correct these effects.

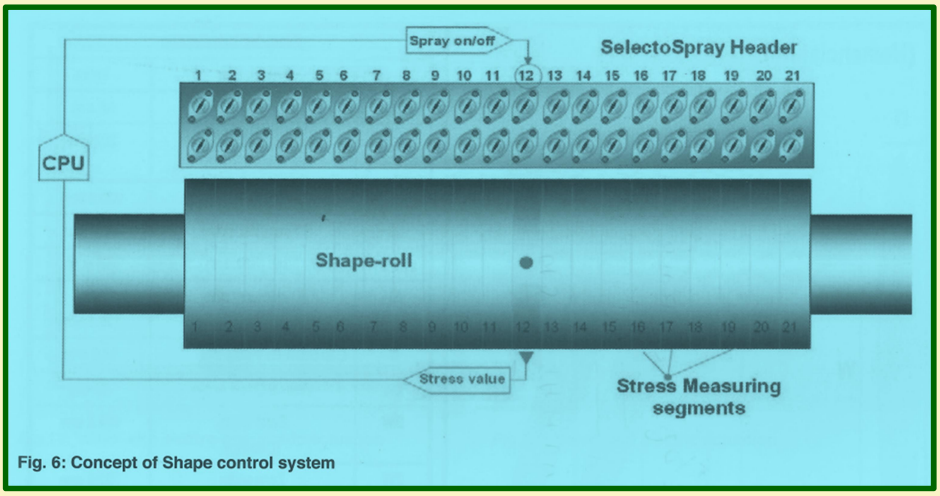


Fig. 6: Concept of Shape control system

The Selective cooling header is used in conjunction with a shape sensing device such as a Shape-roll, the Selective Roll Cooling configuration being dimensioned to exactly match the pitch of the shape metering roll segments (sensors).

To achieve controlled selective cooling, the work roll barrel is cooled by dedicated banks of spray nozzles uniformly spaced across its width precisely aligned to stress-measuring sensors (segments or rotors) on the shape roll (Fig. 6). Every nozzle and valve assembly is controlled by a solenoid valve receiving the electrical signal through an I/O unit from the shape meter control computer.

Each of the zoned spray banks can be operated independently to cool the "hot zone" on the roll body that has expanded in diameter, effectively reducing its actual diameter and eliminating the "over-rolling" that has resulted in that corresponding zone on the strip.

The Shape-roll comprises of an array of circular segments or rotors each housing several radial mounted stress measuring sensors; typically a 26mm or 52mm pitch measuring the stress across the strip width as the strip (under tension) passes over the Shape-roll.

Each coolant valve / nozzle (spray) is controlled by feedback from a corresponding stress sensor on the shape roll or any other shape control system.

Selectospray® Roll Cooling System for Strip Shape Control

To achieve precise cooling of work roll, Lechler developed SELECTOSPRAY® roll cooling system (Fig. 7), where the roll barrel is divided into zones, each of which has coolant precisely applied to it by MODULAX valve controlled spray nozzles. Each of the zonal sprays can be operated independently of others either manually by the operators through push button control, semi-automatically by a PLC or automatically (closed loop) in connection with a shape control system.

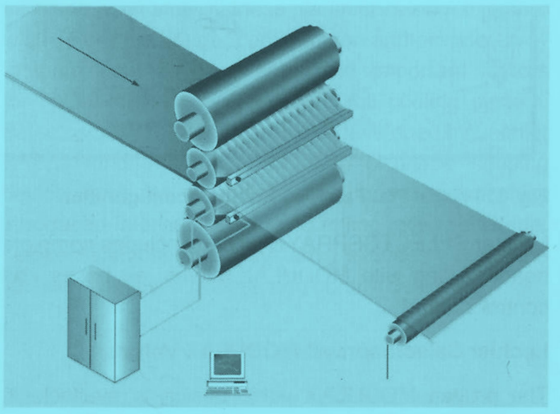
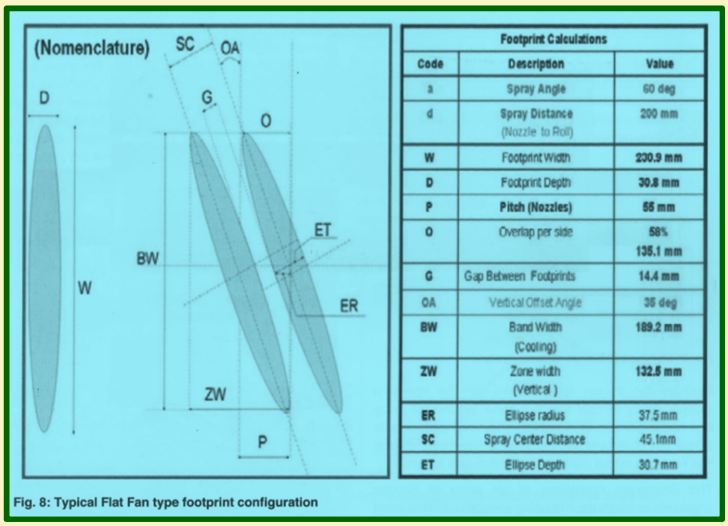


Fig. 7: Lechler SELECOSPRAY® roll cooling system

The SELECTOSPRAY® system can be used in conjunction with any of the shape control systems currently available, the roll zoning being dimensioned to exactly match the shape metering roll involved. Zone widths of both automated and manually controlled systems are available, widths in general use between 25 mm and 100 mm.



Footprint Calculations		
Code	Description	Value
a	Spray Angle	60 deg
d	Spray Distance (Nozzle to Roll)	200 mm
W	Footprint Width	230.9 mm
D	Footprint Depth	30.8 mm
P	Pitch (Nozzles)	65 mm
O	Overlap per side	58% 135.1 mm
G	Gap Between Footprints	14.4 mm
OA	Vertical Offset Angle	35 deg
BW	Band Width (Cooling)	189.2 mm
ZW	Zone width (Vertical)	132.5 mm
ER	Ellipse radius	37.5 mm
SC	Spray Center Distance	45.1mm
ET	Ellipse Depth	30.7 mm

Fig. 8: Typical Flat Fan type footprint configuration

For any roll cooling application it is important how the sprays impinge on the roll surface. An effective and precise footprint geometry (Fig. 8) is the fundamental requirement to establish a uniform cooling from top to bottom work rolls and transversely across the cooling area resulting in an optimal heat extraction across the spray cooling area

on the roll.
When designing a spray header Lechler arranges the sprays without interference or creating hot and cool bands in adjacent cooling zones. The nozzle flow rates and spray angles are taken into consideration besides the positions of the spray headers in the mill for the design of the optimal nozzle offset and impingement angles in order to obtain the best heat transfer.

Lechler SELECTOSPRAY® system includes complete header along with MODULAX valves, air hoses and control cabinet.

Lechler Selectospray® MODULAX Valves

The proven MODULAX valve design is available in three different versions:

- Pneumatically controlled with the solenoid in the control cabinet outside of the mill
- Electro-pneumatically with solenoid directly attached (DSA)
- Purely electrically controlled (EVA)

All the valve versions have very large coolant entry ports, are easily removable from the header front and are protected by the header itself. All valves carry self-aligning flat fan nozzles.

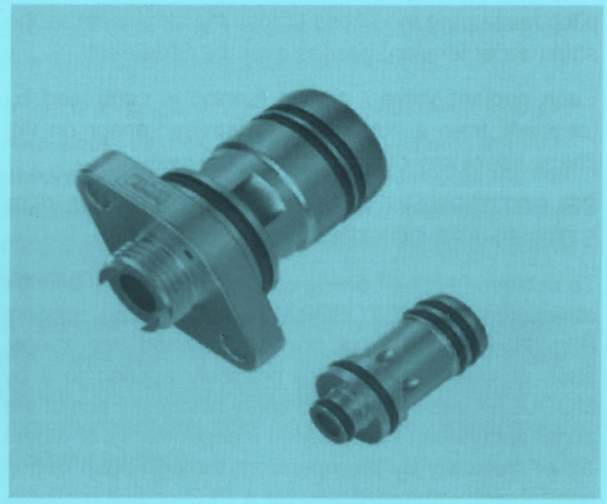


Fig. 9: Valve with pneumatic actuation

Pneumatic valve actuation

This valve (Fig. 9) is simple design and has only one moving part which is the piston. It uses standard shop air and has large internal free passages. Liquid to air pressure ratio is 2:1.

Fig.10: Valve with electro-pneumatic actuation

Electro-pneumatic valve actuation (DSA)

This valve (Fig. 10) has its own dedicated solenoid directly attached. Air for the pilot operation is fed by a single tube directly into the header and instantly available when the electric solenoid is activated. Solenoids can be supplied in either normally open or normally closed. It has shorter response time.

Electric valve actuation (EVA)

This valve (Fig. 11) has large orifice for laminar flow and a stable spray. This is used in rolling mills where inflammable rolling oil or kerosene is used as a coolant. It eliminates the need of compressed air.

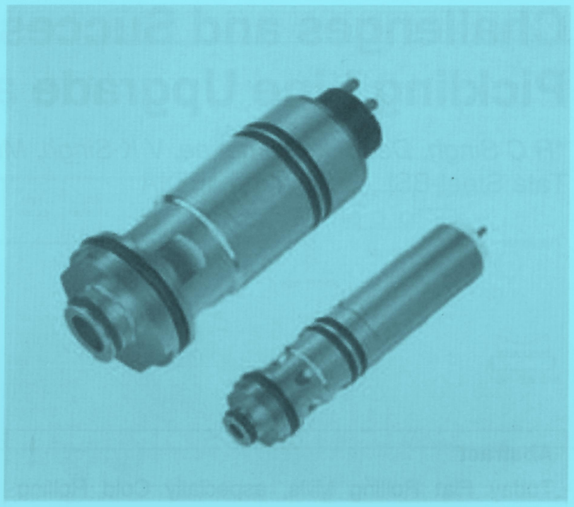


Fig. 11: Valve with electric actuation

Conclusion

Selective work roll cooling system is an effective tool for control of strip flatness variation along the strip width. Effective header configuration and precise spray footprint geometry are two most important factors for optimum design of selective roll cooling system. Selectospray® roll cooling system developed by Lechler which works in conjunction with a shape sensing device such as shape-roll has been successfully introduced in a number of cold rolling mills worldwide. LechlerSelectospray® system includes complete headers, valves, air hoses and control cabinet.

Source: Steel Tech

Challenges and Successes – A Case Study of Pickling Line Upgrade at Tata Steel-BSL

Abstract

Today Flat Rolling Mills, especially Cold Rolling Mill complexes are facing increased demand from customer with respect to high quality products, competitive prices and faster delivery. Also for the sustenance, rolling mills need to comply the stringent environment norms. In cold rolled finished products, both coated and un-coated, apart from internal quality, aesthetics is an important criterion for customer satisfaction. To meet these requirement, production units need upgrades at a regular interval. This paper describes about successes and challenges faced during upgrade of Pickling Line at Tata Steel-BSL, Sahibabad. This plant is operating in the heart of the city, hence complying environment norms is one of the mandatory compliance. Paper presented unique challenges faced during upgrade of old equipment set up, while maintaining the delivery compliances to the customers. Paper outlined the introduction of equipment/pickling line reasons behind the upgrades, detailing of work done and benefits made out from these upgrades. All these upgrades resulting into reduction in consumption of water, steam and energy and quality compliance of outer panels to automotive industries.

Introduction

In view of increasing demand/ expectations from customers for high quality finished products especially aesthetical products at competitive prices and stringent environmental compliances like water consumption, energy savings etc, a continuous pressure is exerting on the manufacturers to cater these requirements. Customer satisfaction can only be improved by meeting their requirement. Parallely, for the sustenance, environmental norms should be complied. This can only be done by modernization/ improvement/upgrading manufacturing units. In recent years, very significant progress has been made in pickling plant design and operation. The 1650 mm high production pickling lines are part of Tata Steel-BSL, located in the heart of the Sahibabad and surrounded by residential areas. These lines were supplied and commissioned by M/s HB-ESMECH in the year 1997. The last modernization project was conducted during the year of 2012, where the work related to addition of one un-coiler along with flattener cum pinch roll unit, one pickling tank (previously it was having 4-pickling tanks) and AC-drives for pl ant terminal equipment was done to enhance the line speed and production. But still problems with line like hot air dryer were existing. To overcome these challenges, upgradation project was taken in pickling line 1. These lines are used to pickle the HR coils made for OEM of automobile sector and appliances.

Pickling Line Details:	Basic Line Data:	Objectives of Project
▪ Number of Pickling Lines: 02 ▪ Year of Commissioning: 1997 ▪ Supplier: M/s HB-ESMECH ▪ Type: Push-Pull Type ▪ Line Direction: Left – Right ▪ Line Speed: 120 mpm ▪ Threading Speed: 0-25 mpm ▪ Un-coiler ▪ Acid Tank ▪ Rinse Tank ▪ Hot Air Dryer ▪ Recoiler ▪ Edge guide system ▪ Coil car at exit	▪ Strip Thickness: 1.6 mm to 6 mm ▪ Strip Width: 800 mm to 1650 mm ▪ Raw Material: Hot Rolled Coils	The main objective of line upgrade: ▪ To increase the line speed from 100 mpm to 120 mpm ▪ To decrease the steam, energy and water consumption ▪ To increase the plant availability ▪ To achieve better coil presentation and quality

Scope of line equipment upgrade

- Uncoiler-2 peeler table, which was installed in 1997, was in bad condition and got deteriorated over the years of running, resulting in large break down hours and repairing cost.

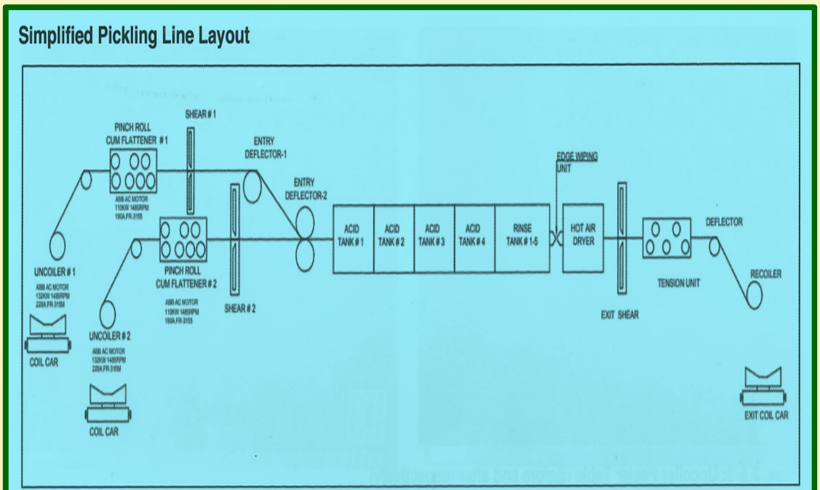


Fig. 1: Layout of Pickling Line

- Squeeze rolls which makes in-feed of HR-Coils into the pickling tanks are very vital in push-pull type pickling line. Constant speed and torque from existing hydraulic motor driven squeeze roll were creating speed limitations, threading delays, mechanical break downs, hydraulic motor and clutches failures.

- Pickling tanks are the most vital part of pickling process. Considering hot dip acid pickling, deterioration in long run is very normal feature. Over the years granite stones were worn-out, resulting in tank leakages at multiple locations, which led to environmental hazard, low speed line running, poor quality and reduced product output.

- After pickling process rinse holding tanks are playing major role in maintaining the quality of surface cleaning of pickled HR-Coils. Existing design of rinse holding tanks were rubber lined metallic type with brick linings. Over the years rubber lining of these tanks got worn-out.

- Hot air dryer used to dry the final product of pickling line. Existing dryer was of poor efficiency and consuming more steam whereas delivering less heat on pickled HR-Strip. Due to this poor drying was taking place, which ultimately reducing the line speed.

- Exit coil car is used for removing finished pickled coil from re-coiler mandrel, and is playing vital role in safe movement of finished coil transfer to Rolling mills. Existing coil car was of weak-design and low capacity. During transverse movement of coil car, same was shaking and many a times hitting extreme end stoppers, resulting in equipment damage and unsafe conditions for material handling.

- This pickling line was running with single fume exhaust system, which is connected to all

pickling tanks, rinse tanks, holding tanks. In rinse section, more amount of steam vapours are getting generate due to high pressure spray of hot water. Our existing fume exhaust system was not able to handle these fumes of rinse section. The high amount of steam vapours/fumes were going in open atmosphere and polluting the air environment.

Project

Planning Activities and Vendor Selection

Project planning was started with the detailed study of existing systems and procedures; accordingly, requirements were laid down. Project activity started with the planning, execution and approval of capital expenditure schemes. After approval of capital expenditure program, Gantt chart was prepared with all considerations. Vendor selection was done based on their expertise, technical skill mapping, execution compliance and work efficiencies. Better environmental conditions for working teams was ensured. Entire activities were carried out safely and maintaining the delivery compliance with customers. Modernization was carried out parallely in different teams covering all aspects of safety, procurement, mechanical, quality and electrical.

Un-coiler 2 Peeler Table

Challenge

Condition of Uncoiler-2 Peeler table, which was installed in 1997, was not good, as it got deteriorated over the years of running, resulting in frequent break downs and high repairing cost (Fig. 2). There were some design issues with Peeler table, as it's up-down mechanism was having only one cylinder at center, which resulted into cantilever load.

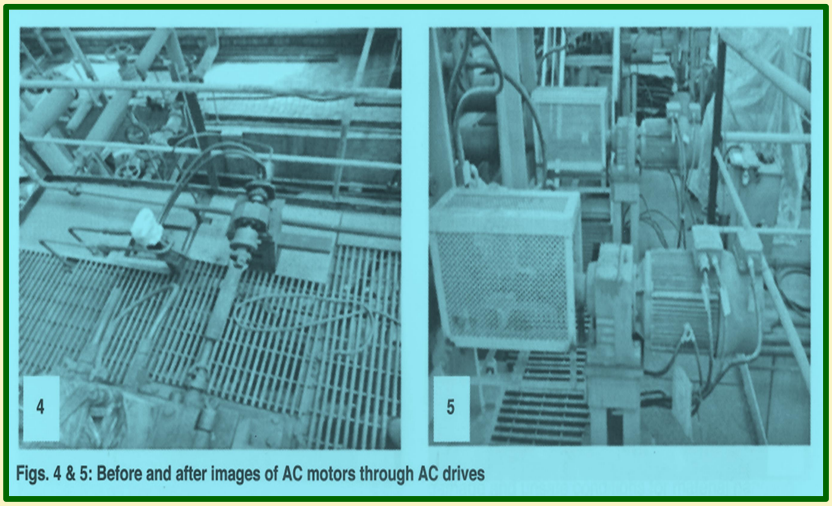
Figs. 2 & 3: Uncoiler Peeler Table (Before and after respectively)

Upgrade

To overcome these issues, two numbers of hydraulic cylinder for up and down operation of table were provided (Fig. 3).

Squeeze Roll Drive Motor (AC) for Pickling Tanks

Challenge


Figs. 4 & 5: Before and after images of AC motors through AC drives

Squeeze rolls which makes infeed of HR-Coils into the pickling tanks are very vital in push-pull type pickling line. Constant speed and torque from existing hydraulic motor driven squeeze roll were creating speed limitations, threading delays, mechanical break downs, failure of hydraulic motor and clutches. Pickling tanks threading problem occurred frequently due to distance of 13.4 meters between two squeeze rolls, which required high torque during threading. Squeeze rolls were driven by hydraulic motor (OMP-315) which was running at fixed speed and low torque (Fig. 4). These squeeze rolls got deteriorated within one or two months period and generating problem in threading process. Squeeze rolls rubber also got damaged due to surface speed mismatch with strip, which was a major loss for this pickling process.

Upgrade

New geared AC-motor with AC-drives are installed (Fig. 5). These new drive mechanisms eliminated the existing mechanical components like over-running clutch, hydraulic motor, hydraulic pipe line etc. In this new system, speed synchronization with threading speed is available. It eliminated the chances of reducing torque and mismatch of speed of squeeze roll and strip surface (1).

Multiple benefits achieved in upgradation of drives of squeeze rolls:

- No threading delay due to drive mechanism.
- No squeeze rolls rubber damage due to drive mechanism.
- Less maintenance cost (Geared motor having long life with respect to hydraulic motors)
- Energy savings due to the use of VVVF drives for geared motors.

- Improved strip surface (no mismatch of speed of squeeze rolls and strip surface)

- Power Flex 753 AC Drives are amongst the best Drives, which installed to drive inverter duty AC motors, which are further used to drive the Squeeze Rolls of the line (Fig. 6). These Drives are capable to deliver very high Torque to the geared AC motors during threading of HR coil into the pickling tanks. During threading mode, these are in torque mode but during running these become idle; hence saving energy, less failure and ease of plant operation.

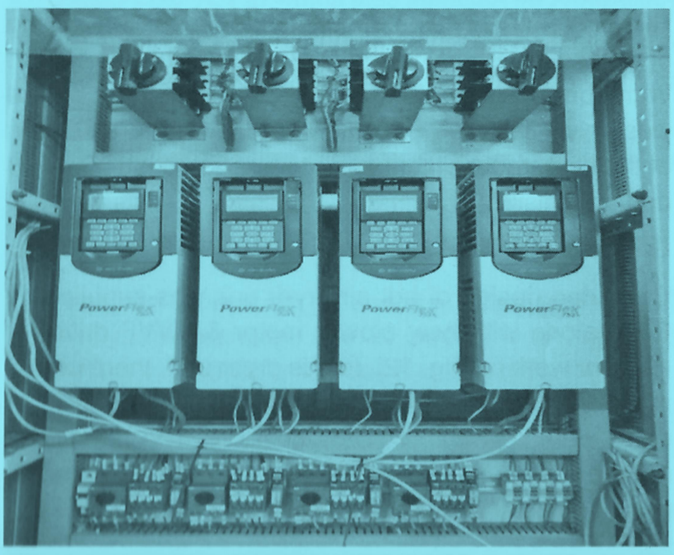
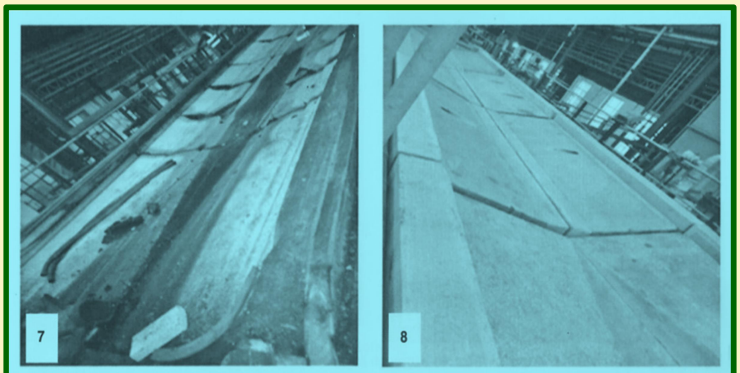


Fig. 6: Image shows PF753AC drives, installed for Squeeze Roll motors inside the drive panel

Acid Tanks along with FRP Piping

Challenge

Pickling acid tanks are the most vital part of pickling process. Hot acid pickling tanks deterioration in long run is very normal feature. Over the years granite stones were getting worn out (Fig. 7). Resulting in tank leakages at multiple location. These leakages created unsafe surrounding, environmental hazard, low line speed, poor quality and reduced product output. During strip threading process head end of strip guided with granite blocks inside the pickling tanks. With passage of time and increased production, deep groove marks formed on these granite blocks. These grooves were generating restriction to feed the strip. Many a times at particular width, strip got stuck-up in these grooves, which rectified by keeping the strip off center. All circulation FRP piping were got deteriorated over the time.



Figs. 7 & 8: Before and after images of acid tanks

Upgrade

Pickling process tanks number – 2,3,4 were changed along with granite blocks and complete circulation piping (Fig. 8)

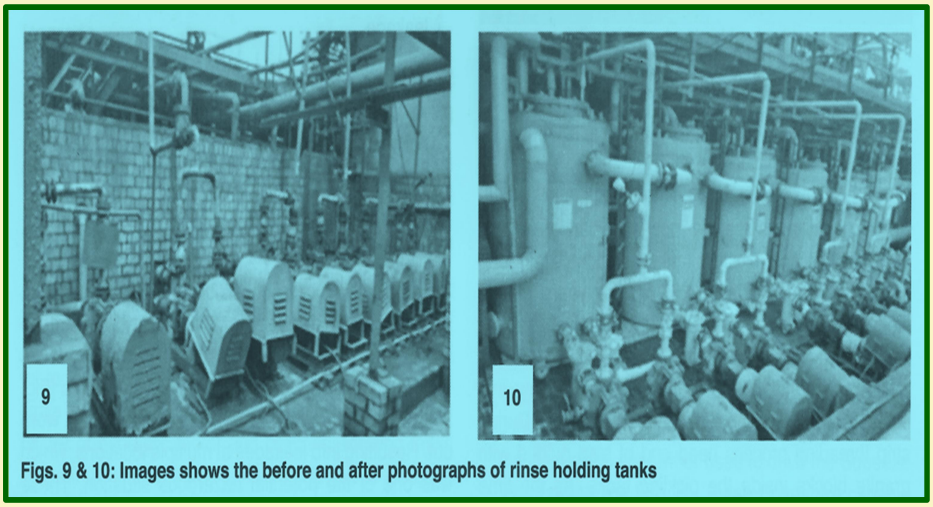
Major benefits of this upgrade:

- Smooth threading of strip in proper center position.
- These new granite blocks are interchangeable liner type design, which can be changed when groove formed in long run. These can be changed by just changing the liner caps.
- Improved environmental conditions due to no acid leakage.
- Sustainability improvement
- Increased plant availability

Cascading Type Rinse Holding Tanks along with FRP Piping

Challenge

After pickling process rinse holding tanks are playing major role in maintaining the quality of surface requirements. Existing design of rinse holding tanks were rubber lined metallic type with brick linings (Fig. 9). Over the years rubber lining of these tanks got worn out. Resulting into leakages at multiple locations, which was one of the potential hazardous situation. These leakages also increasing the water wastage, poor pickling and reduced product output.



Figs. 9 & 10: Images shows the before and after photographs of rinse holding tanks

Upgrade

Above challenges are tackled by modifying the existing design. In this new design, there are separate FRP tanks (Fig. 10). Process tank and holding tanks are interconnected through cascading method. Benefits of cascading system are as follows.

- Lesser chance of bath disturbance as cascading level are perfectly maintained.
- Lesser water spillage
- Lesser fume extraction; which is environment friendly
- Reduction in water consumption (from 1100 – 1200LPH to 500 – 700LPH)

Hot air dryer unit

Challenge

Existing dryer was of poor efficiency and consuming more steam; whereas delivering less heat on pickled HR-Strip (Fig. 11). This resulted into insufficient drying of strip surface, which ultimately reduced the line speed. With 3 bar of steam pressure, air temperature achieved was only 92 degree Celsius; whereas for proper drying of the strip, requirement of air temperature is 100 ~ 110 degree Celsius.

Upgrade

Upgraded design of hot air dryer unit was supplied by OEM along with new blower motor & VVVF drive for efficient working (Fig. 12). In this dryer unit, there are 05 numbers of chevron headers whereas in previous dryer there were only 02 numbers headers. The higher the number of headers, more uniform and efficient working can be done.

Figs. 11 & 12: Old and new design of hot air dryer

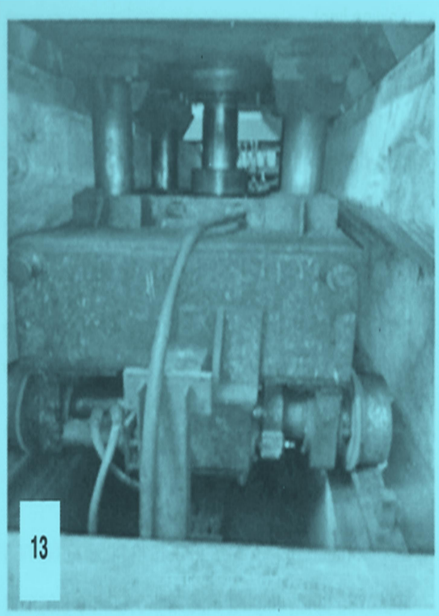
Benefits are as follows,

- Reduction in steam consumption
- Better heat output (Delivering Air temp of 138 degree Celsius at 2 bar steam pressure)
- No water carryover at high speed of line
- Power Flex 753 AC drive was installed for controlling the motor speed of the dryer blower unit. It has saved around 40% of energy without affecting the efficiency of the blower unit.

Exit Coil Car with Dual Speed Transverse Mechanism

Challenge

Exit coil car is used for removing finished pickled coil from re-coiler mandrel, and is playing a vital role in safe movement of finished coil transfer to rolling mills. Existing coil car was of weak-design and of low capacity (Fig. 13). During transverse movement of coil car, same was vibrating due to insufficient load and many a times hitting extreme end stoppers, resulting in equipment damage and unsafe conditions for material handling.



Figs. 13 & 14: Images of exit coil car before and after of upgradation

Upgrade

Guide rod diameter of coil car changed to 240 mm instead of previous 120 mm. It has increased its load bearing capacity. This is heavy duty coil car for 35 MT load capacity (Fig. 14). In its traverse mechanism, dual speed operation has been incorporated. At extreme ends before 300mm distance, coil car speed is getting slow down and before 100 mm from stoppers it will stop. This safety feature added in this upgrade.

In this up gradation we achieve multiple benefits as follows.

- Reduced break down
- Safe material transfer
- Low maintenance cost

Fume Exhaust System Dedicate to Rinse Section

Challenge

Pickling line-1 was running with single fume exhaust system, which was connected to all pickling tanks, rinse tanks and holding tanks. In rinse section, steam vapors are getting generated due to high pressure spray of hot water (Fig. 15). Existing fume exhaust system was not able to take out these fumes and steams from the rinse section. It resulted in exhaustion of high amount of steam vapors/fumes in open atmosphere and air pollution. These acid fumes corrode the surrounding structures and equipment.

15 16

Figs. 15 & 16: Before and after images of rinse tank. Steam along with acid fumes are shown above rinse tank before upgradation

Upgrade

Fume exhaust system is majorly benefiting to the environmental conditions (Fig. 16). Other multiple benefits are as under:

- Better working environment (less acid fumes generation).
- Improved life for surrounding equipment like pneumatic cylinders, roll chocks, square roll stand, structures, shed etc.

Conclusion

Modernization or major upgrade in existing production line is one of the biggest challenge, while maintaining the delivery compliances to customer. Tata Steel BSL, Sahibabad has successfully modernized an old pickling line. These modernizations not only improve the customer satisfaction but also helped in improving the environmental compliances. One of the major milestone of this project was completion under the allocated budget.

Safety

Project was executed with all safety measures and completed within the target date with no injury or process incident.

Environmental Benefits

With the design change in rinsing section and addition of fume scrubbing, all operating parameters related to environment are well below the norms. Major benefits of this project with respect to environment are:

- Reduction in water consumption by 500 Litre per hour. It has a huge impact on usage of water. Since water is scarce. This project will save around 3885 kilo litres of water per year.
- Reduction in steam consumption by 30% (6926 cubic meter to 2077 cubic meter).
- Reduction in energy consumption by 40% (for pickling line).
- Reduction in acid fume generation.

Quality Achievements

- Upgraded pickling line will enhance the surface quality/characteristics of HR coil meant for outer panel (skin panels) application in automotive industry. Line is modified in such a way that no over/under pickling done or scratches generated due to differential surface speed of strip and brush rolls.
- Incorporation of Flat Nozzle Jets in rinse tanks has improved spray impact thus improved the cleaning level. Water carry over is minimized.

Acknowledgement

Authors are thankful to Tata Steel BSL for allowing us to publish this paper. Special thanks to Jitendra Mathur for supporting us in writing the paper and entire team of project and supporting agencies, without their contribution and support, this project would not possible.

Source: Steel Tech

Q-Coating Mass Control to Reduce Zinc Consumption in HDG Lines

The longstanding and intensive competition in the galvanized strip market has required producers to seek tangible reductions of production costs. Reducing zinc consumption is one of the most important parameters that can be used to reduce production costs in hot-dip galvanizing lines, as well as to reach customers' increasingly stringent quality demands.

Tight tolerances and stable performances in the distribution of coating along the strip profile are becoming more critical for the success of our customers worldwide. In addition, off-specification lengths during transitions in production must be minimized as much as possible.

In pursuit of controlling zinc volume and coating cost, Danieli further enhanced its X-Jet air-knives equipment, already well known in the market for its sound wiping performance, by developing the Q-Coating Mass Control (Q-CMC^2), a new closed-loop coating weight control. Uniform coating over the length of a coil (Sigma value less than 1%), reduced operator intervention (pressure control is fully automatic), and zinc consumption savings (coating transition length in one control step and low sigma, reducing over coating) are the key achievements of the Q-CMC. The core of the system is a Machine Learning algorithm capable of predicting the requested wiping parameters for a desired coating, and a final tuning of process parameters based on feedback from a coating gauge. In most hot-dip galvanizing lines the coating-weight gauge is installed tens of meters downstream of the pot area, with consequent delay in providing the feedback relevant to the actual coating weight on the strip being processed. The predicting capability of Q-CMC^2 grants quick and precise transitions from one coil to another, working in an open loop because no feedback is available yet about the actual coating.

Q-CMC^2 System Highlights:

- Coating Sigma <1%
- Quick Coil Transition
- High Transversal Accuracy
- Wiping Parameters Predicting
- 1-T/Day of Zinc Saving
- ROI 6 Month or Faster

On the other hand, once the coating-weight gauge provides feedback to the system, Q-CMC^2 fine tunes the air-wiping equipment for optimal coating uniformity and very tight coating tolerances. Q-CMC^2 has a data-driven approach in order to take into account the peculiarities

of each line, in terms of process response versus change of parameters. The new control system is designed to be fully integrated with DES (Danieli Electromagnetic Stabilizer) to further improve the transversal coating accuracy.

Danieli has installed and commissioned the Q-CMC^2 on lines in Europe and Middle East with excellent results. This was possible thanks to the solid business cooperation developed with customers, and to Danieli's strong passion for and commitment to providing a tool capable of achieving a step change in operating cost reduction. Thanks to the outstanding results in Zinc savings at the plants where the Q-CMC^2 system has been installed, an average return of the investment in less than six months is projected.

Source: Steel Tech

Flexible Tinplate Complex Starts for JSW Tarapur, India

Introduction

Tinplate is used in the packaging industry mainly for its excellent corrosion protection, appearance, strength, light weight, formability and resistance to corrosion by organic substances, dilute acids, bases and salts. It is a reliable alternative to the use of plastic for food packing. The Tin Plate/Tin Free Steel project implemented at JSW Tarapur (Maharashtra) started with the commissioning of a double cold-reduction (DCR) mill in 2018, and now JSW Steel is expanding production, offering a sustainable option for packaging material with JSW Platina® produced through the Danieli Electrolytic Tinning Line.

The new plant facility is mainly based on a DCR mill, a coil preparation line, an Electrolytic Tinning Line (ETL), and two cut-to-length lines.

Double Cold Reduction (DCR) Mill

The final steel grades to be processed are T1 and T5, in single- reduction mode, and DR480, DR8, DR9, DR10, in double-reduction mode. The strip thicknesses will be 0.14 to 0.60 mm (max 0.38 mm for DR), and strip widths will range from 650 to 1,250 mm. The DCR mill is sized to produce 160,000 tpy of tempered products and 40,000 tpy of double cold-reduction products, imparting a maximum elongation of 3% to the strip in temper mode, while 35% is the maximum thickness reduction in DCR mode. The mill can operate or in Dry or in Wet Temper mode with the use of anti-oxide; wet temper mode is particularly suitable for thin gauges. The fast-responding HAGC cylinders located on top of the mill housing ensure proper tolerances and final quality of the products, according to customer requirements.

A separate, direct oil-application and roll-cooling system is used on stand No. 1. The mill stand emulsion systems are required to achieve the high reduction, up to 35%; by using the direct application, it's possible to achieve a rapid change in the lubricant concentration,

allowing a quick adaptation to different rolling conditions.

Automatic cold-rolling process control is performed by the HiPAC, a powerful and advanced Danieli Automation platform, based on IPC solution and EtherCAT field bus technology, that incorporates a full series of dedicated technological packages, i.e.:

- Mass Flow Control,
- Automatic Thickness and Elongation Control,
- Feedback and Feed-Forward Control,
- Gauge Meter Compensation,
- Roll Eccentricity and Friction Compensation,
- Mill Threading setup.

Electrolytic Tinning Line

The tinning line, designed to operate at 400 mpm speed, can produce 200,000 tpy of tinplated products, with coating weight from 0.56 to 16.8 g/m^2 per side for tinplate and 7 to 140 mg/m^2 per side for Tin-Free Steel (TFS). The JSW electrolytic tinplating applies the Ferrostan process, with soluble anodes and vertical tanks, chosen as the one offering the best cost/benefit results.

Prior to the tinplating section, the line features a cleaning section, an electrolytic pickling section and a tension leveler to make the strip shape perfect for downstream processes. In the tinplating process section the ionic tin is converted to metallic tin by the plating bath and deposited on the strip surface through an electrochemical process, involving simultaneous cathodic and anodic reactions in the vertical plating cell.

Danieli also offers the cast-tin soluble anodes technology. The chromium-plated band, or Tin-Free Steel (TFS), also is available in this plant, a type of coating that is a valid alternative to electrolytic tinplating for some applications. The minimum guaranteed parameter for tin coating variation is ±3% on finished products, and the maximum flatness is up to 5IU.

Again the software packages and the integrated functionalities have been developed by Danieli Automation.

Source: Steel Tech

Brief Report on Webinar on Aluminium – Strategic Metal for Indian Economy held on 20.9.2020

Delhi Chapter of IIM organised a Webinar on Aluminium on 20.9.2202 through Google Meet platform. The Theme of the Webinar was "Aluminium – Strategic Metal for Indian Economy".

At the outset Shri K K Mehrotra, Chairman, IIM Delhi Chapter welcomed the speakers & participants to the webinar.

Shri N K Kakkar, Hon Secretary, IIM Delhi Chapter was the moderator for this webinar. After giving brief profile of Dr. Mukesh Kumar, Director , Steel Research & Technology Mission of India (SRTMI) Shri Kakkar requested him to share his perspective on Aluminium Sector.

In his presentation, Dr Mukesh Kumar stated that India enjoys 5th largest Bauxite reserves in the world. The per capita consumption of Aluminium in India is 2.5 Kg against the world average of 11 Kg. There is a large scope of exploration in Aluminium Sector. Demand of Aluminium is expected to grow at 8-10% per annum. Present demand is approximately 4.5 MT. Dr. Mukesh Kumar touched upon the existing capacity and proposed expansion plans of Hindalco, NALCO, BALCO, Vedanta and some other small producers of Aluminium. He also talked about consumption pattern of Aluminium in various sectors, like Transportation, Construction, Packaging, Electrical, Consumer Durables etc. He also gave an overview of Bauxite Resources and Reserves. He also touched upon the challenges in Aluminium Industry. These challenges are energy efficiency, Resource Utilisation, Safety, Residue Treatment, Social & Environment factors, fluoride emissions from smelters etc. He also touched upon the focus areas in Aluminium Sector. Dr Mukesh Kumar stated that the focus areas in Aluminium Sector are:

- Reduction in:
  - Perfluorocarbon emission (PFC).
  - Energy consumption.
  - Water consumption
- Removal of Silica and Iron from Bauxite
- Development of Settler cum filter for separation of solid and liquor.
- Use of Red Mud in :
  - Iron manufacturing.
  - Corrugated sheets, tiles & cement.
  - Iron Powder

- Use of low grade Bauxite for Alumina production.
- Recovery of Gallium from Alumina Refinery liquor.

- Extraction from Red Mud:

  Alfa Iron
  Alumina
  Titanium Di-Oxide

- Manufacturing of Al-Si cement/Geo-concrete from Fly Ash.
- ESP modifications for Indian coal having high ash.
- Special Grade Alumina & Hydrate.
- Treatment of Spent Pot lining.
- Converting Organic waste into power using ultra high temperature gasification.
- Use of lime grit for cement and other usages.
- Alternate technology for Bayer

He also talked about the opportunities in the Aluminium Industry in India. The opportunities are:

- Per capita consumption likely to double due to projects viz. Smart Cities, 24X7 Power supply to all, Water ways, Infrastructure & Digital India
- Opportunities in downstream capacities around smelters for sector specific second level of value addition
- Transportation, Electrical and Construction : Driving the growth
- Rail Wagons, Automotive components and Aerospace Alloys :Focus segments for the future , Opportunities for alloys development
- Make in India Program: Focus from Raw material export to metal export.
- Reform in Mining sector: Bridging the gap for developing better communication with the local communities .

This marked the end of the presentation of Dr. Mukesh Kumar.

Shri N K Kakkar thanked Dr. Mukesh Kumar for his lucid and informative presentation on Aluminium Sector in India.

Thereafter Shri N K Kakkar introduced Shri R K Narang, Member, Executive Committee, IIM DC, to share his thoughts on Aluminium Sector.

Shri R K Narang in his presentation stated that Aluminium plays an important role in economic development of our country. It is the largest non-ferrous metal industry in the world economy. Aluminium is the second largest metal industry after steel. It enjoys diversified use in critical

applications for energy security, national defence, aerospace, automobiles, infrastructure, electrification, consumer durables, packaging etc. Production of Alumina from Bauxite and Power for production of Aluminium metal are the main cost components. These constitute about 75% cost of production of Aluminium.

Aluminium has unique mechanical properties viz:

Light Weight
Good thermal / electrical Conductivity
Recyclability
Corrosion Resistance
Strength and Durability
Machining and Formability

Indian Aluminium possesses huge potential as a strategic metal of future. Major Aluminium producers in the country are:

National Aluminium Co. Ltd. (NALCO)
Bharat Aluminium Co. Ltd. (BALCO)
Vedanta Limited
Hindalco Industries Limited

The major Aluminium producing countries in the world are China, Russia, India, Canada, UAE, Australia, Norway, Bahrain, Iceland, Brazil and USA .

After the presentation of Dr Mukesh Kumar and Shri R K Narang, there was a lively question and answer interaction among the participants.

There were about 30 participants in the Webinar.

Shri K K Mehrotra, Chairman, IIM Delhi Chapter, presented vote of thanks.

Brief Report on Webinar on "Future Prospects of Lead / Zinc in Indian Economy" held on 17th October 2020

Delhi Chapter of IIM organised a Webinar on **Lead / Zinc in Indian Economy** on 17th October 2020 through Google Meet platform. The Theme of the Webinar was **"Future Prospects of Lead / Zinc in Indian Economy".**

At the outset Shri K K Mehrotra, Chairman, IIM Delhi Chapter welcomed the speakers & participants to the webinar.

Shri N K Kakkar, Hon Secretary, IIM Delhi Chapter was the moderator for this webinar. After giving a brief profile of Shri L Pugazhenthy, Executive Director, India Lead Zinc Development Association and Past President, IIM, Shri Kakkar requested him to share his perspective on Lead & Zinc Sector.

Shri L .Pugazhenthy executive Director India Lead Zinc Development Association & Past President IIM

In his presentation, Shri L. Pugazhenthy gave an overview of Lead & Zinc markets in India and emerging scenario of these two metals. He spoke on global production & end uses of Zinc. He also touched upon the Indian production of zinc. It was stated by him that production of zinc in India in 2019-20 was, 6,88,000 tonnes. It was informed by him that 72% of use of zinc in India is in galvanizing area. The other areas where zinc is used in India are die-casting alloys, Batteries, Zinc, Wires etc. He also spoke about different kinds of galvanising and the processes of galvanising. He also touched upon the factors influencing galvanising and traditional applications of galvanising. Mention was also made by him about recent applications of galvanising and future markets of galvanising. He also spoke about Lead production and its end uses. Global production of Lead in 2019-20 was 11.9 MT. The application of lead finds place in batteries, cable sheathing, rolled and extruded products, ammunition, alloys, pigments etc. Production of lead in India in 2019-20 was 1,81,000 tonnes. Major consumption of lead in India is in batteries. He also touched upon market and growth trends of lead battery industry.

Amlan Kanti Das
Sr. Vice President-Battery Operations and R&D Luminous Power Technologies P Ltd

Shri Amlan Kanti Das, Sr. Vice President, Battery Operations & R&D Luminous Power Technologies, spoke on Lead Battery Markets – Current & Emerging Scenarios. He

presented history of Lead Acid Battery, right from 1860. In his presentation, he touched upon the advantages of Lead Acid Battery. It was stated by him that the lead battery has the best recycle rate compared to other consumer wastes. He gave details of global lead-acid battery market. Chemistry of Lead Acid Battery was also explained by him. He also touched upon the emerging applications of lead acid batteries in India.

Shri Sujit Santra, Quesrow Consulting, presented a paper on "Emerging Market Dynamics & Opportunities for Zinc coated sheets in India". His presentation covered zinc coated sheets market in India, its production and consumption trends, potential applications and emerging trends of zinc coated sheets and opportunities for zinc coated sheets in India. It was informed by him that world zinc coated steel demand is growing on the back up of rising demand from advanced market economies. Per capita zinc coated consumption in India is 7 kg which is well below per capita consumption of China, Japan, Korea, USA. Korea has the highest per capita zinc coated steel consumption followed by Japan, USA and China. It means India has a great potential to increase the consumption of zinc coated steel. Emerging opportunities for zinc coated sheet is expected to enhance zinc coated steel demand in India.

There was a lively interaction among participants and speakers after the conclusion of the presentation of the three speakers.

There were about 45 participants in the Webinar.
Shri K K Mehrotra, Chairman, IIM Delhi Chapter, thanked the speakers and participants for participation in the webinar.

Aluminium is the Real Steel

The Indian downstream aluminium industry has aligned itself to support the government's push for 'Atmanirbhar Bharat'. It comes from the vision of being a country that is self-reliant when it comes to manufacturing aluminium products to meet its requirements. The focus on reducing our heavy dependency on imports, and well-though government vision and industry strength, can together write the story of atmanirbharta (self-reliance) in aluminium for India.

Many Southeast Asian nations that enjoy FTAs with India continue the unabated dumping of downstream aluminium

The per capita aluminium consumption of India (at 2.5 kg) is significantly lower than the global average consumption of 11 kg. With a progressive infrastructure push, there is a massive possibility for an upsurge in aluminium consumption in our country from the current level of about 4 million tonnes. However, this sufficient downstream capacity of aluminium available within India has not stopped us from importing aluminium downstream products like extrusions, rolled products, foils and other items from China and nearby countries. In fact, the rising imports of downstream aluminium products need to be restricted to promote domestic production. The import duty on downstream aluminium products in India is only 7.5%, which is not sufficient against the huge incentives given for exports by China. Many Southeast Asian nations that enjoy free trade agreements (FTAs) with India also continue the unabated dumping of downstream aluminium.

For example, the aluminium foils industry. After the imposition of anti-dumping duty on Chinese aluminium foils, the industry has seen resurgence. With existing mills running at full capacity and a whole host of new projects commissioned since the time of the duty imposition, the country has seen a significant amount of investment, talent building and market-building efforts that will yield huge dividend for the economy. Earlier, the foil industry was choked between high inputs costs of primary aluminium and cheap imports from China.

At 4.1 million tonnes per annum primary capacity and a downstream processing capacity of 3.9 million tonnes, the Indian aluminium industry has a ready platform to scale up to support the growth trajectory of India. The country obviously needs aluminium products to meet the various end-user requirements in many industries within the manufacturing sector. The growth of the downstream aluminium industry is dependent on two key points – independent recognition (distinct from primary aluminium) and support derived in the form of government policy. The government must consider the demands of the industry and protect the downstream segment by doing away with import duty on primary aluminium. This will make it affordable and help increase domestic consumption of domestically-produced aluminium. Paying a global premium for India-produced aluminium has to stop. Removing import tariffs on primary aluminium and increasing import duties on downstream aluminium could be a practical solution to this issue, which will incentivise value-addition to aluminium within India. Immediate attention to this can safeguard lakhs of livelihoods associated with this industry.

The sheer range of application in aerospace, defence, high-speed rail and many infrastructure areas makes downstream aluminium industry very important. According to a NITI Aayog report, India's downstream segment comprises of more than 150 companies (both large and midsized) and a large base of smaller and unorganised players that strongly needs an export policy for the downstream aluminium segment. In the global market, Indian MSMEs can be competitive only when downstream aluminium is offered a differential status in India, giving it price-parity through focused government policies. The downstream aluminium segment has all along been a visible symbol of progress. Having extensive forward- and backward- linkages to the economy, policy reforms can reduce its import dependency and help make it contribute towards an Atmanirbhar Bharat.

Source: Financial Express