ALL INDIA INDUCTION FURNACES ASSOCIATION

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What's Inside

हमारे सभी सदस्यों को
नव वर्ष की हार्दिक
शुभकामनाएँ

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Cable Reeling Drum

- Cable Reeling Drum
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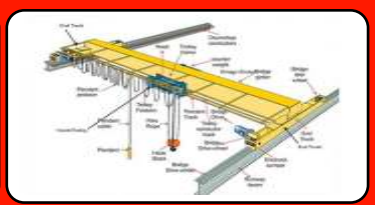
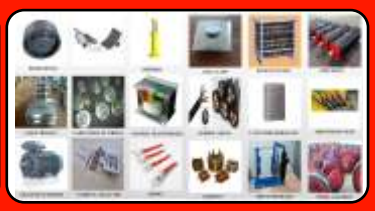


EOT Crane

- Single Girder EOT Crane
- Double Girder EOT Crane

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- Spare Parts & Accessories of EOT Cranes
- Spare Parts & Accessories For Induction Furnace

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Importance of Weathering Steel in Industry

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Introduction: Weathering steel is an alloy steel that is often used in construction and is well-known for its rust-like appearance. The outer appearance is actually a protective rust layer called a “patina” that inhibits further corrosion and extends the life and use of the steel. . Weathering steel is a low-carbon alloy steel wher low amount of carbon with low percent of other elements make the steel products tough and ductile and corrosion resistant. Such properties have become choice os this steel in construction sector.

While weathering steel can rust, but oly forms on the outer surface, outer rust coating and the rust does not go further into the steel. The rust-coated surface serves as a kind of protective shield, preventing the steel from any additional corrosion. The rust layer that is formed on the plain carbon steel is porous and breaks off, which allows it to form another layer deeper into the steel. The cycle continues until the regular steel is useless.

The first layer of rust on the weathering steel forms to hold on because of the contribution of alloys. Hence there is no need to coat the metal with any other protective layer as it is self-protected through any sort of weather that occurs. So construction industries can, can, however, coat weathering steel in a protective coating to stop the rust from staining the surrounding areas as the rust will spread when rained on.

These continental weathering processes are higher in tropical regions, mainly due to conducive climate (higher temperature and intense rainfall). The rivers in the peninsular India predominantly drain silicate terrains and hence, weathering in from this region is likely to play an important role in global carbon budget. Recognizing the importance, appreciable amount of geochemical studies of these, rivers are being carried out continuously at all the Peninsular Indian rivers...

From the geochemical statistics for quantification of the chemical weathering in region, associated CO2 consumption, the factors regulate factors of such phenomenon. The river water chemistry of the Peninsular Indian rivers are mainly dominated by Ca and HCO3, hinting at dominant role of carbonate influencing the hydrochemistry. Although the rivers predominantly flow through silicate terrains, the faster dissolution kinetics of carbonates supply significant amount of solutes to these basins.

The chemical compositions of these rivers also show strong seasonal variations, mainly due to relative changes in silicate-to-carbonate weathering. The silicate weathering rates and hence, the CO2 consumption potential of these rivers are by and large found to be higher when compared to the corresponding rates for the global average for rivers. There was urgent need for producing cheap quality corrosion resistant steel instead of higher cost steel for general application which have good properties for fabrication and shaping..

With exceptional mechanical properties, USA in 1933 developed and commercialized the new corrosion resistant steel primarily for use in railroad hopper cars, for the handling of heavy bulk loads including coal, metal ores, other mineral products with high-strength weatherabile steel accordingly named as weathering steel or corrosion resistant steel named as CORTEN which is also known as weathered steel. However, exactly Corten symbolizes as Corrosion win high

tensile strength the two distinguishing properties of this type of steel: corrosion resistance and tensile strength.

Weathering or Corten Steel: This steel is in the fafily of low carbon or mild steel with low alloy added variety of grades. COR-TEN A or COR-TEN B which are considered proprietary grades, under trademarked and owned by U.S. Steel. As appearance, COR-TEN® forms a coating of dark brown oxidation over the metal surface, which inhibits deeper penetration and eliminates painting needs and costly rust-prevention maintenance. With the protective rust that provides corrosion resistance, Corten steel can last upwards of a few decades even to over 100 years.

How Weathering Steel differ from Carbon Steel:

Based on chemical composition, steels can be grouped into three major classes: carbon steels, low-alloy steels, and high-alloy steels. The major component of steel is iron, a metal that, in its pure state, is not much harder than copper. Adjusting the carbon content is the simplest way to change the mechanical properties of steel. The addition of other alloy elements can also permit tempering at higher temperatures, which generates better ductility of the steel at the same hardness and strength.

There are several thousand steel grades, either published, registered or standardized worldwide, all of which have different chemical compositions. These different types of steel have many possible heat treatments, microstructures, cold-forming conditions, shapes, and surface finishes. One famous example is the commonly known stainless steel. Low carbon steels contain less than 0.30% carbon (termed as mild steel). Medium-carbon steel consists of 0.30% to 0.60% carbon. And high-carbon steel contains more than 0.60% carbon. As the carbon content of steel increases, it becomes stronger and harder.

A majority of low carbon steel is flat-rolled products like sheet or strip; usually they are in a cold-rolled and annealed condition. These steels have high formability as they contain very low carbon, usually less than even 0.10% C, with up to 0.4% Mn. For rolled steel structural plates and sections, the carbon content is often increased to approximately 0.30% and manganese content increased to about 1.5%. These materials are useful for stampings, forgings, seamless tubes, and boilerplates. low carbon steel has excellent weldability, produces a uniform and harder case and it is considered the best steel for carburized parts. Mild/low carbon steel offers a good balance of toughness, strength and ductility. Hot rolled low carbon steel has significant mechanical properties, improved machining characteristics and has a high Brinell hardness measure.

On the other hand, weathering Steel (-Corten) a popular contemporary material It is an alloy or a combination of two or more metallic elements. The development of alloy metals by humans has been done for centuries, and it is intended to provide further strength or resistance to corrosion. Historical records point out its first developments in the 19th century in England, but it is widely recognized that its full development occurred between the 1930s and 1970s. weather steel is nowadays the most commonly used material for building the world's infrastructure and industries.

Corten steel,(Weathering Steel) is a low-carbon steel low alloy developed to eliminate the need for painting and forms a stable rust-like appearance after several years' exposure to weather Corten Steel and Mild Steel are Carbon Steels. Both made from Iron with slightly different chemical compositions. Corten Steel develops a protective layer that slows down the corrosion process. Mild Steel does not form a protective layer but aesthetically is very similar to Corten Steel.(Chemical Composition shown below)

Grade	C	Si	Mn	P	S	Cr	Cu	V	Ni
ASTMA242	0.12	0.25-	0.30-	0.03-	0.03	0.50-	0.25-	-	0.65
Corten A	0.75	0.50	0.20	max	max	1.25	0.55		max
ASTMA588	0.16	0.30-	0.30-	0.03	0.03	0.40-	0.25-	0.02-	0.40
Corten B		0.50	0.50	max	max	0.65	0.40	0.10	max

The mechanical properties of weathering steels depend on which alloy and how thick the material is.

A- Tensile Strength 450 MPa Yield Stress 310 MPa % Elongation 20

B- Tensile Strength 485 MPa Yield Stress 345 MPa % Elongation 49

Corten B Weather Resistant Steel is better suited for Heavy and load bearing Structures, It forms its own protective layer when exposed to atmospheric

elements.

structucture made from corten steel (Kyoto) 20 years after construction

In railways, BG Bogie Open wagon type `BOXN-HA has been designed for carrying increased payload for bulk movement of Coal and Iron Ore. Shipping Container.

Corten Steel Preferred Choice for Construction of Heavy Industries .

The length and width of the wagon are same as those of existing BOXN wagon except the height of wagon, which is 3450 mm from rail level. Thus BOXNHA wagon is higher by 225 mm compared to BOXN wagon. The wagon is fitted with cast steel IRF 108HS, secondary suspension bogie, non-transition centre buffer coupler and single pipe graduated release air brake system.

The wagon superstructure consists of the following sub- structures: ! Underframe ! Body sides ! Body Ends ! Side Doors i. Underframe : The underframe is provided with two sole bars of ISMC 250 rolled channel section with centre sill of standard `Z' section alongwith ISMC 100 for stringers. To combat corrosion, corrosion resistant steel has been used. The body bolster is of box

type construction fabricated by welding of plates and the cross bars are also of fabricated design made out of plate sections. The underframe is of all welded construction with material IS2062 Fe 410 CuWA. The floor plate is made out of Corten Steel to IRS-M41 and welded to the underframe. The details of underframe members are given in Table 11.1.

Reasons for Choice of Corten Steel in Industry: Common Corten Steel Products - Plate , Shet, Various Structural parts, Tube and Pipe etc. Modern days' Engineers, designers are:

Pollution Control Equipment, Industrial Air Pollution Stacks, Air Ducts, Water Tanks, Roof Panels,, Wall Panels, Corrugated Panels, Guard Rails, Landscape Edging, Precipitator Elements, Building Facades, Planter Boxes, Chimney Parts,I ndustrial Flues.

Fabrication Characteristics of Corten Steel Products: Welding corten steel is made of ordinary carbon steel by adding a small amount of weatherproof elements such as copper and nickel, which has good weatherproof performance. Welding Corten steel is different from stainless steel. It also produces rust when exposed to atmosphere. However, this corrosion will stick firmly to the steel product surface, preventing further reaction between the base and the atmosphere, thus playing a good weather resistance.

Welding corten steel can be used without or reduce painting, greatly saving maintenance costs; the thickness of steel can be reduced, saving comprehensive costs. This kind of refractoriness and weatherability also has good self-healing property, that is, the weatherability and fireproof of steel can not be changed after finishing or welding, or after surface rubbing or fire in service. This is impossible for ordinary steel and additional protective layer, and the benefit is difficult to estimate. Welding corten steel has better

Rust Free Steel Gate & Façade Made from Corten Steel Plate/ Sheet

economic benefits and will promote the development of Construction.. Welding corten steel is to improve the weldability of corten steel by some processes. The development prospect of welding corten steel is not allowed to be neglected.Welding Corten steel has been widely used in many buildings. In recent years, with the development of container transportation industry, welding corten steel has been gradually used in the manufacture of container materials. It can effectively resist the corrosion of sea water in maritime transportation and has a great impact on the development of container industry.

A steel sheet is easy to cut yourself. Use an angle grinder or when cutting thin sheets, you can use shears. With sharp saw teeth, this bendable hammer-in steel edging is easy to bend and install.

Corrosion Resistance quality: One of the primary reasons for corten steel's popularity in industrial applications is its exceptional resistance to corrosion. Unlike traditional steel, which can succumb to rust and deterioration when exposed to the elements, corten steel forms a protective layer of rust on its surface when exposed to

moisture. This layer, also known as the patina, acts as a shield, preventing further corrosion and extending the material's lifespan. This feature is particularly beneficial in industrial settings where structures are subjected to harsh weather conditions.

Low Maintenance: Industrial facilities often require materials that are easy to maintain to keep operations running smoothly. Corten steel, with its protective patina, requires minimal maintenance. It eliminates the need for costly and time-consuming painting or protective coatings that other metals may require. This low-maintenance quality not only reduces operational costs but also ensures that industrial structures remain structurally sound over the long term.

Structural Integrity: Corten steel possesses impressive structural integrity, making it a suitable choice for industrial applications that demand strength and stability. It maintains its structural properties even in extreme conditions, such as high winds, heavy snow loads, and seismic activity. This makes it an excellent choice for building industrial structures like bridges, warehouses, and storage tanks.

Environmental Benefits: In an era where sustainability and “green building” is a top priority, corten steel's environmental benefits are a significant factor in its use in industrial applications. Its long lifespan and low maintenance requirements result in reduced resource consumption over time. Plus, its rusty appearance aligns with a natural, weathered aesthetic, which can be appealing in eco-friendly and industrial designs.

Corten steel industrial applications

All in all, corten steel has revolutionized industrial design by offering a unique combination of durability, aesthetics, and environmental benefits. Its corrosion resistance, low maintenance, and adaptability make it a compelling choice for industrial manufacturing applications.Essentially, the top layer corrodes which then protects the steel beneath it. The natural finish does not normally require any form of maintenance such as painting, which makes the material a highly cost effective alternative to other structural steels.Painting and maintenance will be required if the structure is is continually wet as a protective layer will not form. An good example is where the base of the structure meets with the ground or is partially submerged.

Based on chemical composition, steels can be grouped into three major classes: carbon steels, low-alloy steels, and high-alloy steels. The major component of steel is iron, a metal that, in its pure state, is not much harder than copper. Adjusting the carbon content is the simplest way to change the mechanical properties of steel. The addition of other alloy elements can also permit tempering at higher temperatures, which generates better ductility of the steel at the same hardness and strength. There are several thousand steel grades, either published, registered or standardized worldwide, all of which have different chemical compositions. All these different types of steel have many possible heat treatments, microstructures, cold-forming conditions, shapes, and surface finishes.

Weathering steel makes up the first and earliest of six current classes of high-strength, low-alloy steels. Weathering steel is considered the strongest and 4 to 8 times more resistant to atmospheric corrosion than plain low-carbon steels. A unique feature of weathering steels is that as a result of exposure to outdoors, they develop a thin brown patina, which differs in appearance, composition, and structure from other types of rusts. This patina turns orange with time on constant exposure to wetting and drying cycles, then becomes reddish-brown. The patina becomes dark brown after a year of exposure and especially in urban settings.

This material contains alloying elements such as copper, chromium, and nickel, which create a protective oxide layer on its surface when exposed to the elements. This layer not only gives weathering steel its characteristic rusted appearance but also acts as a barrier, slowing down further corrosion. Weathering steel offers several advantages, including: longevity, low maintenance requirements, and a range of ASTM specifications tailored to different applications.

The Disadvantages of Corten Steel : Corten Steel is significantly more expensive than other metals with a similar finish. For smaller projects, this may not be a big deal, but for larger construction sites and infrastructure projects, the difference in price can be significant. Over time, Corten Steel will naturally develop a rust-like appearance. While this looks great on steel, it's not a great look on walls and pathways. The other downfall is that Corten Steel has staining issues where the rust can stain nearby surfaces, and potentially ruin walls and floors. Lastly, Corten Steel is not overly environmentally friendly because the run-off is not great for the environment. For those of you that have had neighbors with Corten Steel outdoor products know that runoff ends up in nearby drains and ponds, which can ultimately cause significant damage to the local ecosystem.Another disadvantage of Corten steel is its susceptibility to rusting. Corten steel is designed to form a protective layer of rust on its surface, but it can break down over time, leaving the steel vulnerable to corrosion. Corten steel is also available in limited quantities, making it difficult to find for some projects. This can lead to delays or even the need to change materials altogether.Corten steel can also be difficult to work with, as it is harder than other types of steel. This can make cutting, welding, and other forms of fabrication more difficult and time-consuming. The rusting process can create an uneven or patchy appearance.

High Strength Weathering Steel Developed : Chemical composition of high-strength weathering steel kept as C 0.01～0.04, Si 0.20～0.35, Mn 1.30～1.80, 0＜P≤0.060, S≤0.010, Cu 0.25～0.40, Cr 0.20～0.40, Ni 0.15～0.35, Mo 0.10～0.40, Nb 0.040～0.090, B 0.0008～0.0030 and Ti ≤0.030, Al ≤0.040, Zr ≤0.010, rest iron which is inevitably mingled andt satisfy the welding cold crack sensitivity coefficient. The reason of C, Si, Mn, P, S, Cu, Cr, Ni, Mo, Nb, Ti, Al, Zr limited amount in development where.C content chosen in 0.01%～0.04%.C for serving as the reinforcement constituent element.

Conclusion: Corten steel offers many benefits like High strength, Low maintenance cost,Easy installation, No need for protective paint,Cost-effective,Provides unique design and appearance, Environmental-friendly steel when used in construction projects for strength, durability, and aesthetic appeal. However, there are some drawbacks, such as limited availability and higher costs associated with the production process compared to regular carbon steels. Weathering steel is considered the strongest and 4 to 8 times more resistant to atmospheric corrosion than plain low-carbon steels.

Ref: ASTM Std : A588, A242, A606-4, A847, A871-65 and A709-50W.

Concept of Direct Rolling in Secondary Steel Sector

P. Mishra
Sr. Executive Director, AIIFA

Abstract:

The steel re-rolling mill sector and electric induction furnace sector forms the key segments of the secondary steel production in the country. A significant percentage of units from these two sectors are in the form of 'composite units' wherein induction furnace and rolling mill are present in the same premises. The secondary steel induction furnace and re-rolling mill units are small in capacity, uses obsolete technologies and consumes high level of energy due to use of inefficient technologies. Thus, the sectors possess substantial potential towards implementation of energy efficient technologies and improving the present (baseline) level of specific energy consumptions.

Direct rolling, which is a revolutionary technology, introduced during early 2012, aims at utilizing the latent heat available in the continuous cast hot billets at the discharge of mould tube with a controlled cooling to ensure required solidification till the withdrawal of billet and thereby ensuring the maintenance of temperature required for re-rolling of steel through the existing rolling setup itself. Thus, the technology completely eliminates the use of re-heating furnace and forms a direct transfer mechanism for the hot billets from the continuous casting machine to the rolling mill directly.

The process leads to complete elimination of use of fuel (furnace oil or gas or coal) required for heating of billets in the re-heating furnace. In addition, the technology also leads to substantial improvement in the overall yield and productivity of the unit. The implementation of 'Direct Rolling' thus leads to a significant saving of greenhouse gas (GHG) emissions from these plants by eliminating completely the use of fossil fuel in the entire process.

Introduction:

The secondary steel sector forms an unavoidable link to the overall steel production in India with a significant contribution of around 70% of the total long products manufactured in the country. Due to the versatility of this sector in producing any section or size and any odd tonnage of rolled products, it has created its own niche space in the steel sector. However, the state of the technology in this sector is unsatisfactory as compared to developed countries. There is an urgent need for this industrial sector to modernize & upgrade its technology and adopt energy efficient technologies. Intense competition and high energy cost forces this sector to adopt energy efficient and environmentally sustainable technologies. Additionally, this is an unorganized sector with low engineering, limited technology innovation & poor R&D base, lack of technically & operationally skilled employees, etc.

Thus, the need for the steel sector for energy efficiency improvement is most essential because of various reasons such as:

- The earth is facing climate change threat as per which it is the first and foremost requirement that the greenhouse gas emissions must be reduced which is possible through adoption of cleaner technologies.
- That the Indian Economy is also facing stiff competition with large global players. Thus we need to improve our operating system and overall plant efficiency to

reduce cost of operation. This is possible through continuous upgradation to latest and cleaner technologies.

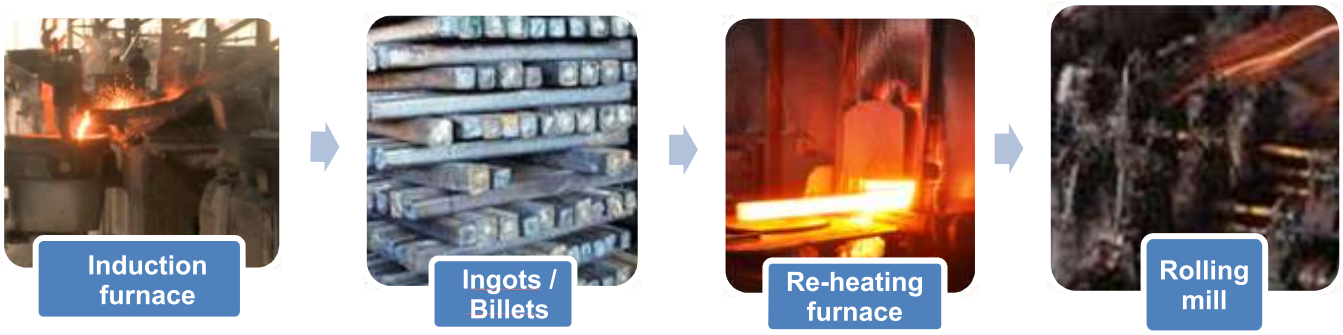
- The small and medium scale units are facing tough competition also from large scale and integrated steel plant. Thus, in order to remain competitive, cost optimization through efficient use of energy is a key for survival in the present scenario.

Thus, in the present scenario of rising competition, sustainable development is possible through technological upgradation and adoption of cleaner technologies. The proposed 'direct rolling' technology is one of the recent innovations towards sustainable future for the secondary steel sector and provides an opportunity for making a transformational change in the sector.

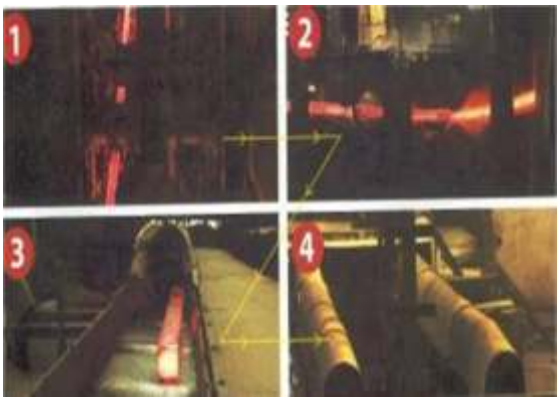
Existing conditions:

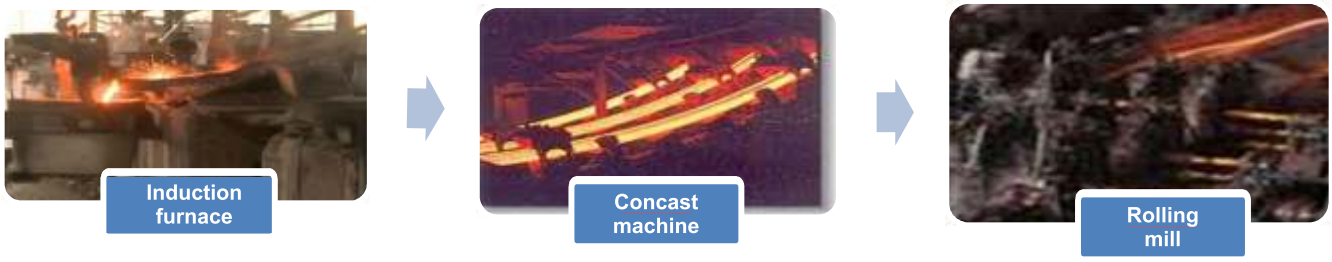
In a typical composite unit consisting of induction furnace & rolling mill, the process flow of material involves the following:

1. Steel scrap or sponge iron is melted in electric induction furnaces to produce M.S. ingot through 'Ingot Moulding'. Some units also have the continuous casting machine which is used to convert the melt to continuously casted billets.
2. Casted ingots or billets are cooled, cleaned, and stacked in the raw material yard.
3. The cooled ingots or billets are then reheated by placing them into a re-heating furnace which operates on fossil fuel like: “furnace oil or coal or gas”; after the billet or ingot is heated up to 1200 °C, these are discharged and taken for re-rolling.



Thus, the process involves lot of fuel consumption in the re-heating furnace as well as burning loss too. In addition to the energy consumption, the production in re-rolling mills also gets affected many times due to the limitations of the manpower handling and the re-heating furnace system. In the re-heating process, there is also a burning loss of





about 1.5% of metal. Burning of fossil fuel in the re-heating furnace leads to significant GHG emission into the atmosphere.

Direct rolling concept:

Introduced to the secondary steel industries during early 2012, **'Direct Rolling'** has emerged as one of the most revolutionary technologies in the recent past. The technological process of 'Direct Rolling' aims at utilizing the latent heat available in the continuous cast hot billets at the discharge of mould tube with a controlled cooling to ensure required solidification till the withdrawal of billet and thereby ensuring the maintenance of temperature required for rerolling of steel through the existing rolling setup itself.

In order to achieve this target, the following facilities are required to be installed in the CCM section of any induction furnace and re-rolling mill complex:

1. A suitable radius of continuous casting machine (CCM) with preferably double strand facility. However, depending of the capacity of the rolling mill, single strand can also be set up or three or more strands can also be used. But based on the present sizes available in the small and medium enterprises (SME) units, it is proposed to use single strand with a backup availability of second strand which can put into use as per the emergency requirement.
2. A suitable radius mould tube having indirect cooling through demineralized (DM) water followed with a secondary cooling facility having direct spray cooling through controlled spray of water, controlled by programmable logic controller. By varying the flow rate of spray water during the secondary cooling, it is also desired to have a control on the flow of cooling water for the mould tube cooling too; so that the controlled cooling can be achieved.
3. Subsequent to that, in each strand, one hot billet shearing machine should preferably be installed to ensure that billet being cast are cut to the desire length by consuming minimum time and in line with the casting speed without causing any loss of metal and also without creating any distortion in the end of the billet so that, the ends of the billet do not cause any adverse impact at the entry of first pass. Although at many locations people prefer to install only the manual gas torch cutting facility by using acetylene and oxygen or the LPG with Oxygen. But this has several disadvantages over the on-line hot shearing machine.
4. Once the hot cast billets are cut to size by the billet shearing machine, the conveying speed of the cut billet is enhanced to ensure fastest travel of hot cut piece of the billet to the first pass. The layout may require that the cut billets to be shifted at 90-degree angle or may it also be possible to convey it straight to reach the rolling mill conveyor. This will depend on the mill layout with respect to the induction furnace layout.
5. Rolling mill conveyors may be required to be designed to provide a linear speed of 1.5 mt/s or even little more to convey the hot cut billets as fast as possible. The conveyors will be driven by variable frequency drive (VFD). In case the distance of conveying is more, it may require that the conveying mechanism is so designed that the heat loss during travel is minimum. The roller conveyors are provided in certain enclosures and canopy covers, made of refractories, to avoid heat loss.

6. The temperature profile from the induction furnace up to the first pass of rolling mill stand should be maintained in the following levels:
    i. Tapping temperature at induction furnace should be maintained between 1660 to 1670 ^{0}C depending on the number of factors.
    ii. The ladle designed should be so provided to minimize the loss of heat during transporting the liquid metal up to CCM. It is expected that not more than around 3 to 4 minutes should take to transport the ladle. Temperature drop during pouring will be 40 ^{0}C and during transport shifting of ladle to CCM will be 10 to 12 ^{0}C. Thus, enough heat will be available even with the liquid metal during the casting from ladle.
    iii. Subsequently during nitrogen purging another 5 ^{0}C drop will take place.
    iv. Accordingly, the opening temperature of liquid metal while start of pouring in the mould will be about 1590 ^{0}C and is likely to remain above 1550 ^{0}C by the time the pouring/casting is completed.
    v. The solidification of the liquid metal in the mould will take place due to the indirect primary cooling and thereafter controlled spray of direct cooling water during the secondary cooling. The programmable logic controller (PLC) controlled water spray system will help to ensure that the billet is completely solidified at the withdrawal point and also have a skin temperature of above 1050 to 1100 ^{0}C.
    vi. The billet shearing machine should be placed at the closest possible point so as to avoid any more heat loss during further conveying.
    vii. The heat loss should be further protected by providing insulated cover over the conveyor roller table
    viii. All this protection and minimum time to convey the billet from shearing machine to the first pass should ensure that the maximum temperature drop is not likely to be more than 5 to 10 ^{0}C.
    ix. The insulated cover will also help in protecting the scale losses.
    x. The CCM is likely to operate 24 hours whereas rolling mill will require at-least 2 hours of maintenance time. Therefore, for accommodating the material casted during this rolling mill shutdown period; the cast billet should be conveyed to the cooling bed for which a sufficient length cooling bed should be provided.
    xi. It is important to take into consideration the present melting facilities and re rolling facilities capacity.
    xii. In order to efficiently use the direct rolling technology, it is also required to modify the roll pass design to cater to the changed temperature profile. Also, in some cases, the gear box in the first rolling stand needs to be strengthened.

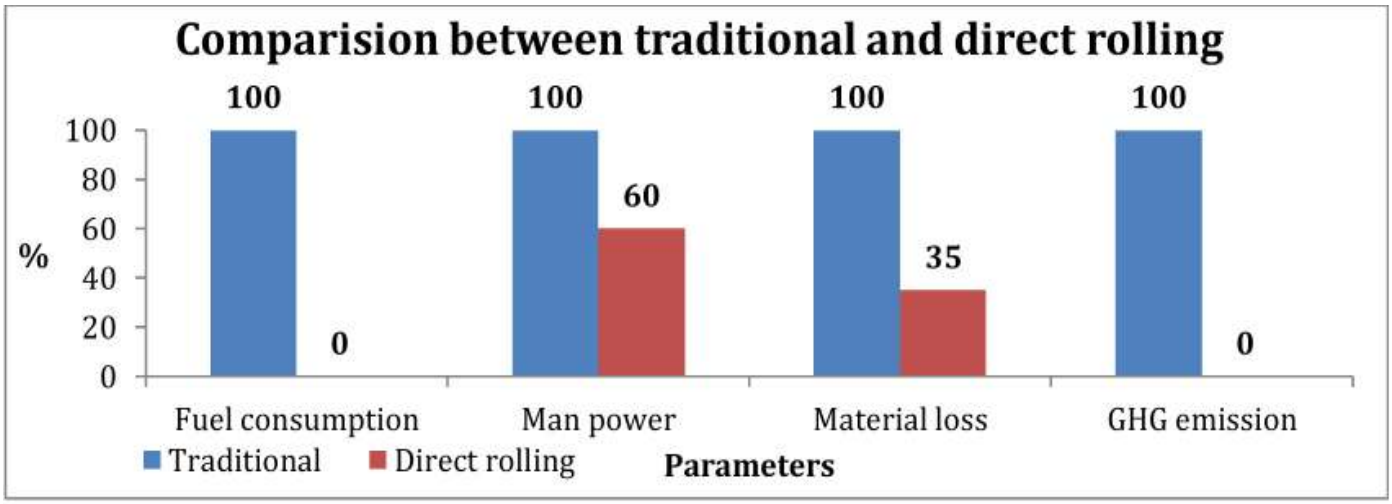
Direct rolling (advantages):

The implementation of direct rolling can bring significant savings in terms of cost optimization, use of energy and GHG emissions. Some of the

key advantages of using direct rolling as a technology are as follows:

1. Complete avoidance of furnace oil /coal/gas required for heating of the steel bars which will result into enormous saving in fuel energy and thereby reduce the GHG emission due to the same.
2. Reduction in the mill scale loss to the extent of 1.5 to 2%, which would have been burned in the billet reheating furnace.
3. Savings due to avoidance of runners, risers etc. improving the yield about 2.5%.
4. Savings in the loss of ingot moulds, refractory, etc.
5. The rolling of hot cast billets will also improve the quality of the rolled steel products and also substantially reduce the rejections generated during rolling because of the mould cast Ingots.
6. It will improve the productivity of the mill and also that of the manpower engaged in the plant.
7. It would also result in some saving in power consumption because of the indirect savings of burning loss and improved liquid metal to finished steel etc.
8. It will also help in reducing the manpower required in any unit and also reduce the risks of lower production caused due to the manpower engaged in vital function of mould settings; ingots finishing and loading in the billet reheating furnace etc.
9. It will set example before the other similar units operating in the country to follow the suit.

The below graph elucidates the advantages of direct rolling over the traditional rolling process on various parameters:



However, implementation of 'direct rolling' calls for certain pre-requites, which needs to be catered to, for effective use of the solutions.

Once the re-rolling process is integrated on line with that of hot cast billet rolling then the entire process must be very well synchronized and it will require very care full and perfect planning in every aspect of operation from beginning till the end such as:

- Proper selection of raw material.
- Complete analysis of the charge and proper material balancing before melting itself to target the proper levels of carbon, phosphorus and sulfur to be achieved.
- Scheduled predictive/preventive maintenance in time for all the facilities.
- Proper selection of the acidic/neutral ramming mass and proper application of

the same. Timely relining of the crucible well in advance and after every defined number of heats.

- Proper and adequate arrangements for proper ramming mass.
- Controlling the melting temperature and time to achieve the scheduled sequence.
- Maintenance of the desired temperature profile as planned.
- Maintenance of the passes and the mill area equipment in perfect operating conditions.
- Adequate stocks of the spares and emergency backup facility along with the emergency backup power.
- Proper training to the manpower from testing, operation, maintenance to quality and inventory control.
- Reduce the dependence on any manual handling even in the re-rolling mill. Hence the re-rolling mill feeding and discharge of the rolling objects must be automated.
- Cooling bed must also be made automatic.
- It is to be realized that after the induction furnaces are synchronized with the re-rolling mill through the caster then the success of the plant depends on the failure free and maintenance free operations. Thus, all the equipment and machines & spares must be carefully procured from very good and reputed makes & manufacturers.
- It is also very important that the design and operations of the plant is given in hand of experienced and expert persons only. The success of the plant brings profit and happiness to the unit and at the same time protects the environment and makes the steel industry as more sustainable. The life of earth is increased due to reduced GHG emission.

Case study:

In the year 2004, United Nations Development Programme (UNDP) along with Ministry of Steel, Government of India and Global Environmental Facility (GEF) launched a project titled as "**Removal of barriers to energy efficiency improvement in the Steel re-rolling mill sector in India**". The project aimed in penetrating energy efficiency technologies in the SRRM sector, thereby reducing associated emissions of Green House Gases (GHG). At the end, the project developed 34 model units equipped with energy efficiency equipment/technologies. All these units were able to reduce their specific energy consumptions and associated emission to a great extent on comparing to their baseline. Out of these 34 model units, 3 units had gone for direct rolling and thereby achieved a milestone of "***steel goes green"*** i.e. steel making process without the re-heating furnace and thus saving 100 percent thermal energy.

The following passage, describe the benefits attained through direct rolling by one of the model unit in Raipur. The unit was initially using furnace oil as fuel for re-heating the ingots and high cost was spent on this.

Fuel savings:

No.	Parameters	Unit	Baseline	Post implementation
1	Production	tph	10.5	13.2
2	Annual production	tpy	37,800	47,520
3	Type of fuel	-	Furnace oil	Direct rolling
4	Specific fuel consumption	L/t	45.34	0

- Fuel saved per tonne = 45.34 – 0
  = 45.34 L/t
- Overall annual fuel savings = 45.34 * 37,800
  = 1,714 kL of furnace oil.
- Cost of furnace oil = INR 35/L
- **Total cost saved annually = 1,714,000 * 35**
  = INR 59,990,000
  = INR 6 crores (approx.)
- Investment towards energy efficiency = INR 1.5 crores
- Simple payback period = (Investment / savings per year) * 12
  = (1.5 / 6) * 12=3 months

GHG emissions reductions:

- Calorific value of furnace oil =40.4 MJ/kg
- Density of furnace oil = 0.94 kg/m3
- Specific fuel consumption (baseline) = 45.34 L/t
  = 45.34 * 0.94
  = 42.62 kg/t
  = 42.62 * 40.4
  = 1722 MJ/t

Since, the unit had adopted the direct rolling the specific fuel consumption for post implementation is zero.

- Specific fuel consumption (post implementation) = 0 MJ/t
- CO_2 emission factor for furnace oil = 77.4 tCO2/TJ (as per IPCC guidelines)

Total CO_2 emissions – baseline = (1,722 * 77.4) / 10^-6 = 0.13 tCO2/t

Annual CO_2 emissions = 0.13 * 37, 800
= 4,914 tCO2/y

- **Total amount of CO_2 reductions avoided per year = 4,914 – 0 = 4,194 tCO2/y**

By implementing direct rolling, the unit was able to completely eliminate the usage of fossil fuel in re-heating the ingots/billets and thus saving the 100 % fuel and also reduce the GHG emission substantially.

Government Initiatives for Steel Decarbonisation

Over the last few years, the central government has taken various initiatives to decarbonise the steel industry. Given that the Ministry of Steel needs to depend on other ministries for implementing certain policy measures, the initiatives encompass those taken by various government departments. The steps include:

- In 2012, the PAT Scheme was introduced under the National Mission for Enhanced Energy Efficiency to incentivise the steel industry to reduce energy consumption. The sector has achieved 5.5 million tonnes of oil equivalent (MTOE) and a corresponding CO2 reduction of 20 million tonnes from 2012-20.25 The government introduced a total of seven PAT cycles from 2012-24
- In 2013, the Indian steel industry adopted the Best Available Technologies (BAT) available globally to improve energy efficiency and mitigate GHG emissions. This resulted in a considerable reduction in CO2 emissions from around 3.1tCO2/tcs in 2005 to around 2.5tCO2/tcs in 2020. In 2016, India and Japan's New Energy and Industrial Technology Development Organization (NEDO) signed a memorandum of understanding (MoU). The project model was implemented in steel plants for energy efficiency improvement.
- In 2019, the government introduced a Steel Scrap Recycling Policy to enhance the availability of domestically generated scrap and reduce coal consumption in steelmaking.
- In September 2021, the government issued The Motor Vehicles (Registration and Functions of Vehicles Scrapping Facility) Rule 2021 to increase scrap availability in the steel sector.
- In January 2023, the Ministry of New and Renewable Energy (MNRE) announced the NGHM for green hydrogen production and usage. It made the steel sector a stakeholder in the mission.
- In March 2023, the Ministry of Steel signed 57 MoUs with 27 companies for specialty steel under the Production-Linked Incentive (PLI) Scheme.
- The government has allocated Rs63.22 billion (US$763.9 million) under PLI to boost the steel sector.

Source: Institute for Energy Economics and Financial Analysis

Government's PLI 2.0 Set to Transform Indian Steel Sector

Dec 28,2023

The Indian government is actively shaping the future of the steel sector through the upcoming Production-Linked Incentive (PLI) 2.0 initiative, scheduled for implementation in 2024. This strategic move is set to revolutionize the steel manufacturing landscape, fostering growth, innovation, and sustainability. In response to emerging global challenges, the PLI 2.0 for the steel sector aligns with the government's vision to enhance domestic production, reduce dependency on imports, and bolster the overall economic resilience. The initiative aims to provide a significant boost to the steel industry, creating a competitive edge in the international market.

Source : Metal Junction

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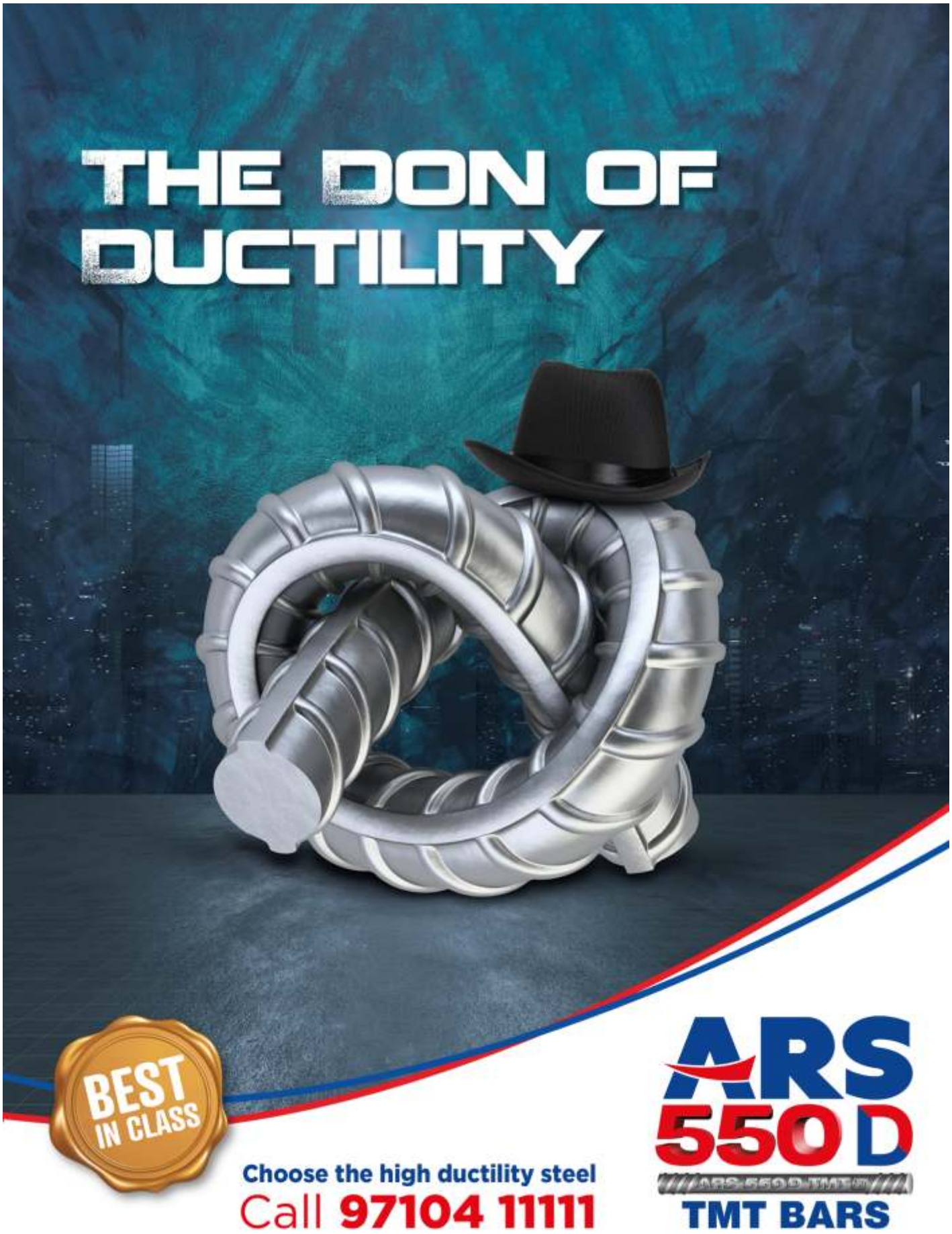
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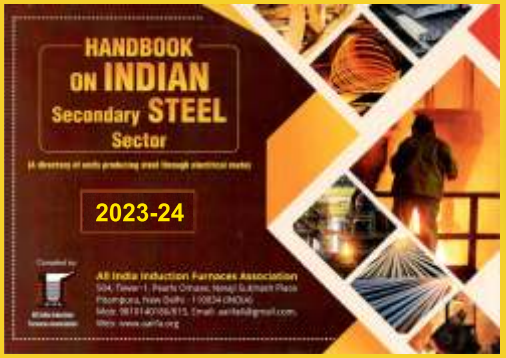

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