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What's Inside

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Induction Furnace Steel making Units- Moving Forward

Kamal Aggarwal
Hon. Sec. General,AIIFA

Introduction: Steel, as indispensible material for society and nation due to its characteristics such as recyclability, durability and versatility making it it a material "permanently" available to future generations improving living standard of developed regions. In the competitive global market of alloy & special steels, product cost, processing cost, product quality, response time for enquiry handling, lead time from arranging raw material and other resources, unit wise production and finally quality product supply followed by after sales services against customer requirements are the major factors in gaining the reputation of steel producers. Quality is such a relative term, it is important to define and specify by the customers to the producers the actual quality they need e.g. ultra high purity steel with low concentrations of interstitial elements, inclusion content their shape/ size distribution, defect free product with internal soundness meeting properties of end products.

There is widespread demand that mini steel plants should pursue superiority in both customer satisfaction and productivity of the plant. These two goals are not always compatible If a plant improves productivity by "downsizing," it may achieve an increase in productivity in the short-term, but future profitability may be threatened. There are potential tradeoffs between customer satisfaction and productivity for steel industries. If efforts to improve productivity can actually harm customer satisfaction and vice-versa the downsizing mini steel plants should be viewed with concern. This follows developing better understanding of how customer satisfaction and productivity relate to each other of substantial and growing importance, especially in light of expected continued growth of the plants throughout the country's' economy.

Management has to investigate whether conditions exist under which there are tradeoffs between customer satisfaction and productivity. One school of thought in the management team arguing as customer satisfaction and productivity are compatible, improvements in customer satisfaction can decrease the time and efforts devoted to handling returns of products on quality ground, rework at the producers end or customer premises adding extra cost, warranties, and complaint, while at the same time lowering the cost of making future output. The second thought argues that increasing customer satisfaction should increase costs, as doing so often requires efforts to improve product attributes or overall process and process design.

A conceptual framework useful in resolving these contradictory viewpoints are suitably solved jointly by producer and customers. The framework serves, in turn, as a basis for developing a system relating customer satisfaction and productivity of producers. Also, this system predicts that customer satisfaction and productivity are less likely to be compatible when customer satisfaction is relatively more dependent on customization—the degree to which the plant's offering is customized to meet heterogeneous needs of customers—as opposed to standardization—the degree to which the plant's offering is reliable, standardized, and free from deficiencies and when it is difficult (costly) to provide high levels of both customization and standardization simultaneously.

The Indian metals and steel sector benefits from robust demand from key buyer sectors like automotive, construction, and increased government spending in infrastructure improvement (construction of roads, railways, ports and airports) worth USD 1.4 trillion between 2020 and 2025. However, supply chain disruptions and high input prices are issues because metals and steel sales prices have not increased enough to compensate for the rise in energy and raw material costs (coking and thermal coal, refractories and ferroalloys). While the Indian government removed import duties on raw materials like coking coal in May, it has also imposed export duties on steel products, to curb inflation and to increase supply in the domestic market. The resulting excess capacity triggered a price decrease of about 20% for finished steel goods. Therefore, the increase in profit margins seen in 2021 will not continue in 2022. That said, the government is likely to cut or abolish the duties again, which should help to support exports of key steel products, and partly compensate for sales price decreases in the domestic market.

China's Policy of Induction Furnace Steel Making – China banned induction furnaces for steel making in a crackdown on polluting producers as low-quality steel, but these machines have made their way to parts of Southeast Asia, hitting domestic steelmakers and fueling safety and environmental concerns. The Philippines and Indonesia have seen an influx of these furnaces since China prohibited their use for steelmaking in June 2017, eliminating 140 million tonnes of capacity - or just over the combined output of the United States and Germany. The two Southeast Asian nations - big steel importers with fast-growing economies - are ideal markets for these induction furnaces which produce cheaper steel. But some big Indonesian and Philippines steelmakers claim that IF-produced steel does not meet national quality standards and poses a major risk in these countries that are prone to earthquakes and typhoons.

They have urged their governments to ban IFs. Unlike electric arc furnaces, IFs have limited or no capacity to remove impurities in the process of producing steel, resulting in inconsistent product quality. Since most IFs in the two countries produce rebar, which is used in construction, rival steelmakers say that IF steel posing safety hazards. In the Philippines, "the rebar market is under attack from IF producers" which sell the product 20 per cent cheaper than those from electric arc furnaces, said Roberto Cola, president of the Philippine Iron and Steel Institute.

In Indonesia, after China banned IFs, the furnaces were imported by factories to reduce steelmaking costs at the expense of safety, said Silmy Karim, chief executive of top Indonesian steelmaker Krakatau Steel. Though China is the Global Leader of steel production but is in a bad mood, as reported by Beijing-based commodities consultant Mr. Simon .In china, steel inventories are slowly piling up in the warehouses of the country's steelmaking units as well as in the provinces.

The steel mill owners are of the opinion demand for steel will continue to fall crippling construction activities and there is negative energy all round and entire steel industry which is just not making even any profit. As such, steel being the key raw material in the manufacturing and construction sectors continued to grip the Chinese economy's growth engines resulting property construction and infrastructure development eroding steelmaking profitability. Still, many plants are now operating close to full capacity, at more than 90% despite thinner profits or even at negative margin.

China's steel industry has traditionally focused on the production of 'long' products, which are widely used in residential and non-residential

construction such as bars, wires, tubes and sections. However, in recent years, higher value 'flat' products, which are used extensively in manufacturing (such as steel strips and sheets), have accounted for a rising share of production. Although China can satisfy most of its own steel requirements, the composition of its production has meant that over recent years failing around 2-3 per cent of good quality higher grade steel. Indian induction furnace has the opportunity of filling such gap for their reputation on quality of products.

Steelmaking capacity in India has been expanding rapidly in recent years, and the country has recently become the second largest economy in terms of capacity. Further growth is expected in the short and medium term to meet steel demand for infrastructure projects opening up opportunities of capturing international market demand improving steel quality. Most of the entrepreneurs of Indian mini steel plant have decided to set up liquid steel reefing facilities and taken various steps for product and process development reducing cost of production. China's National Development and Reform Commission has decided about issues like elimination of overcapacity banning incorrectly labeled low quality steel mainly produced from induction furnaces at small mills which are identified as polluting producers and responsible for producing sub-standard/ poor quality products. The IFs banned induction furnaces have made have made their way to parts of Southeast Asia, hitting domestic steelmakers and fueling safety and environmental concerns.

The two Southeast Asian nations - big steel importers with fast-growing economies - are ideal markets for steel. Both the countries are claiming that steel produced in their country from Chinese supplied IFs are not meeting national quality standards and posing major risk in these countries that are prone to earthquakes and typhoons. They have urged their governments to ban IFs in their countries.

Change of Perception: To move forward for entering in global market, it is believed that pre and post sales services of quality steel product supply are more likely to have the preceding characteristics of growth. Hence, tradeoffs between customer satisfaction and productivity of plant should be more prevalent for customer services than only sale of products. Although this classification is not precise as many services are standardizable which has the advantage of allowing an initial test of the propositions.

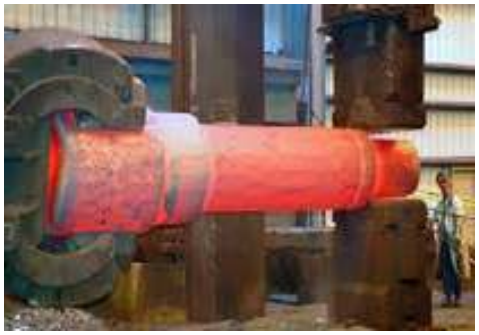
FINANCIAL YEAR	QUANTITY (MT)
2011-12	21.77
2012-13	22.04
2013-14	23.91
2014-15	25.90
2015-16	28.05
2016-17	30.39
2017-18	32.91
2018-19	35.65
2019-20	38.61
2020-21	41.82

Mini steel plants are smaller steel producing units melting steel, alloy steels from electric arc furnace or electric induction furnace using steel scrap , scrap substitute like sponge iron/ HBI, ferro-alloys etc. The liqud steel is primarily shaped as ingot or continuous casting billet/ bloom, slab/ flat etc. Several melting furnaces are engaged as casting units. Ingots produced are forged or rolled as finished products from the plants. Which are, further, re-rolled or forged for different manufacturing or processing industries. These plants meet mostly meet the requirements of the local market reducing pressure on large

scale steel plants and can produce any grade of steel ts. These plants do not require heavy investments. Steel making route from electrical energy suffers due to irregular supply of electricity and high cost.

Indian Mini steel plants: These steel plants, as decentralized secondary units scattered across the country to meet local demands, are smaller in capacity for making , shaping and treating of steel product having electric furnace or electric induction furnace having facilities of ingot teeming or continuous castng, forging , rolling unit, casting unit with heat treatment & finishing facilities. These units produce steel and alloy steel gradess like Case hardening, Cr-Mo, Cr-Mo-Ni grades, Tool & Die steel High temperature/





Steel Melting in IF, Rolling in Re-Rollin Mill, Forging in Forging Press ,

Focus on Demand in Market and Customer Need - The focus identifies the object of a customer satisfaction usually entails comparing performance to some standard which may vary from benchmark standard to general standards, competitors' performance. There are often multiple foci to which these various standards are directed including the product, consumption, purchase decision, saling methodology. The determination of an appropriate focus for satisfaction varies from context to context. However, without a clear focus, any definition of satisfaction would have little meaning since interpretation of the construct would vary from plant to plant, process to process (chameleon effects).

Timing of the Response - It is generally accepted that customer satisfaction right from handing enquiries upto end of post selling phenomenon hearing from customer about supplied product and services, yet a number of subtle differences exist in this perspective. The purchase decision of customer may be evaluated after choice prior to the actual purchase of the product based on the reputation of suppliers. Customer decision on order placement may vary dramatically over time on financial and commercial ground.

Need for Technological Up-gradation - In economics, "competition" is the rivalry among producers on cost and quality who try to achieve for staying in the competitive market increasing profits, market share, and sales volume by varying the elements of the marketing mix e.g. price, product quality, distribution, and promotion.

At production stage, productivity of workers depends upon the quantity and quality of input

used, equipment health and functioning in which they work, skill and knowledge of workforce. For higher productivity and production of quality products, the processing equipments of production have to be technologically efficient and superior. The technological options open to an economy determine the input mix like scrap, sponge iron, fe-alloys and various additives for production. The products can be produced by various technologies though process follows standard process with skill, knowledge of persons following standard operating practice with managerial and organizational expertise guidelines in line with the technological requirements of production. Thus, technology in the present stage of economic development is an indispensable factor of production.

However, all will agree that this is the age of technology, the developing countries are obsessed by the desire to make rapid progress in technology so as to catch up with the present-day developed countries leading to frantic efforts are made to install improved technology and process in mini steel plants.

Technological change for advancement is the most important factor that determine rate of financial and economic growth as It plays a important role than the capital formation. It is the technological change which can bring about continued increase in quality product as output. Thus it is the prime-mover of mini steel plant for economic growth. Technological change or progress refers to the discovery of the new and improved process in steel industry of producing semis and finished products. Sometimes technological advances result in the increase in available supplies but more generally technological changes result in increasing the productivity of processing equipments, labour, capital and other resources. The productivity of combined inputs of all factors in steel business is called total factor productivity.

As a result of technological improvement, it becomes possible to produce more quality output with same resources or the same amount of product with less resource and less rejection in cost-effective ways.

Steel making units particularly mini steel plants having induction furnace melting units of present generation producing alloy & special steels, the key performance indicator (KPI) has been considered as “improve quality.” But, it's not necessarily about arbitrarily improving quality, it's about delivering quality products consistently. For specialty steel manufacturers in particular, who produce steel for construction projects, automobile, power industry , bearing industry etc. the main consideration given as end products must meet specific standards or regulations across the entire order.

Many steel manufacturers produce on demand avoiding inventory at high level for products of precise quality, chemical specifications, property for each order. It's crucial that this chemistry make-up is tracked from beginning to end—again to make sure quality standards are precise. If at any point in the manufacturing process a variation occurs the entire batch is decided for dispatch as a less profitable grade to non-priority customers.

With regard to quality it is pertinent to compare modern day market demands with that of yesteryear. For example, the steel used to build the Titanic ship was produced in a steel plant of note and by the then best process technologies known and practiced at that time. This steel contained 650 ppm sulphur and metallographic examination revealed that MnS stringer-inclusions, up to 25 mm in length were present. By contrast modern quality requirements for linepipe steels for arctic applications would require a sulphur content of less than 10 ppm while tire cord steel would be rejected by the customer if it contains inclusions greater than 10 µm in diameter. Using modern steelmaking technologies, it is possible to produce steel with a total impurity content of less than 50 ppm. Alloy additions can then be made, judiciously and

selectively, often in vernier quantities to attain specific mechanical properties.

This approach to the production of quality steel has important consequences also for the ferroalloy industry because it places ever-increasing demands on the purity, homogeneity, size and size distribution as well as impurity content of the ferroalloys used to trim the chemical composition of the steel to perfection. It is quite apparent that the market demands imposed on the steelmaker will reflect on the ferroalloy producer because steel making in mini steel plant has to meet the stringent quality requirements referred to above in tonnage quantities. Technological advances, customer expectations and especially globalization have increased the need for higher productivity. After all, entrepreneurs of steel making industries must now compete with companies in countries such as China and India where labor costs are a fraction of what they are in most of the developed countries.

The emergence of new steel grades is largely driven by the need to produce high quality steel at a competitive price. The principal aims are to attain ultra-high purity, (especially low interstitial elements) and ultra-cleanliness (by the control of the inclusion content and size). Whereas the steel used to build the Titanic contained 650 ppm sulphur, resulting in MnS stringer-inclusions 25 mm in length, modern quality requirements for arctic pipelines would only allow 10 ppm of sulphur and inclusions in ball-bearing steels must be smaller than 5µm. Most developments are aimed at hot-metal treatment before refining and ladle treatment after decarburisation. Because ferroalloys are added during or after the refining step, it is the secondary (ladle) refining production technologies that are of specific interest to the ferroalloy producer. Through ladle treatment, hydrogen and nitrogen contents are reduced, ultra-low levels of solute impurities are attained and the shapes as well as the composition of inclusions are modified.

Steelmakers are concerned about the cost effectiveness of the use of ferroalloys such as consistent product analysis and delivery, improved financing arrangements and technical support. Minimal variation in product sizing is vital because it impacts on handling problems and because particle size determines the rate of particle dissolution. The required ferroalloy product quality depends on the specific use but in general sulphur, phosphorous and nitrogen contents are of concern. Apart from the presence of trace and impurity elements, ferroalloys also contain inclusions. For example, ferromanganese may contain MnO-MnS-SiO2 inclusions while high-carbon ferro-chrome may contain different kinds of Cr-Mn-spinels. The presence of these impurities and inclusions has a significant impact on steel production techniques and cost and hence, on the selection and use of ferroalloys. The interrelationship between ferroalloy quality and steel production technology is plant and product specific and hence, effective communication between ferroalloy suppliers and steel producers is essential.

Significant benefits of Technology Up gradation – Technology up-gradation is an initiative that encourages the adaptation of apt modern technology or up-grading existing process which would aid induction furnace steel making, shaping and treating of steel which will, together, helps to increase their sustainability. Such activity is an essential component of every successful steel business. Until and unless steel making, shaping and treating is aided by technology product does not meet the standards of modern day customers and this negatively impacts the revenue of businesses. In case of MSMEs, if the business is not able to generate sufficient revenues, it would not be able to grow.

The most important areas for improving Performance in mini steel units are:

? Input-Output Conversion Cost,

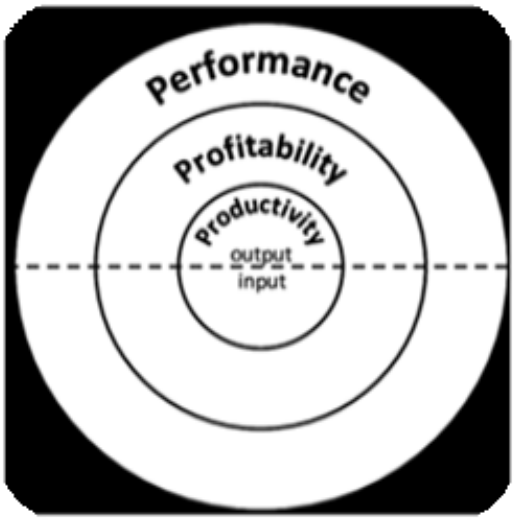
? Output value = Output Quantity X Unit Price

? Price Recovery= Unit Price/Unit Cost

? Profitability = Productivity X Price Recovery ,

? Productivity and Profitability relationship where -

? Input Value = Quantity Used X Unit Cost

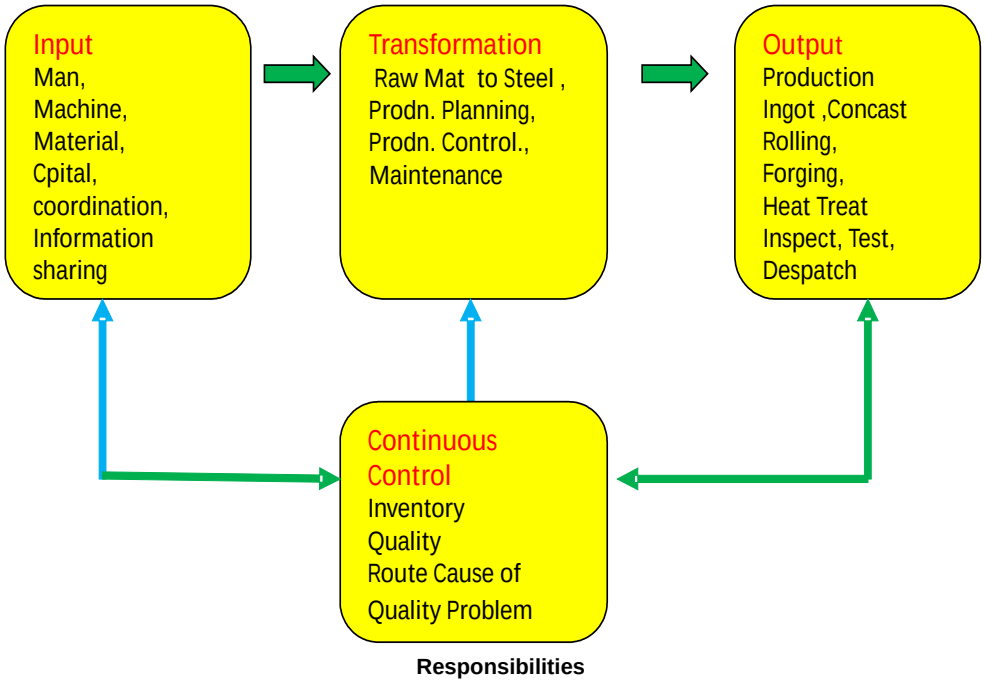


In today's technology driven world where there are cutting-edge and developed products to suit customer preferences, MSME steel business should be technologically driven if it were to survive in the cut-throat competition. Moreover, having technically advanced production system will make it more efficient ensuring minimizing associated cost. Mini steel plants with EAF/ IF are normally secondary steel producers located near consumer markets & based mainly on steel/iron scrap and scrap substitute, sponge iron, HBI/ DRI, final products as making billet/bloom by rolling using or CCM (continuous casting machine) to cast billets for further rolling of mainly of mainly long products. Also ingot products are forged in different shapes by forging in hammer or press. Enabling steel business with the latest technology may be financially difficult, especially for MSMEs which have limited access to capital. However, benefits come to the plant as : Improvement of Productivity & Profitability , Minimize investment cost, Product Quality Improvement, Control of Rejection and Wastage, Reduce operating and maintenance costs, Security and investment protection, Centralized process and yield control

In a formal sense, productivity in mini steel plant refers to how well the unit converts input (such as labour, materials, machines and capital) into steel products or output followed by services to customers. But today it is no longer limited to measuring ratios of inputs and outputs. Basically, increasing productivity just means smart working for opportunities to improve efficiency in the plant. Considering the key areas like equipment health, quality of inputs, strict adherence of standard process can help the plant to reduce the risk of costly errors improving the way of doing steel business. Before buying any equipment plant should be sure for being familiar about process limitation and apparitional characteristics which will, hopefully, meet currant and future needs. For ay modification or replacement of part/ component or unit as a whole, short term or long term investment should be critically examined before taking action. Regular monitoring activities, hopefully, will improve performance.

Performance of Plant is, normally, assessed by Customers by objective study. Outsourcing by management can be a cost effective for value addition to focus efforts on what production units in steel making business making productivity gains. This should be decided for choosing to outsource logistics, accounting, payroll, logistic supports, various handing system/ execution of plant activities grasping what drives costs and profits in the plant properly assessing current production and costs such as location, shipment and client/

Feedback Mechanism & Perfomance Monitoring



Responsibilities

1.Enhance Skill	2.Maintain Equipment Health	3.Meet Customer Requirements	4.Calculate Product Cost and ROI
5.Action Taken for Growth	6.Synchronize Internal Activities	7.Plan Production, Knowing Demand	8.Translate Activities Financially

supplier proximity examining the core functions which increase revenues and noncore functions increase expenses affecting productivity of plant.

However, trend is also there that some entrepreneurs don't tap into outsourcing opportunities because of fear of losing control of business or are concerned about expenses. Therefore, right steps are to be taken examining cost and quality of services from outsourcing agencies.

Conclusion: Building a profitable steel business by mini steel plant is challenging and running it in sustainable way is too tough due to various constraints and limitation, but support from ministry is available for all the times in the critical areas beyond control of entrepreneurs. However, management has to rethink and re-imagine possibilities all the possibilities of achieving results. It is amazing to see and feel how far process technology and process development like secondary refining unit, installation of concast route in mini steel unit have transformed steel making, shaping and treating of products meeting stringent quality and property requirements optimizing cost translating traditional way of production process. Today's leaders are facing with an incredible opportunity to carve out future of steel business by importing the principles of sustainability into plant strategy focusing on employee's output and profit. The onus lies with management figuring out right balance of profit and cost between short and long term priorities in creating enhanced values in the market.

Steel Bright Bar Production, Process and Application Areas

P. Mishra
Sr. Executive Director, AIIFA

Introduction: Specific shapes, mechanical properties, defect-free surface, bright finished appearances are essential quality and property requirements of steel bright bar. Grade selection depends upon specific areas of industrial application, medical, construction or any other consumer application. Hot working and then Cold working of hot rolled products are the major operations for these products as metal working operations that plastically deforms carbon, alloy and stainless steel below its recrystallization temperature as each alloy grade has a unique recrystallization temperature which is around halfway of the metal's melting point, for steel it is coming around 700? C or even below at room temperature.

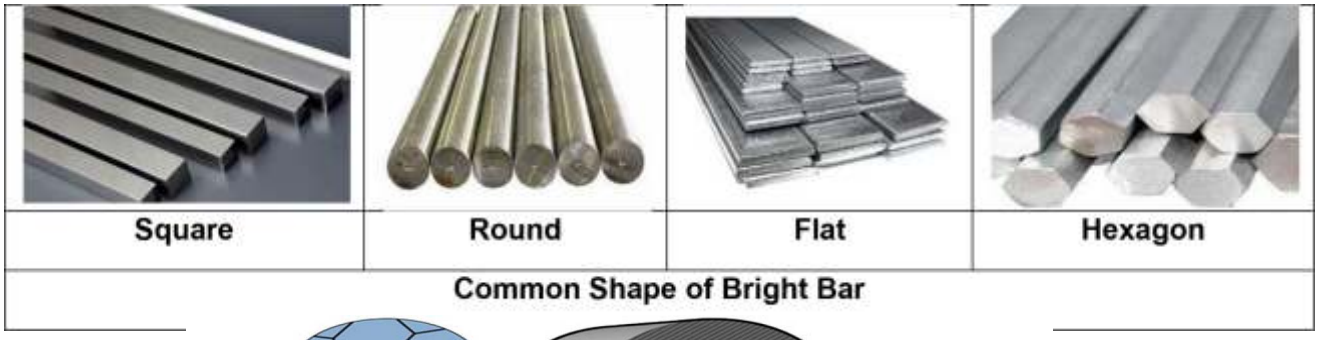
Melting and Refining Steel: Steel scrap, Sponge Iron Fe-alloys, preferably low carbon ferrochrome is melted in EIF or EAF. Liquid steel is primarily shaped as ingot or Concast billet/ bloom/ slab. At places units are equipped with VOD or AOD. Both the refining are the dominant methods for refining stainless steels with low carbon contents. Compared to VOD refining process, AOD process is popular because of resulting higher metallic yields with lower material costs ending up accurate chemical composition even down to 0.01% carbon or less lowering rapid desulfurization to less than 0.001%.

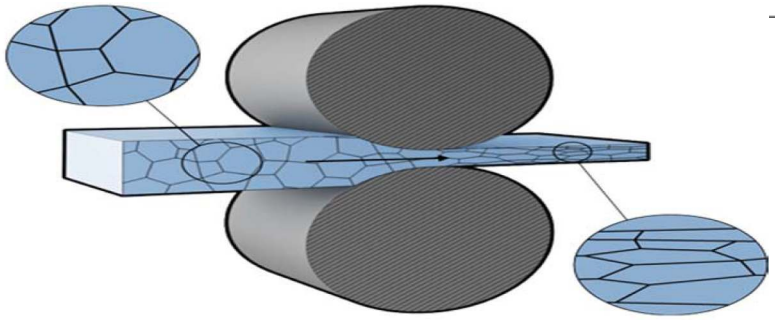
Shaping Operations:

Primary Shaping - Liquid steel is initially shaped for producing bright bar by hot working either Concast billet, rolled billet or pencil ingot forged flat. Hot working temperature by rolling Concast billet or ingot forging varies between1200–1220" C i.e., much above the recrystallization temperature depending on steel grade which is approximately 0.75 of melting temperature of grade. In rolling operation, the stock is passed forward and backward through a pair of rolls reducing the thickness between the rollers in incremental ways in each pass. In case of forging ingot is forged in open die forging or press.

Finally, the rolled or forged products are given final shaping by squeezing to get the shape by cold rolling operation of material with a high degree of dimensional and mechanical precision, as well as excellent reproducibility and interchangeability.

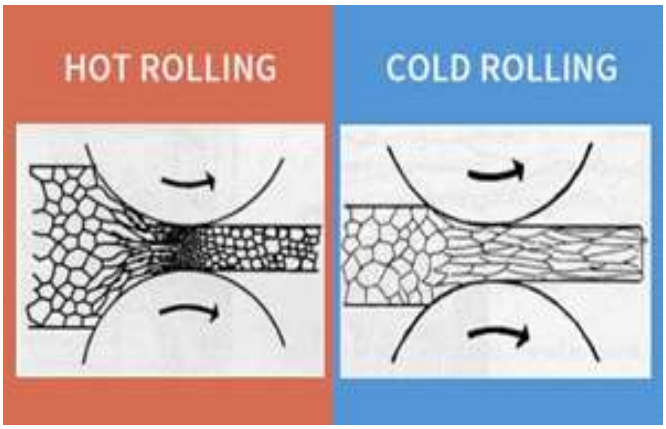
Final Shaping - Cold working of hot worked products is the final shaping process which is the result of intentional activity because strong materials with good surface finish are desirable in many applications. Normally, metal becomes harder when deformed due to squeezing activity at the atomic level occurring work hardening under stress when atoms in its grains dislodge and "lock" into place. Thus, the addition of work, or energy, makes the metal stronger. These processes are common in aerospace, automobile and many other industries.





Structural change during Hot rolling

Cold working: This process is usually performed at room temperature, but may be at mildly elevated temperatures to provide increased ductility and reduced strength. Effects of cold working results in • higher stiffness, reduced strength, malleability of the metal, improves. fatigue and wear properties achieving superior dimensional control where secondary machining may be avoided. Contamination problems in bright bar products are minimized.



Shaped Products are square bar, Flat bar, round bar, hexagonal bar other shaped bars used in the areas like Automotive, Production of equipment's, Construction/ Power Generation equipment's, Construction/ Housing Projects, Rlys, other general application.

The main difference between hot and cold work is the working temperature for deformation/ shaping. Recrystallization is an important phenomenon in metallurgy where metal atoms are energized to a point at which new crystals start forming. Cold rolled steel, sometimes abbreviated as CRS and is well-known for being an extremely ductile material and ideal for applications where precision is necessary. It is used in many applications, like household appliances, furniture, lockers, filing cabinets and in construction applications.

The addition of work, or energy in the metal makes the bright bar stronger. Cold working is often the result of intentional activity because strong materials with good surface finish are desirable in many applications. These processes are common in aerospace, automobile and many other industries.

In cold reduction, critical reduction ratio is about 30 % mostly varying in range 25-35%, The reduction ratio simply refers to how much area compression occurs when producing bright bar from hot rolled bar. Interestingly, the reduction ratio of 12:1 was once the norm and resulted in quality applications, but that is not happen at present.

Process Metallurgy- Different grades of steel can be melted in EAF or EIF and liquid steel is hot shaped either as ingot or concast billet/ bloom/ round which are prepared as hot rolled bar normally in 2-hi rolling mill which are input material for cold rolling producing closest dimensionally bar and finally the bright produced are polished as bright finish bars. Normally during hot rolling 50-70% reduction is possible depending upon grades and reduction ratio of 25-35% during cold drawing/ rolling of hot rolled products take the shape of bright bar. The other way of producing hot rolled bars are pickled and drawn through a Tungsten Carbide Die.

For special applications, the Hot rolled bars are subjected to cold drawn in Turning machine for squeezing in proper shape to attain a specific size. The final product is called 'Cold Drawn Bright Bar' as the production process does not require external heating. Commonly produced shapes include Round, Flat, Rectangular, Hexagon, Square or any other Shape as per requirement. Bright Bars are preferred over traditional hot rolled bars because of, Brighter, cleaner and defect free surfaces, higher, accurate tolerance levels. These qualities allow the bar to be utilized in high performance, maximum stress conditions.

In the bright bar process technology, hot rolling, normally, do not generate defects if heating and soaking is proper. Only defects in steel like seam, blow hole, inclusions etc. are exposed. Further, such defects during cold reduction are elongated. Better, hot rolled bars should be inspected before cold rolling/ drawing and defects are to be removed by hand grinder fitted with 180 grit emery paper before cold rolling.

However, at many places, the brightness of bright bar is made maintaining reduction ratios as low as 6:1 which are now established as standard process for many applications. Liquid steel should be inclusion, blow hole free, better casting practice both in CCS and ingot is to be ensured. In case hot forged bars, the reduction ratio of 4:1 is considered as a standard and in case of higher sizes, 3:1 is also acceptable. **Cold drawn bar** is subjected to further fine-finishing processes such as annealing, turning, grinding, polishing etc.

In cold rolled process product is strengthened changing shape without using heat. Strain hardening can then increase the metal's strength by up to 20%, and can also improve metal's surface finish. During cold rolling process, when the metal is put under mechanical stress, it causes a permanent change to the crystalline structure causing increase in its strength often improving corrosion resistance. Along with improving its surface finish, another advantage of cold rolling is better dimensional accuracy.

Stainless Steel Bright Bar - Cold rolled stainless steel is processed in the types Austenitic, Ferritic, Martensitic, Precipitation hardening mostly in coil form as precision manufactured rod, wire allowing the product to extremely tight tolerances. The act of work hardening the stainless-steel material through cold rolling allows to achieve various levels of tempering, such as quarter-half- and full hard. The hardness level depends on how much cold work has been done on the steel. Quarter-, half-, and full hard stocks have greater amounts of reduction (sometimes up to 50%). This increases the yield point but decreases the ductility of the steel.

Nominal Properties of Common Stainless Steel Bright Bar

AISI Type	301	304	3004L	309S	310S	316	316L
Yield Strength (0.2% Offset) MPa	275	290	270	310	310	290	290
Tensile Strength MPa	755	580	560	620	655	580	560
Ratio of Yield to Tensile (%)	36.4	50	48.2	50	47.3	50	51.8

Major Chemical Elements Common Stainless Steel Bright Bar (AISI)

	301	304	304L	310S	316	316L
Carbon	0.15 max	0.07 max	0.03 max	0.08 max	0.08 max	0.03 max
Cr	16-18	17.5-19.5	17.5-19.5	24-26	16-18	16-18
Ni	6-8	8-10.5	8-12	19-22	10-14	10-14
Mo	-	-	-	-	2-3	2-3

Quarter-hard stainless steel can be bent back over itself without breaking, while half-hard can be bent at a 90-degree angle, and full hard can be bent at a 45-degree angle without breaking it. Cold rolled metal is often used in applications where the metal needs to be bent without the risk of breaking. Application areas are Aerospace, Automobile, Rlys, Medical device, many cold-worked components, Blind rivets, gaskets, and shielding, many other complex shapes can be best made through cold working. However, heating of parts is not required in all the products

Conclusion: The various properties of stainless-steel bright bars e.g., corrosion resistant, high tensile strength, durable, temperature resistant, easy formability and fabrication, low-maintenance (long lasting), attractive appearance, environmentally friendly (recyclable) product with smooth and bright surface have made stainless steel bright bars attractive in construction and specific industrial applications.

Ref; Hand Book of Hot & Cold Rolling Process, Stainless Steel Data Sheet Melting Process of Stainless Steel, AISI Data - Composition and Properties of Stainless Steel

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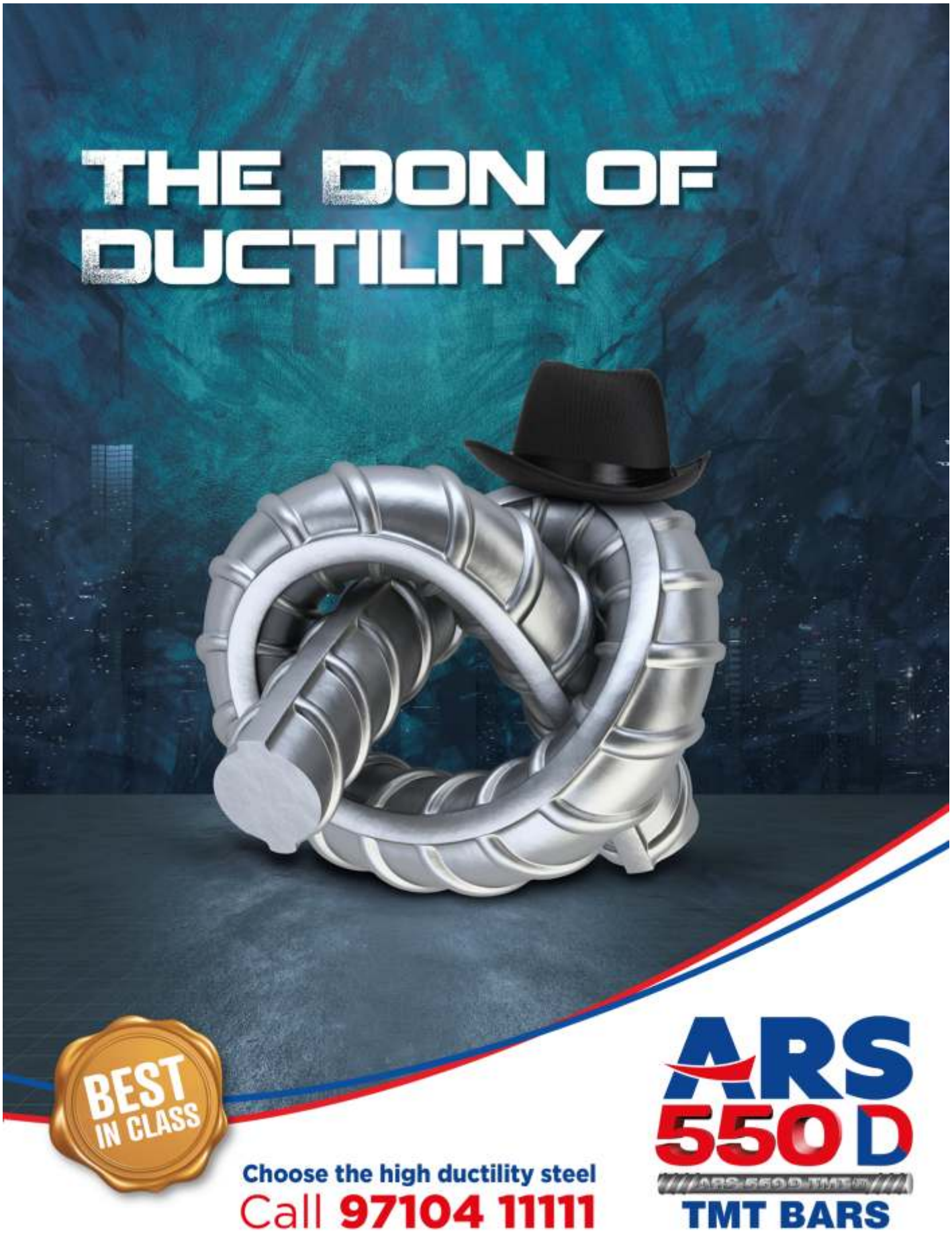
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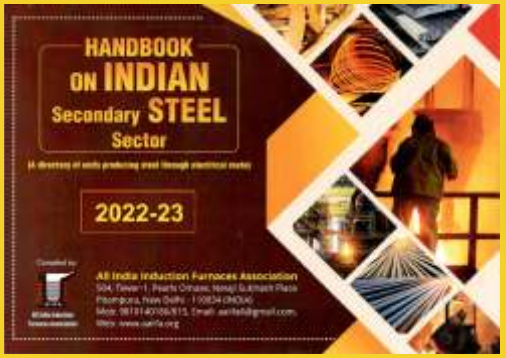

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