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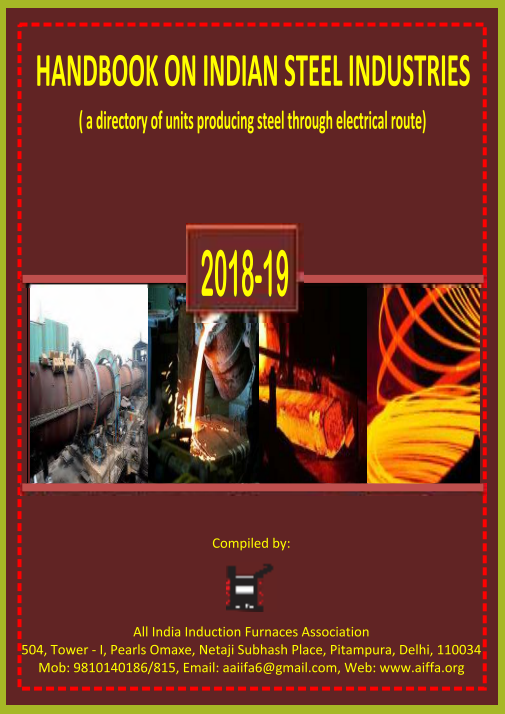

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Cost Management & Quality Steel Production in Mini Steel Plant.

P. Mishra
Sr. Executive Director, AIIFA, Delhi

Introduction : The intent of producers of Indian mini steel plants is to identify specific market opportunities that provide a more complete, overall solution to the specific customer's needs by developing a comprehensive situation analysis right from order procurement suiting to capability of equipments in the plant, conversion of quality products as output from cheap and quality inputs. Management of those units should always priorities their strategic directions on competitors' activities, consuming sectors as well as the producers' position within these markets earning anticipated revenue and also future success. The key areas for the management of the plant are performance measurement of productivity, product quality, optimization of product & process cost and revenue earning against the target stated in their plan. This persistence, hopefully, will enable the plant to both meet its objectives, as well as to react to process and product development, modernization and revamping of existing unit for improving process efficiency through operational excellences opening up challenges for entering in new areas.

In the increasingly global competitiveness, mini steel plants in India have been identified as alloy & special steel producing sectors because of contribution to their national economy. Inspite of the global economic decline within several key market segments, including automotive, engineering and manufacturing sectors, most of the mini steel plants are trying to utilize their units managing to maintain performance at optimum level satisfying customers taking challenges to overcome constraints which are beyond their control. This situation has been further exacerbated by the fact that the steel producers in mini steel plants are putting emphasis on developing new grades and products which was un-imaginable few years back exploring both domestic as well as export market availing opportunities. Even within their traditional automotive segment being the key consuming industry for alloy steels, they have been able to significantly increase penetration of an existing customer to include multiple divisions and locations of that account which have enabled the producers to invest in new capital equipment that has allowed them to more effectively serve this customer as well as pursue additional customers with similar product needs.

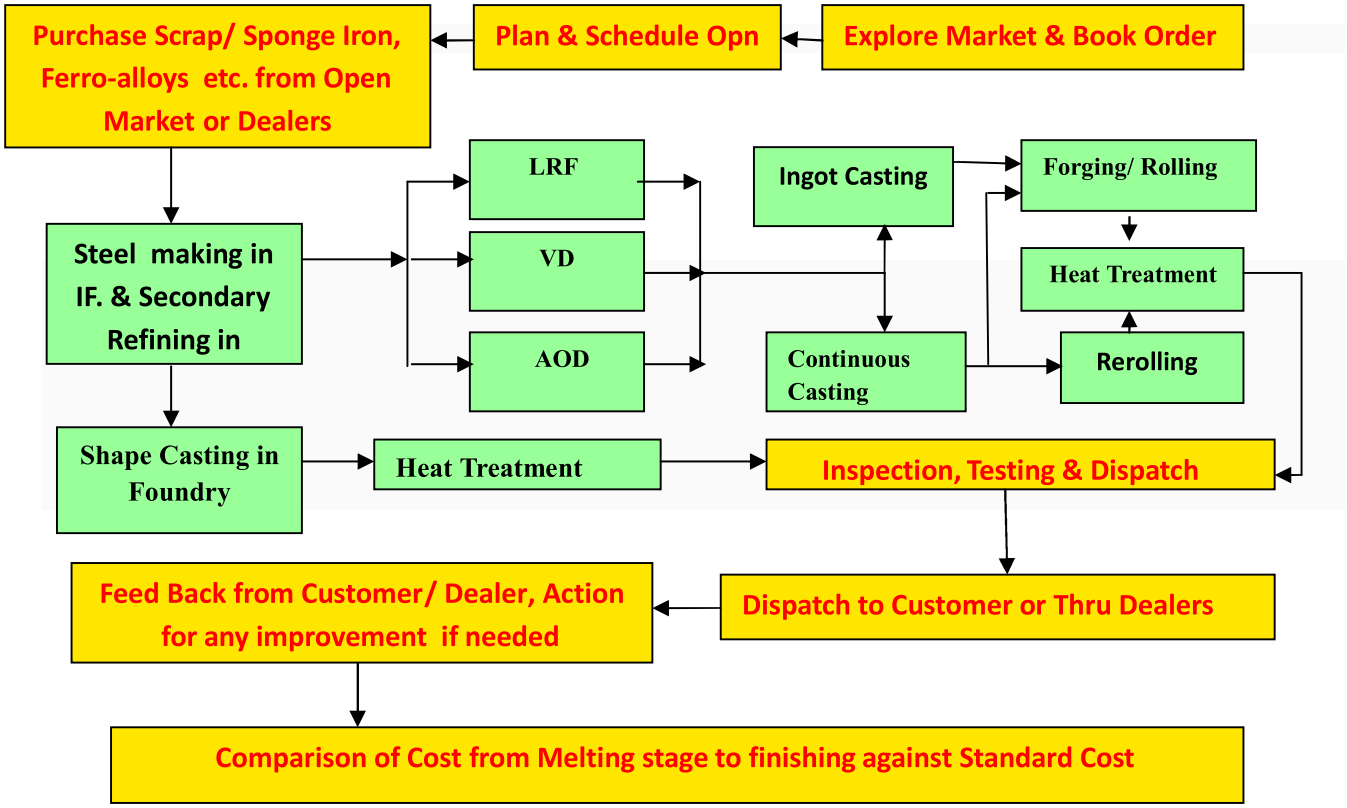
In this sector, the basis of competition has shifted more and more to the creation and assimilation of growing knowledge of entire involved personnel of the production unit in developing cost-effective process and product to perform better because the competitive advantage has opened up challenges in all the sphere of activities. In view of such situation in the market, McKinsey Global Institute (MGI) has suggested all the production and manufacturing units should set their goals in major activities very deliberately and act accordingly keeping an eye on the current and future development considering Quality & Cost as Hallmarks in most forward-looking, dynamic, and challenging ways.

Process Technology: Induction furnace steel making and liquid steel teeming as ingot or continuous casting of liquid steel either as batch or sequence strictly monitoring the activity-wise standard process parameters can benefit in various ways. This will lead to improved productivity and quality across a broad throughput range using the latest development of secondary refining processes like vacuum degassing, ladle refining, argon oxygen decarburization etc. for reduction of unwanted, undesirable and detrimental non-metallic

inclusions or trapped gas in the form of inclusions. Thus resulting liquid steel comes out free from various steel defects with lower level of harmful contaminants in the final product. The challenges to the involved working personnel and management for survival of plant demand exceptional end-product quality and high productivity, both of which are influenced by ensuring technical discipline to avoid any quality degradations which are costly for producers. It is felt that process technology of the mini steel sectors in India can be instrumental in unlocking profitability.

Mini steel plants mostly produce both low & high alloy grade alloy steel, tool & die steel, stainless 400 series steel and other group of mini steel plants roll or re-roll structural steel products and castings also. The high strength low alloy type segment in India is expected to lead the high strength steel market even beyond in 2019. The growth of this segment of the market can be attributed to the increased demand for high strength low alloy steels from the automotive industry, various engineering and manufacturing industries. These steel grades are the most widely used steels in various end-use industries as they offer superior mechanical properties such as high corrosion resistance, increased formability, and excellent weldability, among others. Likewise, tool and die steel demand will continue to grow exponentially. The ingots or concast bloom/ billet are processed either in rolling mill or forging units keeping the standard percentage reduction.

Process Flow & Operational Activities in Indian Mini Steel Plants (Having Induction Furnaces & Shaping Units)



Steel making operation in mini steel plants, mostly, is done in Induction Furnace by melting steel scrap, sponge iron, other scrap substitutes, ferro-alloys. Most of the units have installed vacuum degassing unit to produce quality steel needed in various sectors. During degassing in vacuum chamber, inert gas argon is purged in the ladle from bottom to remove the reactive gases like H, N, O and P, which negatively affect the

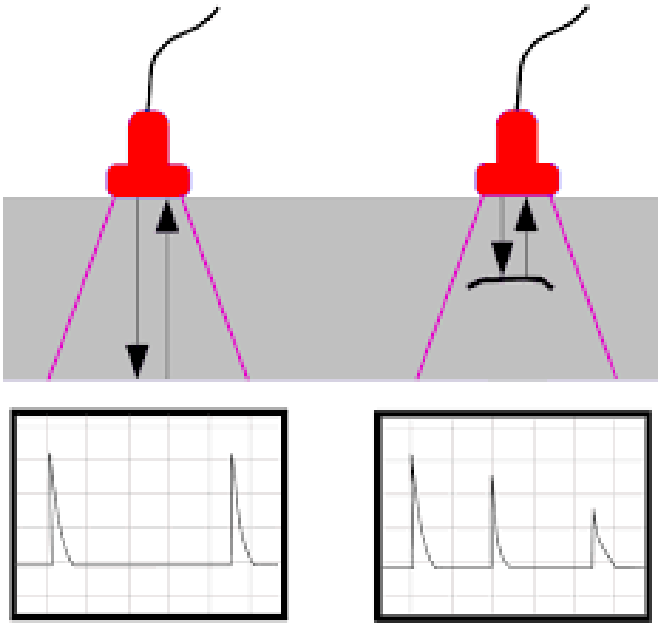
steel's performance characteristics. This degassing process, normally, lasts for approx 10-15 minutes depending upon the rate of temperature drop from calculated super heat taken in liquid steel at a vacuum pressure below 2.0 torr level. Under this vacuum level, the dissolved gases in liquid steel H,N,O,CO and inclusions are removed maintaining uniformity of temperature.

After degassing liquid steel, gas reduction is possible to the extent of H$\leqslant$ 2ppm, N $\leqslant$ 20ppm, O$\leqslant$ 15ppm. However, few units in the country have started using ladle refining furnace to produce clean and ultra-clean steel for lowering S (%) to the level $\leqslant$ 0.010. Further, only few units have installed electro slag refining (ESR) unit to produce ultra/super clean steel, suitable for application in aero-space and few other specific areas for critical application.

For improving productivity and quality reducing cost, few mini steel plants having IF units have installed continuous casting to cast liquid steel as billets for rolling re-bars (mostly TMT bar products). The structure of concast billets is similar to that of ingots, therefore, products obtained from continuous casting are regarded as semi-finished products according to their shape and dimensions.

Up heeled teemed Ingots are either rolled or forged to different dimensions against customer orders. Concast billets are, generally, intended for conversion into finished products by rolling, re-rolling or forging or stamping in various shapes. Few units have installed AOD, particularly stainless steel grades,which alters the operating atmosphere and its pressure to permit the removal of impurities, while protecting the molten steel from recombining with either contaminant gases or residual solids.

Conrtol of Steel Quality : Presence of any internal discontinuities like seam, crack, burst, pipe, flake, coarse grain, inclusions etc. in the products are checked by ultra-sonic test to find and locate the position to correlate the probable reason and source. In US test method (shown in photo), a short pulse of ultrasound is generated by means of an electric charge applied to a piezoelectric crystal, which vibrates for a very short period at a frequency related to the thickness of the crystal. This pulse takes a finite time to travel through the material to the interface and to be reflected back to the probe. The product defects should be analyzed and assessed to find the root cause of the problem whether those coming from melt shop area or shaping operations accordingly corrective action to be initiated and implemented to prevent its recurrence.



Nowadays, customers insist steel producers for supply of clean and even ultra- clean steel keeping low inclusion level. In general, inclusion generated as classified into two sources, indigenous and exogenous. Oxide particles are formed as a result of deoxidizer additions made to the steel ladle as a means to reduce the level of dissolved oxygen in the liquid steel. If these deoxidation products are not removed from the steel prior to casting, they will be present as oxide inclusions in the steel product. The inclusions generated via this process are inherent to the steelmaking process, and therefore are indigenous in nature. Exogenous source of inclusions may arise from uncontrolled oxidation of liquid steel (re-oxidation) as well as excessive melt stirring resulting in slag entrainment and refractory erosion. Indigenous inclusions usually have modest influence on material properties due to smaller particle size. They can only be minimized through process

control but cannot be eliminated completely. The presence of non-metallic oxide inclusions is a major cause of incompatibility between the attainable and desirable level of cleanliness in many grades of steel and to a great extent responsible to degrade the mechanical properties of the steel and thereby reduce the ductility and toughness of the cast metal and increase the risk for mechanical failure of the final product. Dr. Philip B. Crosby, one of the greatest Quality Guru in the World, has expalined cost of quality as two main components:

1. The cost of good quality or the cost of conformance which helps in earning reputation of the plant earning more revenue. The cost of good quality affects-Costs for investing in the prevention of non-conformance to requirements, Costs for appraising a product or service for conformance to requirements.
2. The cost of poor quality or the cost of non-conformance affects - Internal and external costs resulting from failing to meet requirements.

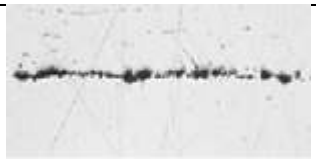
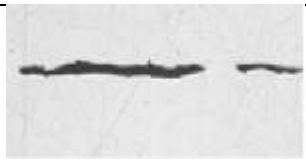
However, analysis of cause & effect of defect generation may help in controlling quality of product and process as:

1. Many times, dendritic ingot structure at the interior of forging is not broken due to insufficient penetration of force exerted by hammer as actual forging, particularly in hammer, takes place only at the surface. In such cases, press forging is the better option.
2. Cracks may penetrate on inner portion due to too low forging temperature and excessive hammering on the surface which can be reduced increasing flash thickness or relocating flash and finally stress relieving after forging.
3. Proper forging techniques or use of proper die may avoid folding on the surface, under/ over filling during forging.
4. Proper heating, soaking the stock using grade-wise correct forging temperature and removing dropped scale from die will help in giving correct output avoiding scale penetration.
5. Flakes, mostly in flake sensitive grades, are basically internal ruptures. Secondary refining of liquid steel in vacuum lowers the detrimental gases, still improper cooling may cause internal ruptures as rapid cooling causes the exterior to cool quickly causing internal fractures. Proper cooling or anti-flake cycle treatment eliminates this problem. (International Journal of Scientific and Research Publications, Volume 4, Issue 6, June 2014 -15 ISSN 2250-3153 www.ijsrp.org).
6. Improper grain flow may be seen due to improper die design and improper flow of material.
7. Slow cooling of the forging in a furnace or under ash/ mica cover over a period of time reduces the possibility of internal discontinuities.
8. In rolling also, heating and soaking the stock at prescribed standard temperature and proper disposition as per standard will improve product quality.
9. Impurities in ferroalloys may affect steel quality to some extent as most of them are having a high content of the major component, typically in range of 50-90 %, the rest being mostly iron (Fe) and more or less "residues" of reductants used in ferroalloy production. Sulfur is the most harmful impurity in steel that cannot be economically removed which forms a compound with iron, iron sulfide (FeS) and molten at the hot rolling or forging temperatures of steel.

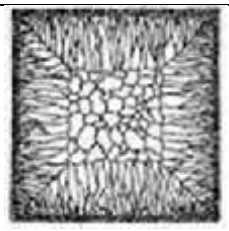
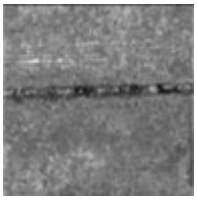
The molten FeS wets the austenite grain boundaries leading to brittle grain boundary fracture as hot

shortness during forging or rolling. Mn addition forms MnS replacing FeS overcomes this problem. However, small MnS stringers, a type of inclusion is seen in the steel. They have little effect on the toughness of the steel for deformation in its longitudinal direction (the direction of the stringers) but can dramatically reduce toughness for deformation in the transverse direction, that is, deformation at right angles to the stringers.

Sulphide, Alumina, Silicate , Globular Oxide Inclusion in Steel

			
A: Sulphide	B: Alumina	C: Silicate	D: Globular Oxide

Defects in Steel Products

					
Segregation	Gassy Heat	Flake	Forging Crack	Forging Stress Crack	Central Looseness

Cost Management and Cost Control: To run mini steel plants in effective way, management must think and consider total cost aspects in the organization as a way to support their strategy for productivity, quality, and cost as precious investment which will fuel organization's growth and reputation. They should put their money where their strategy is and continually cut bad costs and redirect resources toward good costs factoring target for Net Income which can be explained simply as Sales – (Fixed Cost + Variable Cost). After all, if management aren't directing spending to the right places, what chance do they have to grow?. However, management spends a lot of effort separating out the costs that truly fuel their distinct advantage from the ones that don't deciding where to cut and where to invest on the need for enhancing strengths enabling them to create unique value for customers.

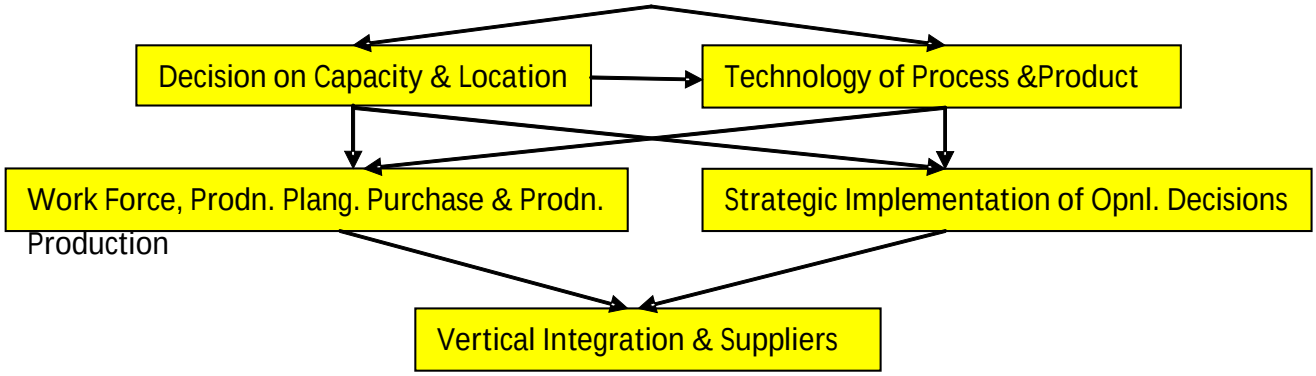
Mini steel plants are engaged in the business of making, shaping & treating of steel from different units where different activities taken place following standard operating practices. Virtually all the activities support the production and delivery of products to customer meeting quality, therefore all operational activities are to be considered in the product costs. The total costs inclusive of Logistics, Production, Marketing and Sales, Distribution, Service, Technology, Financial Administration, Information Resources, General Administration are to be suitably build up in the costing system. However, conventional economics and management accounting system treat costs as variable only if they change with short-term fluctuations

in output. Entrepreneurs have found that many important cost categories vary not with short-term changes in output but with changes over a period of years in the design, product/ grade mix/ dimension and range for customers.

To develop competitive strategy, individual plant should be in essence of the development of a broad formula for the way by which company will compete in the market (Porter, 1991). It is very important for mini steel plants to define its operational network and to identify its competitive strengths so as to plan tasks for each strength to make a forecast of the necessary resources to establish the goals and then construct a framework on the probable profitability (Porter and Millar, 1979).

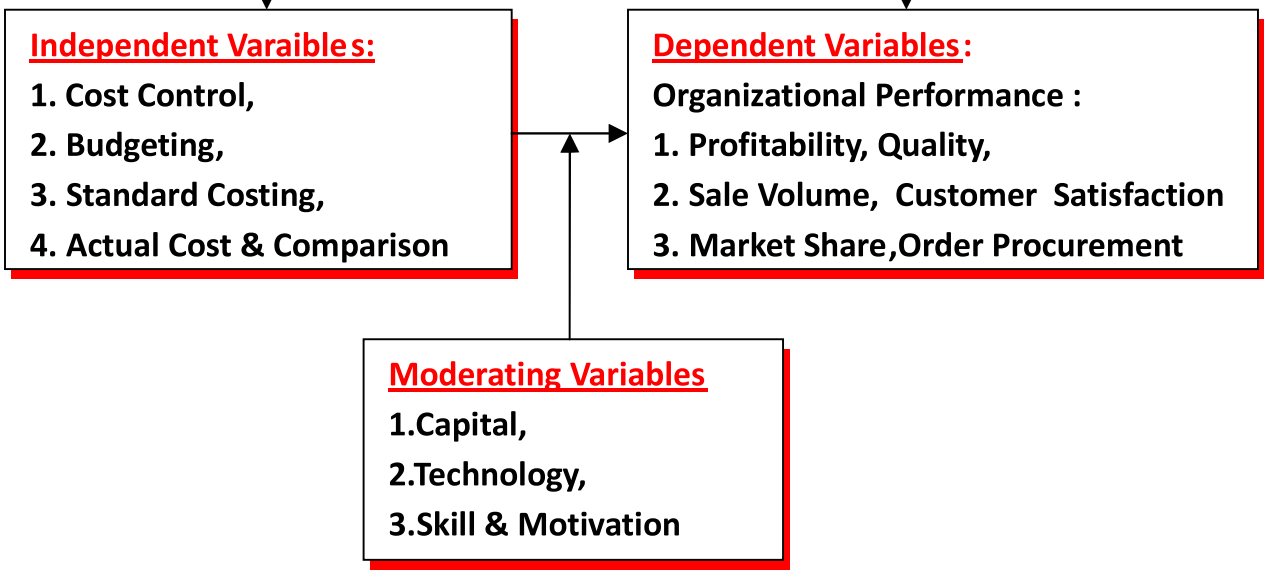
Mini steel plants should be concerned with creating consistent solutions situated between customers' needs ensuring quality and cost through operational excellences and standard practices. Skinner (1996) identified the establishment of performance measures, such as quality, production speed and volume or attendance, reliability, flexibility and costs, as the practical aspects of competitive advantage. Cost control activities in the identified areas and reducing cost against the expected results are most important function for organization to increase profit in the competitive market. Buffa (1985) already stressed that the formulation of production strategy, it would be important to consider all aspects of operational decisions which he classifies into 6 major components as basic elements for formulation of production strategy for positioning system which provide a broad scenario for choosing feasible alternatives. These have effects in the long run in the plant's competitive scenario causing impacts on costs and quality of products and also on the production flexibility intensity.

Major components for Positioning System in Plant



Cost reductions should be sought in the manufacturer's internal activities and external sourcing. Although a manufacturer has significant legal and ethical obligations in maintaining safety and health of its employees, customers, and users of its products, and legal and regulatory requirements become more and more onerous every year, companies must cut costs wherever possible. Sometimes, however, cost savings are just not possible, and the product characteristics must be scrutinized again to isolate cost savings. Despite the ever-increasing volume of liquid steel more than 90% level routing through continuous casting, production of steel ingots for forgings, rolling and machine components is irreplaceable. Steel casting into the ingots allows even for the production of oversized components of more weight. The main precondition of the competitiveness of any steel plant is production of consistently high quality and therefore, it is expected to save the processing cost and energy, improve the product yield to make the forged, rolled or casting products.

Conceptual Framework of Cost Management



Conclusion: The success of mini steel plants largely depends on the profit which it can realize i.e. cost recovered from the total process and cost incurred from all the activities. It is essential for plant to know the areas where control can be exercised to get benefits. Therefore, it is necessary to integrate the cost in all activities in the process chain for controlling cost. Technical discipline and functionality in the entire operational processes in the plant will, hopefully, improve productivity and quality of products maintaining consistent profitability ensuring smooth running of plant earning desired revenue.

Technical up-gradation of process and investment om that account, fixing benchmark in specific areas in line with leader industries will create success in production and performance. Priority has to be given by mini steel plant for customer satisfaction strengthening entire production processes and supply chain management system improving marketing network for fully loading the production units.

References: 1.Suggestion of Mckinsey Global Institute, 2. International Journal of Scientific Research Vol 4, Issue 6, Jan 2014, 3. Steel Defect, ASTM, 4.Michael E Porter, Elwood S. Buffa & Marcus C Bogne,Wickham Skineer,5. Dr. Philip B. Crosby, Quality Guru.

Rourkela Steel Plant To Be Expanded: Union Minister Dharmendra Pradhan

Rourkela: Union Steel Minister Dharmendra Pradhan said on Sunday that the Rourkela Steel Plant in Odisha would be expanded while a modernised steel cluster would be set up in Rourkela.

"Rourkela Steel Plant located in the heart of the mineral rich belt of Odisha can be a leader in steel production in India and can contribute significantly towards achieving the target of producing 300 million tonnes of steel," said Pradhan.

Rourkela Steel Plant (RSP) located in Sundargarh district has the installed capacity of 4.5 million tonnes per annum (mtpa).

Pradhan, who visited the plant on Sunday, reviewed the present infrastructure, current capabilities and future prospects of the plant.

Informing that the plant is one of the best performing steel plants of the Steel Authority of India Limited (SAIL), Pradhan urged the top management to re-calibrate their approach and further leverage new technologies and digitalisation to enhance productivity and profitability.
He reviewed a presentation on the business, processes and performance of the Rourkela Steel Plant.

Officials of RSP will explore the options for localisation of consumption of the primary steel produced at the plant. This will ensure growth of the downstream steel industry in Rourkela, Pradhan added.

Source : https://odishatv.in 30 Sep 2019

Global Steel Industry Facing Surplus Production: Dharmendra Pradhan

Indian steel industry is facing some challenges amid the ongoing trade war between the US and China, according to Union Steel Minister Dharmendra Pradhan. The minister also noted that the global steel industry is facing the challenge of surplus production.

Pradhan was interacting with reporters on the sidelines of two-day International Galvanising Conference event here. When asked if the local industry could face challenges amid the ongoing US-China trade war, the minister replied in affirmative. "It's facing," he said, without speaking further. According to official data, share of imports of finished steel from FTA countries such as Korea, Japan and Indonesia aggregated around 70 per cent of total imports to India in August 2019.

Source : https://www.khabarindia.in **20 Sep 2019**

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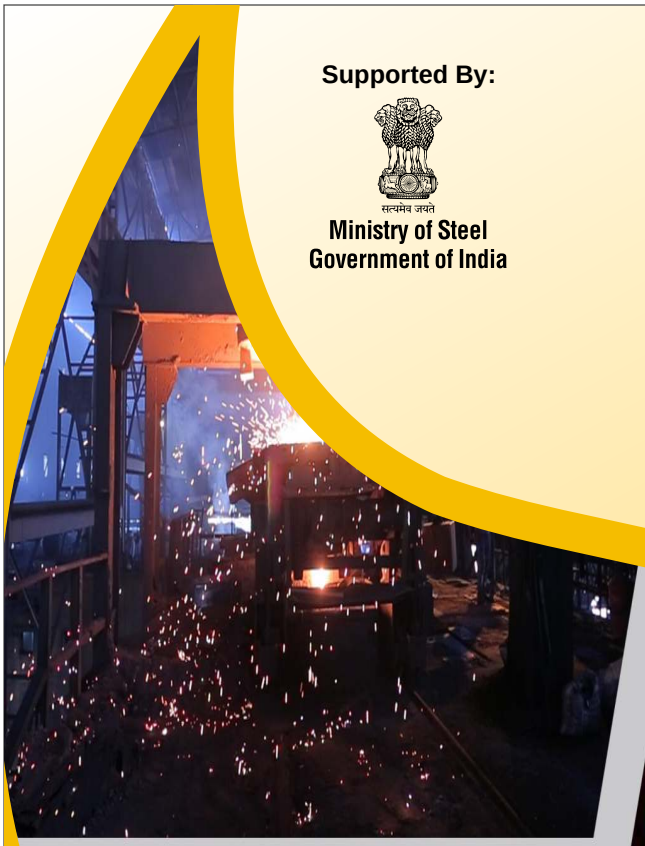

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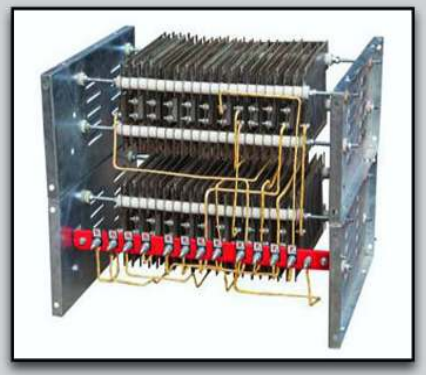

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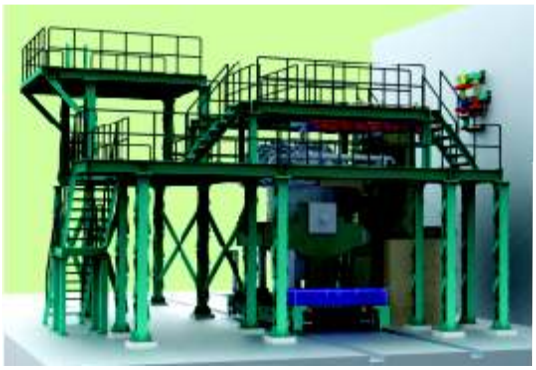

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