ALL INDIA INDUCTION FURNACES ASSOCIATION

AIIFA

NEWSLETTER

Voice of Indian Sustainable Steel Manufacturing Sector

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What's Inside

हमारे सभी सदस्यों को होली की हार्दिक शुभकामनाएँ

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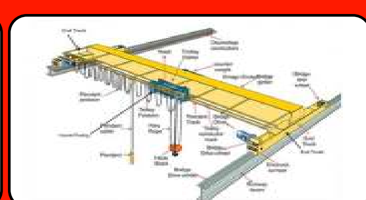
Electromagnet

- Scrap Lifting Circular Electromagnets
- Billet and Bars Lifting Rectangular Electromagnets
- Scrap Lifting Elliptical Electromagnets

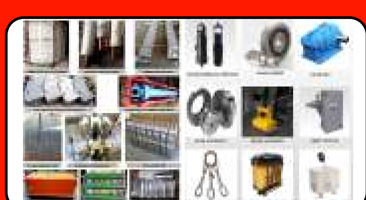

Cable Reeling Drum

- Cable Reeling Drum
- Lining Vibrators
- Electrical Control Panel

EOT Crane

- Single Girder EOT Crane
- Double Girder EOT Crane




Spare Parts & Accessories

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

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Hardenable Steel Grades Produced from Indian Induction Furnace Units

Kamal Aggarwal
Hon. Sec. General, AIIFA

Introduction-By far the largest tonnage of low cost special steels produced globally for various applications in engineering and manufacturing industries are in the types containing carbon generally 0.25 to 0.55%, or even less than 0.25% C, and usually given treatment of hardening and tempering to achieve high strength and toughness. Properties. Products from steel produced from Indian Induction Furnaces are supplied to various customers the hardenable steel grades.

Elements, normally, added during melting of carbon steel in induction furnace either singly or in combination/s are added - Manganese (Mn), Silicon (Si), Nickel ((Ni), Chromium (Cr), Molybdenum (Mo), V)anadium (V), Aluminum(Al) and Boron(B) etc. in these low and medium carbon steels to enhance the properties after quenching and tempering.Application wise, these alloy added steels are ordinarily quench-hardened and tempered to the level of achieving hardness, strength desired.

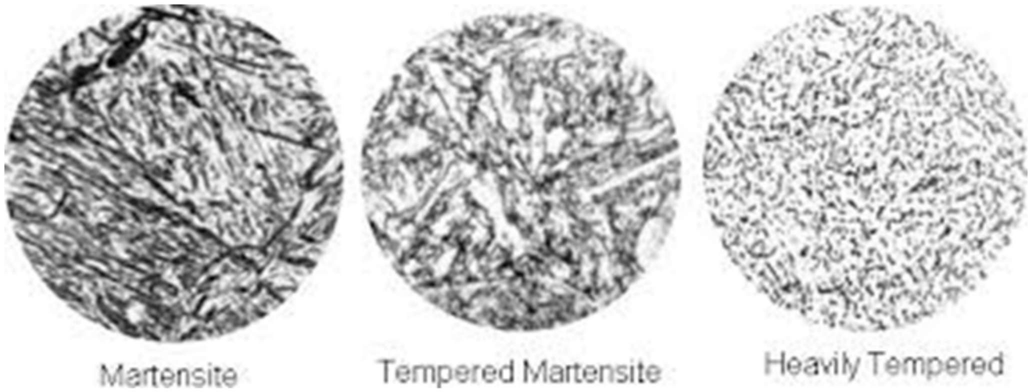
Even though the strength level at which the steel is used may be as low as, or lower than, that which could be achieved by the microstructure (fine pearlite or upper bainite) developed by a simple cooling after completion of forging or rolling operations by normalizing, still steel products are quench-hardened and tempered, which directly or indirectly reflec the engineering and economic basis of the demand for these types of steel.Grades can be hardened and tempered –

However, Low-alloy and low-carbon steel react best during the case hardening process. High-carbon steels can be case hardened, but special steps need to be adhered to in order to ensure the hardening process doesn't affect the inner core.The microstructure (tempered martensite or bainite) produced by quenching and tempering these alloy steels is characterized by a greater toughness or capacity to deform without rupture at any strength level. Similarly, under the adverse state of stress below a notch in bending, the tempered martensite may flow considerably at a testing temperature far below that at which a pearlitic steel of equal strength would break in a brittle manner; the Charpy or Izod values are thus improved.

The basic phenomenon of developing of favorable microstructure by heat treatment is manifested in plain carbon steels, but only in small sections; thus the most important effect of the alloying elements in these steels is to permit the attainment of this microstructure, and the accompanying superior toughness in larger sections.

Importance of micro-structure of steel products -The microstructures of iron and steels is complicated and diverse which is influenced by composition, homogeneity, heat treatment, process and section size. Microstructure of castings looks different than those of the wrought products even if the composition is same and even if the same heat treatment is given. Pure iron is polymorphic. Two allotropic phases exist for pure iron in solid state depending on the temperature.

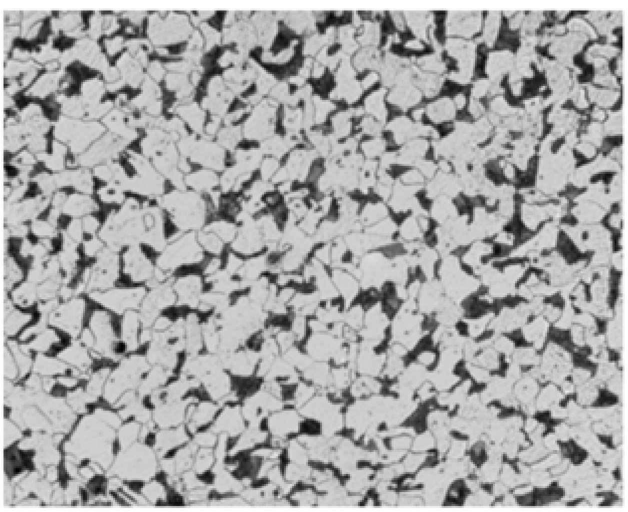
One is bcc (body centered cubic) and the other is fcc (face centered cubic). The bcc crystalline form is stable until a temperature of 912 deg C when it is transformed to fcc. The ?-iron remains stable until 1394 deg C, and then it reverts to bcc structure-iron is stable until the melting point of 1538 deg C. High purity iron is very weak. The ability of iron to accommodate heavy interstitials, namely carbon and nitrogen, is mostly responsible for the strength and the hardening effects. Hardening process changes the microstructure of the steel. the hardening process improving uniformity of the ferritic-pearlitic microstructure, and this fine grained structure induces the steel have both high strength and good toughness.



Images of Different Condition Grain Structure

Martensite results from quenching medium- or high-carbon steel. Tempering reduces martensite grain size. Fine-grained martensite are more ductile and tough when compared to coarse-grained ones.

Austentic grain size is five or finer according to the McQuaid Ehn test as detailed in ASTM Standard E112, Standard Test Methods for determining Average Grain Size which is not same as 'as rolled' grain size or 'as quenched' grain size. For specification and engineering purposes, manufacturers talk about austenitic grain size.



Fine Grained steels are more ductile than coarse grained as Coarse Grained steels have slightly higher tensile and yield strengths than Fine Grained steels. Fine Grain steels are less susceptible to grinding cracks,Less distortion in heat treatment, Higher ductility at the same hardness, Higher impact strength at the same hardness, Higher elastic ratio, Higher % elongation

Pearlite is usually formed during the slow cooling of iron alloys, and can begin at a temperature of 1150°C to 723°C, depending on the composition of the alloy. It is usually a lamellar (alternate plate) combination of ferrite and cementite (Fe 3C).

The microstructure of a steel is a fundamental aspect that determines its properties and mechanical behavior referring to the grain and phases that make up steel which are made up of iron atoms and other alloying elements, arranged in a crystalline structure. The shape and size of the grains, as well as the distribution of the phases, directly influence the mechanical properties of the steel products.

Austenite was originally used to describe an iron-carbon alloy, in which the iron was in the face-centred-cubic (gamma-iron) form. It is now a term used for all iron alloys with a basis of gamma-iron. Austenite in iron-carbon alloys is generally only evident above 723°C, and below 1500°C, depending on carbon content. However, it can be retained to room temperature by alloy additions such as nickel or manganese.

Similarly, ferrite was a term originally used for iron-by diffusion. This can begin within a temperature range of 900°C to 723°C, and alpha-ferrite is evident to room temperature. Delta ferrite is alternate plate) combination of ferrite and cementite (Fe3C). It is formed by eutectoid decomposition of austenite upon cooling by diffusion of C atoms, when ferrite and cementite grow contiguously, C precipitating as Fe3C between laths of ferrite at the advancing interface, leaving parallel laths of Fe and Fe3C which is pearlite. the high temperature form of iron, formed on cooling low carbon concentrations in iron-carbon alloys from the liquid state before transforming to austenite. In highly alloyed steels, delta ferrite can be retained to room temperature.

Pearlite is usually formed during the slow cooling of iron alloys, and can begin at a temperature of 1150°C to 723°C, depending on the composition of the alloy. It is usually a lamellar (carbon alloys, in which the iron was in the body-centred cubic (alpha- or delta-iron) morphology, but is now used for the constituent in iron alloys, which contains iron in the alpha- or delta-iron form. Alpha ferrite forms by the slow cooling of austenite, with the associated rejection of carbon

Martensite is formed in steels when the cooling rate from austenite is sufficiently fast. It is a very hard constituent, due to the carbon which is trapped in solid solution. Unlike decomposition to ferrite and pearlite, the transformation to martensite does not involve atom diffusion, but rather occurs by a sudden diffusionless shear process. The term is not limited to steels, but can be applied to any constituent formed by a shear process which does not involve atom diffusion or composition change.

The martensite transformation normally occurs in a temperature range that can be defined precisely for a given steel. The transformation begins at a martensite start temperature (Ms), and continues during further cooling until the martensite finish temperature (Mf) is reached. Ms can occur over a wide range, from 500°C to below room temperature, depending on the hardenability of the steel. The range M (start) to M (finish) is typically of the order of 150°C. Many formulae have been proposed to predict the martensite start temperature. Most are based on the composition of the steel.

The most common phases in the microstructure of steel is ferrite, which has a body-centered cubic structure. Ferrite is soft and ductile, making it suitable for applications requiring high toughness. Another important phase is pearlite, which forms when ferrite cools and combines with carbon to form iron carbides. Perlite is harder and more resistant, but less ductile.

Alloying Elements Dissolved in Austenite - Alloying elements are used to alter the mechanical and chemical properties of steel to give them advantages over standard carbon steel. While there are many alloying elements used to achieve various enhanced properties, certain elements are much more common than others. Alloy steel is a type of steel alloyed with several elements such as molybdenum, manganese, nickel, chromium, vanadium, silicon, and boron. These alloying elements are added to increase strength, hardness and toughness.

The general effect of elements dissolved in austenite is to decrease the transformation rates of the austenite at subcritical temperatures. The only one among the common alloying elements to behave exceptionally in this regard is cobalt. Since the desirable products of transformation in these steels are martensite and lower bainite, formed at low temperatures, this decreased transformation rate is essential; it means that pieces can be cooled more slowly, or larger pieces can be quenched in a given medium, without transformation of austenite to the undesirable high-temperature products, pearlite or upper bainite.

This function of decreasing the rates of transformation, and thereby facilitating hardening to martensite or lower bainite, is known as hardenability and is the most important effect of the alloying elements in these steels. Thus, by increasing hardenability the alloying elements greatly extend the scope of enhanced properties in hardened and tempered steel to the larger sections involved in many applications.

The several elements commonly dissolved in austenite prior to quenching, increase hardenability in approximately the following ascending order: nickel, silicon, manganese, chromium, molybdenum, vanadium and boron. The effect of aluminum on hardenability has not been accurately evaluated. But at 1% Al, as used in "nitralloy" steels, the effect on hardenability seems to be relatively small. Further, it has been found that the addition of several alloying elements in small amounts is more effective in increasing hardenability than the addition of much larger amounts of one or two.

In order to increase hardenability effectively, it is essential that the alloying elements are dissolved in austenite. The steels containing the carbide-forming elements - chromium, molybdenum and vanadium - require special consideration in this respect. These elements are present predominantly in the carbide phase of annealed steels, and such carbides dissolve only at higher temperatures and more slowly than iron carbide. Since the basic function of the alloying elements in these steels is to increase hardenability, the selection of steel and the choice of suitable austenitizing conditions should be based primarily on the assurance of adequate hardenability. More than adequate hardenability is rarely a disadvantage, except in cost.

Since the alloying elements have the general effect of lowering the temperature range at which martensite is formed, the thermal and transformational stresses set up during quenching tend to be greater in these alloy steel parts than those involved in quenching the necessarily smaller sections of plain carbon steels. In general, this means greater distortion and risk of cracking.

The alloying elements, however, have two functions that tend to offset these disadvantages. The first and probably the most important of these functions is that of permitting the use of lower carbon content for a given application. The decrease in hardenability accompanying the decrease in carbon content may be offset very readily by the hardenability effect of the added alloying elements, and the lower-carbon steel will exhibit a much lower susceptibility to quench cracking.

This lower susceptibility results from the greater plasticity of the low-carbon martensite and from the generally higher temperature range at which martensite is formed in the lower-carbon materials. Quench cracking is seldom encountered in steels containing 0.25% C or less, and the susceptibility to cracking increases progressively with increasing carbon content.

The second function of the alloying elements in quenching is to permit slower rates of cooling for a given section, because of increased hardenability, and thereby generally to decrease the thermal gradient and, in turn, the cooling stress. It should be noted, however, that this is not altogether advantageous, since the direction, as well as the magnitude, of the stress existing after the quench, is important in relation to cracking.

In order to prevent cracking, the surface stresses after quenching should be either compressive or at a relatively low tensile level and, under certain circumstances, lowering the cooling rate may lead to increased tensile stresses at the surface, thus increasing the tendency to crack. In general, though, unless a study of the particular piece being quenched indicates that it falls within this category of increased susceptibility with decreased quenching rates, the use of a less drastic quench suited to the hardenability of the steel will result in lower distortion and greater freedom from cracking.

Furthermore, the increased hardenability of these alloy steels may permit heat treatment by "austempering" or "martempering", and thereby the level of adverse residual stress before tempering may be held to a minimum. In "austempering", the work piece is cooled rapidly to a temperature in the lower bainite region and is allowed thereafter to transform, completely at some chosen temperature. Since this transformation occurs at a relatively high temperature and proceeds rather slowly, the stress level after transformation is quite low and distortion is held to a minimum.

Role of Alloying Elements in Tempering - Hardened steels are softened by reheating, but this effect is not the one actually sought in tempering. The real need for increasing the capacity of the piece is to flow moderately without fracture, and this is inevitably accompanied by a loss of strength. Since the tensile strength is very closely related to hardness in this class of steels, as heat-treated, it is satisfactory to follow the effects of tempering by measuring the Brinell or Rockwell hardness. The statistical mean of the relationships among.

Steels with 0.45% C with increase in the tempering temperature, for one hour. Somewhat shorter or longer intervals at temperature would show little difference in hardness values.As a first approximation, the softening pattern of steels similar but differing in carbon content through the range from 0.25 to 0. 55% C .The effect of carbon content on the hardness of the tempered steels is much greater for the lower tempering temperatures than for 649oC and higher, and that the effect likewise decreases when there is more than 0.50% C.

Chromium, molybdenum and vanadium, on the other hand, which migrate to the carbide phase when diffusion is possible, bring about a retardation of softening, particularly at the higher tempering temperatures. These elements do not merely raise the tempering temperature; when they are present in higher percentages, the rate of softening is no longer a continuous function of the tempering temperature. That is, the softening curves for these steels will show a range of tempering temperature in which the softening is retarded or, with relatively high alloy content, in which the hardness may actually increase with increasing tempering temperature. This characteristic behavior of the alloy steels containing the carbide-forming elements is known as "secondary hardening" and results presumably from a delayed precipitation of fine alloy carbides.

Alloy & Special Steel Production from Electric Induction Furnace For Manufacture of Mining Equipments

P. Mishra
Sr. Executive Director, AIIFA

Activities in Mine with Steel Equipments

Introduction:- Modern processing in mines involve prospecting for ore bodies, analysis of the profit potential of a proposed mine, extraction of the desired materials, and final reclamation or restoration of the land after the mine is closed. Mining is the removal or extraction of minerals and metals from underground. Some materials mined are iron ore, gold, coal, etc. The mining industry requires a lot of custom-made equipment. Steel, alloy steels fabricated are perfect for the mining industry.

Operational activities are carried out by safe working with a team of man-machine-and computerized equipment. Steel products in various grades are used in the equipment and machineries to make vehicles in mining industry rather than use of other metal like aluminum. Steel is used to manufacture tools & tackles, conveying & transportation throughout the mining industry and has been developed to have high wear, fatigue resistance, and high hardness,strength. With high tensile strength and high wear resistance, steel equipment can be used multiple times in mining without material depreciation.

Ideal Properties of Steel Best Suited for Mine Applications – Mining grade steel is generally *stronger and more durable than aluminum for* making it suitable for heavy-duty applications. Because of high melting point of steel compared to aluminum, more heat-resistant and less likely to warp or deform at high temperatures. Steel is also *more resistant to impact and fatigue* than aluminum, which makes it suitable for use in vehicles and other machinery that undergo constant stress and wear in handling mining products either during mining excavation or processing activities in mine also as low cost product than aluminum and widely used for large scale manufacturing process in mines.

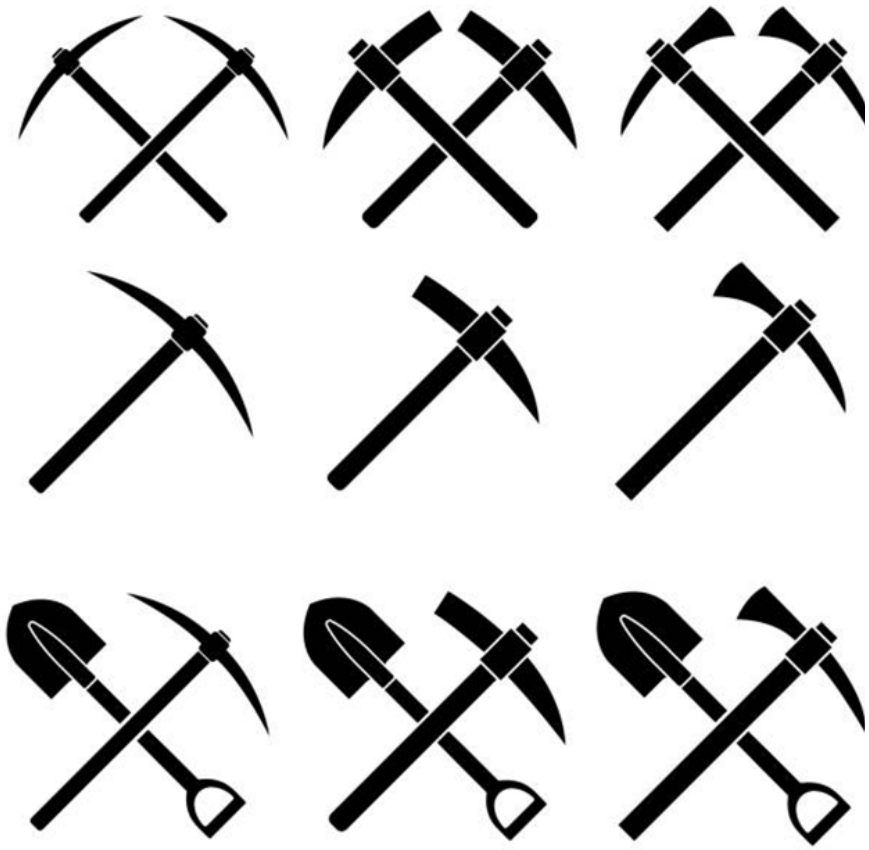
Steel Grade and Products – Application wise, there are wide ranges of product of carbon steel, high strength low alloy steel, tool steel grade of long, flat and forged product in different steel grades which have a wide range of applications in the mining industry for durability as well as various properties as inexpensive. Temperature and corrosive resistant properties of steel help in withstanding rough and abrasive mining environments. The quality of steel has to be high quality products to endure the above said scenarios..

Tools like Top hammers, tools, demolition equipment, drill rigs, mining support equipment, grinding media, mining screens, fluidized bed boilers, pumps, heat exchangers, as well as heavy mining machinery such as mass excavators, bulldozers, shovels, and crushers all have to rely on the material properties of steel.Steel grades that are regularly used and deemed the top series from each type include Carbon steels: A36, A529, A572, 1020, 1045.

Carbon Steel Gradecommonly used (presence of elements nominal)-

A36 consists of carbon (C) content 0.25 – 0.29%, Copper (Cu) content 0.20%, Iron (Fe) content 98.% Manganese (Mn) content 1.03 percentage, Phosphorus (P) content 0.04 percentage, Silicon (Si) content 0.280 percentage and Sulfur (S) content 0.050 percentage.

A529 carbon steel, commonly used in construction, is a low-to-medium-carbon steel containing varying amounts of C. Mn, Si, P & S and Cu. It offers moderate strength and is suitable for structural applications where high strength is not a primary requirement.



Common Mining Tools Manufacture from Steel

ASTM A572 steel plate is a popular grade of high-strength low-alloy (HSLA) steel that is typically used in structural applications. A572 steel contains chemical alloys that enhance the material's hardness and ability to bear weight, and this material is lightweight relative to steel grades with similar compositions..

AISI 1020 as Principal Design Features is one of the very commonly used plain carbon steels. It has a nominal C 0.20 and Mn 0.5..

AISI 1045 steel is defined as medium carbon steel which has 0.43%-0.5% Carbon.It offers good weldability, good machinability, high strength and impact properties,but low in hardenability because of lack of suitable alloying elements,but it can obtain surface hardnesses 54-60HRC after flame or induction hardening.

Alloy & Special Steels used as Hardened & Tempered Condition -

AISI 4130 High strength low alloy grade Cr-Mo, C 0.25. Si 0.25,, Mn 0.65. Cr 1.05, Mo 0.20 S & P 0.035 max, Hardness – 217 (Brinell scale) – 95 (Rockwell B), Ultimate Tensile trength – 540 MPa., Yield Tensile Strength – 460 MPa., Modulus of Elasticity – 205 GPa., Machinability – 72% (in annealed state)

AISI, 4140 Med C high strength low alloy grade C 0.42, Si 0.25, Mn 0.65Cr 1.05, Mo 0.20 S & P 0.035max., Tensile Strength: Typically ranges between 655-740 MPa,Yield Strength approximately 415 MPa,Elongation: Around 25.7%,Hardness: Brinell hardness of around 197, machinability in annealed cond 45%.

AISI 4150 C 0.50, Si 0.25, Mn 0.65, Cr 1.05, Mo 0.20, S & P 0.035 max

AISI 4340 High strength Low alloy Cr-Mo-Ni gradeC 0.40, Mn .65, Si 025, Cr 0.75, Mo 0.37, Ni 1.35, Tensile strength 730MPa, Yield Strength 380 MPa , Elongation 20% Hardness 197

AISI 9310, Low C, Ni, Cr, Mo grade C 0.10, Mn 0.65, S & P 0.035 max, Si 0.25, Ni 3.0, Cr 1.20, Mo 0.10, TS 820MPa, YS 440MPa, Elongation 17.3%,Hardness 241

AISI 52100. (Ball bearing Grade) C 0.9-1.2, Si 0.25, Mn 0.65, S & P 0.035 max, Cr 1.0-1.6

Stainless steels: 304 (Ni-Cr), 316 (Ni-Cr-Mo), 410 (C 0.15, Cr 11.5-13.0), and 420 (C above 0.15. Cr 12.0-14.0)

Tool steels: D2 (High C High Cr), H13 C 0.35, Cr 5.0, Mo 1.5, V 1.0), and M2.(C 0.85-1.0, Cr4.0, Mo 5.0, V 2.0)

Steel Products used in Common Mining Method - Surface Mining which is best suited to extract minerals that are close to the surface of the earth, Underground mining (or subsurface mining) , Placer mining -Unlike hardrock mining, which extracts veins of precious minerals from solid rock, placer mining is separating heavily eroded valuable minerals like gold and or gravel In-situ mining – This simply means "in position", and in different contexts the term can refer to different processes. .

Surface Mining

Placer Mining

Effect of Alloying Elements in Steel used for Mining Activities- Increase of **Carbon content** increases its yield point and tensile strength reducing ductility and impact. Meanwhile, too much carbon content will reduce the weldability. **Silicon** significantly increases the elastic limit, yield point and tensile strength of steel, but like carbon, the weldability of steel would decrease by adding too much amount of silicon. **Manganese,** as good deoxidizer, and desulphurization in the steelmaking process improves strength and hardness improving the hardenability of steel and the hot processing performance.

Surface Smoothness of mining equipment – This aspect is to be seriously considered for life span of equipments specially coming in contact wear resistance for applications like the truck bodies, conveyor belts, and fan blades, surface smoothness is critical for such equipment tfor abrasion in the surface because smooth surface can ensure uniform wear as well as bending radius, which can provide a precise bending accuracy.

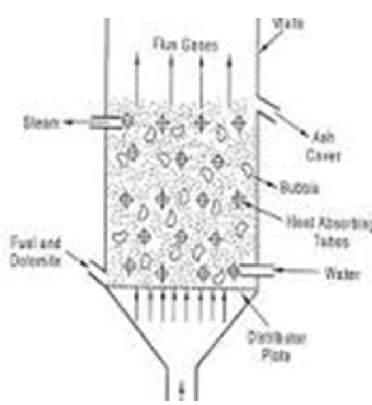
Hardness Variations in material in equipment - The core hardness value affects the lifetime of the wear parts, for example, as wear occurs and new material is exposed, if the core hardness value of the steel plate is higher, the wear rate will be minimized compared to the steel plate with a low core hardness value likely to reduce the service life of the parts..

Activities in Mine Using Steel Equipments

Steel Products – Besides different components, hot rolled bars, cold worked bars, hard chrome plated bars, and seamless hot rolled and cold worked tubes. Plate, forged steel products in correct specification are used in the manufacture of top hammer and down the hole tools, drill rigs, demolition equipment, mining support equipment and screens as well as grinding media. Stainless steel is specifically used for mining screens, fluidized bed boilers, pumps, heat exchangers, vessels, pipes, tanks, structural components and cathode plates. This is because it does not rust and therefore is more suitable for these applications. Due to its smooth and tough properties, stainless steel is a good choice for workbenches as well as for storage of substances without possibility of contamination.

Vital Steel Components in Mining - Important components in mining and mining equipments are Wear Resistant Rock Bolt for hole mining as they are drilled into holes in the roofs or walls of tunnels in order to prevent movement in the rock formations providing support for the tunnels.

Wear Resistant Rock Bolt



Fluidized Bed Boiler

Mining Screen

Steel can survive severe and abrasive mine settings, which is why it is used to make tools, drill rigs, demolition equipment, grinding media, mining screens, fluidized bed boilers, pumps, heat exchangers, vessels, pipes, tanks, and cathode plates. Steel is the primary material used to construct large mining equipment such as bulldozers, shovels, and crushers. Structural Steel and stainless steel are used to build most of the mining infrastructure. Steel products for most advanced equipments should able to withstand harsh environments and have longer life span.

Grinding balls used for grinding mill to pulverize mineral resources in mine are manufactured by high-carbon steel.

High-strength plates used in mine are also produced from high-strength steel, which is thought to be of a higher grade than regular steel.

The mining operation as a whole depends on high quality steel products satisfying the necessary technical standards for strength, toughness, and flexibility must be present in any underground my working.

Conclusion – Mining equipment should be of high strength, wear and tear resistat with abrasion resistance in all the steel equipments needed in mining activities. The requirements for steel used in mining applications are not only unique but also challenging in the tough conditions of mine for which steel is the best suited and perfect material in mine activities with its properties in the equipments used successfully for Excavators, Crushers and Bulldozers, Mining and earth-moving machinery, Liners and structural elements for buckets, Dump Truck bodies, Crushing and pulverizing equipment, Conveyor belts, Fan blades, Scrap presses, Paving moulds

Sl. No.	Technology	Sector	Energy Saving Potential			Savings Type	Other Advantage	Reference for Energy Saving Calculations	Energy Saving Potential		Variable Factors for Energy Savings	Annual GHG Emission Reduction		Technology Pricing		Fuel Type	Unit rate of Fuel	Unit rate of Electricity	Annual Monetary Saving		Pay back	
			%						TOE/y			tCO2/y		INR Lakhs					INR Lakhs		Month	
			Min	Max	Average				Min	Max		Min	Max	Min	Max				Min	Max	Min	Max
	Baseline Energy Consumption								2116			11160										
1	Energy Efficient Pulveriser	RM	2	7	4.5	Thermal	Enhanced life of pulverizer; Consistent pulverizing of coal	Annual production 36000 t/y	40	141	Fuel quality; material of pulverizer	223	781	8	15	Pulverized coal	Rs 10 / kg (Coal)		7	25	4	25
2	Coal Drying System	RM	3	5	4	Thermal	Enhanced refractory life; Improved combustion	Annual production 36000 t/y	60	101	Fuel quality	335	558	7	15	Pulverized coal	Rs 10 / kg (Coal)		11	18	5	17
3	Swirl Burner for Pulverised Coal Firing	RM	1	3	2	Thermal	Lower unburned Carbon and reduced Nox emissions; Reduced Slagging and Fouling; Enhanced flame stability	Annual production 36000 t/y	20	60	Sufficient time for burning; Proper mixing of Air and fuel; To attain Ignition temperature	112	335	2	5	Pulverized coal	Rs 10 / kg (Coal)		4	11	2	15
4	Replacement of Furnace Oil fired Re-heating Furnace with Energy Efficient Biomass based producer gas fired Re-heating furnace (min 15 tph)	RM	3	8	5	Thermal	Net-zero emission; Elimination of fossil fuel	Annual Production: 72000 t/y	35	284	Calorific value of biomass; Furnace design; producer gas temperature	7276	7278	120	150	Furnace Oil (baseline) Biomass (post implementation)	Rs 55/ltr (FO) Rs 7/kg (biomass)		1001	1191	1	2
5	Anti Friction Roller Bearings in Rolling Mill Stands	RM	3	5	4	Electrical	Reduced Friction and Torque; Longer bearing life and less Maintenance	Annual Production 36000 t/y	11	19	Mill Layout; Type of Rolling Stand	102	171	10	25			Rs 7/kWh	9	15	8	33
6	Universal Couplings/Spindles in Rolling Mill Stands	RM	5	9	6.5	Electrical	Reduced Friction and Torque; Reduced Jerk Losses; Longer bearing life and less Maintenance	Annual Production 36000 t/y	19	30	Mill Layout; Type of Rolling Stand	171	273	30	60			Rs 7/kWh	16	24	15	40
7	Y-Table/Tilting Table/Repeaters in Rolling Mill for Material Transfer	RM	3	5	4	Electrical	Reduced Downtime; Higher Mill Utilization	Annual Production 36000 t/y	11	19	Mill Layout; Available Space; Product Types	102	171	10	25			Rs 7/kWh	9	15	8	33
8	Combustion Air Blower with Energy Efficient Motor & Variable Frequency Drive	RM	3	5	4	Both	Air-fuel Ration Control; Controlled Furnace Draught	Annual Production 36000 t/y	24	40	Mill Layout; Available Space; Product Types	146	251	6	10			Rs 10 /kg (Coal) Rs 7/kWh (Electricity)	11	44	2	11

Sl. No.	Technology	Sector	Energy Saving Potential			Savings Type	Other Advantage	Reference for Energy Saving Calculations	Energy Saving Potential		Variable Factors for Energy Savings	Annual GHG Emission Reduction		Technology Pricing		Fuel Type	Unit rate of Fuel	Unit rate of Electricity	Annual Monetary Saving		Pay back	
			%						TOE/y			tCO2/y		INR Lakhs					INR Lakhs		Month	
			Min	Max	Average				Min	Max		Min	Max	Min	Max				Min	Max	Min	Max
	Baseline Energy Consumption								2018			11160										
9	Installation of Energy Efficient Pumps with VFD	RM	2	5	3.5	Electrical	Optimum Water Consumption; Better Tempering of products	Annual Production 36000 t/y	7	19	Motor Type; Control	68	171	10	20			Rs 7/kWh	6	15	8	40
10	Energy Efficient Screw Compressor with Permanent Magnet Motor	RM	1	2	1.5	Electrical	Lower Downtime; Better Compressed Air Delivery	Annual Production 36000 t/y	4	7	Compressed air delivery line	34	68	5	10			Rs 7/kWh	3	6	10	40
11	Housingless Mill Stands (min 25 tph)	RM	7	10	8.5	Electrical	Lower Downtime; Enhanced Mill Utilization; Increased Productivity	Annual Production 132000 t/y	1192	1703	Mill Layout; Product Type; Available Space	1095	1564	250	350			Rs 7/kWh	970	1386	2	4
12	Energy Efficient motors	RM	5	7	3	Electrical	Lower Downtime; Increased Motor Life	Annual Production 36000 t/y	18	28	Motor efficiency class	171	238	20	40			Rs 7/kWh	15	21	11	32
13	Provision of IR Sensors for Material Movement (min 15 tph)	RM	3	5	4	Electrical	Lower Downtime; Increased Motor Speed; Increased Mill Utilization	Annual Production 72000 t/y	22	37	Mill Layout; Level of automation	205	341	30	50			Rs 7/kWh	9	15	24	66
14	Dry Type Starter for Slip Ring Motor (min 15 tph)	RM	1	2	1.5	Electrical	Lower Downtime; Increased Motor Speed; Increased Mill Utilization	Annual Production 72000 t/y	7	15	Mill Layout; Level of automation	68	137	5	7			Rs 7/kWh	3	6	10	28
15	High Efficiency Burners with Multifuel Capacity	RM	2	3	2.5	Thermal	Reduced Scale Loss; Better Combustion; Enhanced Flame stability	Annual Production 36000 t/y	40	60		223	335	5	10	Furnace Oil	Rs 55 / Litre (FO)		22	33	2	5
16	Heating & Pumping	RM																				
17	Liquid and Gaseous Fuel Ratio Controllers (Ratiotrols)	RM	5	6	5.5	Thermal	Proper temperature across the furnace; Maintains correct furnace presure and draught; Optimum Air Fuel Ratio leads to proper combustion	Annual production 36000 t/y	101	161	Automation level	558	893	7	10	Coal; Furnace Oil; Natural Gas	Rs 10 / kg (Coal)		18	29	3	7

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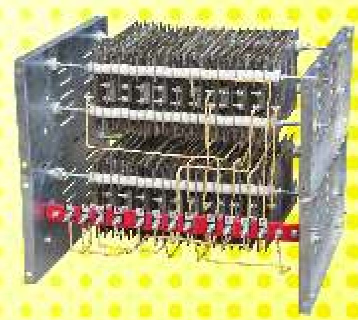

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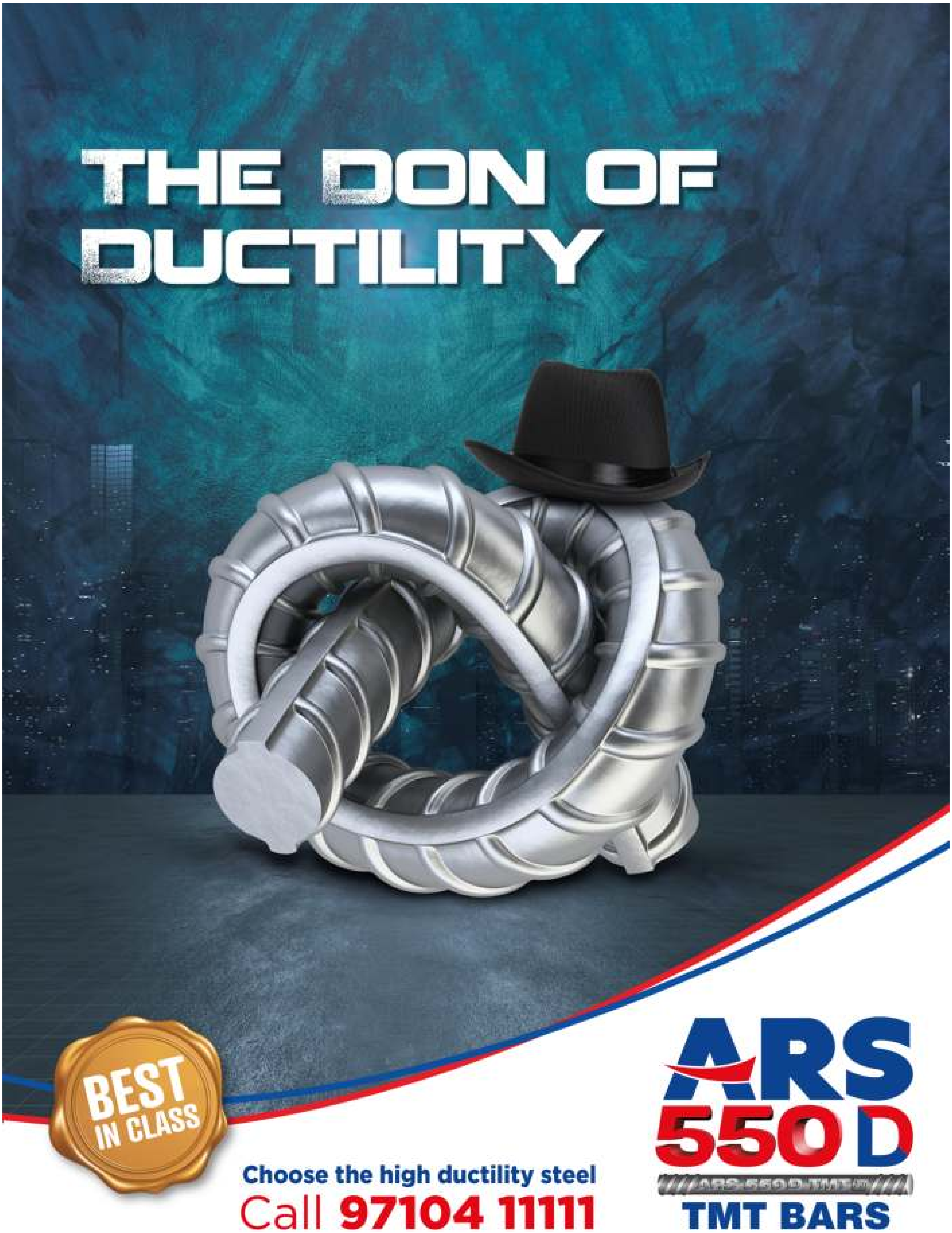
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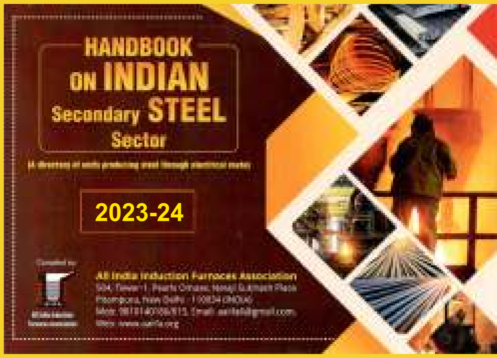

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