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BILASPUR

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

Session (2020-2021)

A SEMINAR REPORT ON

SEGMENT HEALTH RELIABILITY

at

TATA STEEL

in the department of Steel Making and Mechanical Maintenance

LD#2 & SLAB CASTER

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R. SHREE PRAGYA

CERTIFICATION

Prashikshan -2019

SHAVAK NANAVATI TECHNICAL INSTITUTE

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CERTIFICATE

This is to certify that R. Shree Pragya (Reg. No. VT20193727),
Student of GURU GHASIDAS VISHWIDYALAYA, BILASPUR C.G.,
has undergone Vocational Training Program at Tata Steel Ltd., Jamshedpur from
02-December ,2019 *to* 30-December ,2019. *The details of the programme are as under:*

Department Covered	STEEL MAKING MECHANICAL MAINTENANCE
Project Title	SEGMENT HEALTH RELIABILITY

He/She has successfully completed the Programme

Ammi kumari

Place : Jamshedpur
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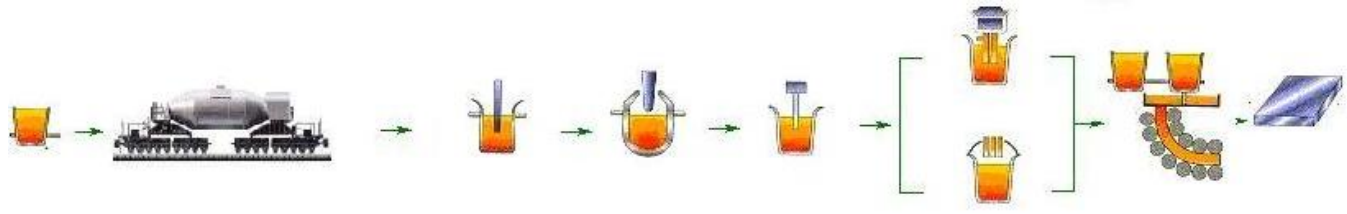
LD#2 STEEL MAKING PROCESS

The process was developed in 1948 by Swiss engineer Robert Durrer and commercialized in 1952–1953 by the Austrian steelmaking company VOEST and ÖAMG. The LD converter, named after the Austrian towns Linz and Donawitz is a refined version of the Bessemer converter **Basic oxygen steelmaking** (**BOS**, **BOP**, **BOF**, or **OSM**), also known as **Linz–Donawitz-steelmaking** or the **oxygen converter process.** Where blowing of air is replaced with blowing oxygen. It reduced capital cost of the plants, time of smelting, and increased labor productivity. Between 1920 and 2000, labor requirements in the industry decreased by a factor of 1,000, from more than three man-hours per metric ton to just 0.003. The majority of steel manufactured in the world is produced using the basic oxygen furnace. In 2000, it accounted for 60% of global steel output.

Modern furnaces will take a charge of iron of up to 400 tons and convert it into steel in less than 40 minutes, compared to 10–12 hours in an open hearth furnace. It is a faster process of Steel making in which pure oxygen is utilities in refining process.

It is a method of primary steelmaking in which carbon-rich molten pig iron is made into steel. Blowing oxygen through molten pig iron lowers the carbon content of the alloy and changes it into low carbon steel. Following are the procedure steps involved in L.D process of Steel Making.



About LD#2:

Supplied by S.N. Portugal of Portugal LD 2 was commissioned in 1993. With two BOF vessels from VAI, the plant has a rated capacity of 1.10 million tones**.** Hot metal is supplied in 200 t nominal capacity torpedo ladles from the blast furnaces. The metal is poured into 150 t transfer ladles at the hot metal pouring pit .The hot metal in the transfer ladle is desulphurised at the desulphurization unit and thereafter, taken to the converters. The details of hot metal handling system are:

1. **Hot Metal Desulphurization:** The inherent inability of the LD process to reduce sulphur makes hot metal desulphurization imperative.

2. **Converter:** The 3 BOF vessels (two operating at a time) have been supplied by SMS Demag.

3. **Ladle Furnace:** Liquid steel from the converter is tapped into preheated ladles and then treated at the ladle furnace for homogenization, increase of temperature and for trimming additions are done.
4. **RH Degasser:** In order to produce steel for high-end applications, liquid steel is routed through. This degassing unit in which treatment takes place under vacuum.

Torpedo Unloading hot metal

The LD#2 Shop has three Converters of 140 tons capacity each, producing 2.6 million tons of crude steel per annum. Hot Metal is brought from E, F, H, F and I Blast Furnaces in Torpedo ladles. The metal from the Torpedo ladle is taken into the Hot Metal for Desulphurization. It is then charged into the vessel. Primary refining of steel is done in the Ladle Furnace (LF) and RH Degasser (RH) to make cleaner steel of different value added grades. **LD 2 makes superior & cleaner grades of steel required to process Flat products of world-class standards.**

Furnace

The L.D furnace is made of a pear shaped steel vessel is lined, inside this lining tar bonded, dead burnt dolomite and magnesite along with carbon (Magcarbor) bricks are placed which is known as refractory lining or Converter Champaign. The Converter water cooled oxygen lance is used for blowing. Pure oxygen on to the surface of the liquid metal. The oxygen pressure applied is 7-11kg/cm^2 and O_2 consumption is 50 - 60m^2 / tone of metal. Height of blowing is 1 to 2m (2m) from metal surface. A tap hole is located at the conical portion of the furnace.

PRINCIPLE OF LD FURNACE :

Pure oxygen (99.9%) is blown on the surface of the liquid metal to be refining. The pure O_2 reacts with the impurities to form their respective oxidized. The oxidation product from slag combined with CaO addition in the bath and flux over the top of the metal oxide. The slag is removed after blowing and refining metal is taped out.

View from control Room

Suitability of L.D Process to Indian Raw Materials

Indian pig Iron commonly average 0.30% P due to availability of high phosphorus raw material. So this pig Iron is unsuitable for steel making by acid and basic Bessemer process and acid open hearth, to produce low phosphorus steel. This is carried out in BOH process but it take longer time and very slow. So that L.D process is adopted to obtain low P steel which is much faster process and produce low nitrogen content steel also.

Charge/Raw Materials For Steel Making :

Introduction :

For any metallurgical process to final end product there are certain specific raw material are required in steel making progress.

Following are the essential material used for the process to perform.

1. Sources of metallic iron: Molten pig iron (**From the blast Furness**), steel scraps, sponge iron etc

2. Oxidizing agent: Iron oxide and pure oxygen air. Here iron oxide is used in the form of lumpy hematite ore and mill scale. Here nearly 25% of oxygen is required by the applying weight or present weight.

3. Fluxes: lime and limestone and dolomite, ganister.

4. Sources of heat : Exothermic oxidation of heat, solid pulverized fuel, liquid fuel like oils, tars and producer gases, water gas, coke oven gas, natural gas, B.F gas and pure oxygen also electricity. Some process like Bessemer, LD, Kaldo and rotor process, they are not requied heat. But when solid material used heat energy provides by fuel and electrical. Some electrical agents are induction heating, resistance heating, arc heating.

5. Deoxidizer and alloying elements : These are Al, Si, Mn, Zn, Ti, B etc.
Alloying elements are Ni, Cr, Ti, V, Mo, Cu, Co, C etc.

6. Furnace refractory: These are silica, fireclay, chromite, dolomite, alumina, magnesite etc.

7. Sources of iron: Mainly it divided in two type I.e. primary which is hot metal, liquid pig iron, sponge iron and secondary steel scraps.

Basic oxygen Furness convertor

Basic oxygen steelmaking is a primary steelmaking process for converting molten pig iron into steel by blowing oxygen through a lance over the molten pig iron inside the converter. Exothermic heat is generated by the oxidation reactions during blowing.

Basic oxygen steel-making process

1. Molten pig iron (sometimes referred to as "hot metal") from a desulpherising unit is poured into a large refractory-lined container called a ladle.
2. The metal in the ladle is sent directly in the vessel/converter for basic oxygen Furness to steelmaking pretreatment stage. In which High purity oxygen at a pressure of 700–1,000 kilopascals (100–150 psi) is introduced atsupersonic speed (2 to 2.25 mech i.e. 1 mech = 330m/s) onto the surface of the iron bath through a water-cooled lance, which is suspended 2 meter above from the surface of the metal.
3. Pretreatment of the blast furnace hot metal is done externally to reduce sulphur, silicon, and phosphorous before charging the hot metal into the converter.
4. The molten iron in the ladle and several hundred kilograms of powder magnesium are added and the Sulphur impurities are reduced to magnesium sulphide in a violent exothermic reaction. The sulfide is then raked off. Similar pretreatments are possible for external desiliconisation and external dephosphorisation using mill scale (iron oxide) and lime as fluxes. The decision to pretreat depends on the quality of the hot metal and the required final quality of the steel.

5. Filling the furnace with the ingredients is called *charging*. The BOS process is autogenous, i.e. the required thermal energy is produced during the oxidation process. Maintaining the proper *charge balance,* the ratio of hot metal from melt to cold scrap is important. The BOS vessel can be tilted up to 360° and is tilted towards the **deslagging** side for charging scrap and hot metal. The BOS vessel is charged with steel or iron scrap (25%-30%),if required. Molten iron from the ladle is added as required for the charge balance**.** A typical chemistry of hotmetal charged into , all of which can the BOS vessel is: 4% C, 0.2–0.8% Si, 0.08%–0.18% P, and 0.01–0.04% S be oxidized by the supplied oxygen except Sulphur. (which requires reducing conditions)
6. The vessel is then set upright and a water-cooled, copper tipped lance with **6** (3–7) nozzles is lowered into it and high purity oxygen is delivered at supersonic speeds. The lance "blows" 99% pure oxygen over the hot metal, igniting the carbon dissolved in the steel, to form carbon monoxide and carbon dioxide, causing the temperature to rise to about 1700 °C. This melts the scrap, lowers the carbon content of the molten iron and helps remove **unwanted chemical elements.** It is this use of pure oxygen (instead of air) that improves upon the Bessemer process, as the nitrogen (an undesirable element) and other gases in air do not react with the charge, and decrease efficiency of furnace.[11]
7. Fluxes (burnt lime or dolomite) are fed into the vessel to form **slag have density 2.8**, to maintain basicity above 3 and absorb impurities during the steelmaking process. During "blowing", churning of metal and fluxes in the vessel forms an emulsion, that facilitates the refining process. Near the end of the blowing cycle, which takes about 20 minutes, the temperature is measured and samples are taken. A typical chemistry of the blown metal is

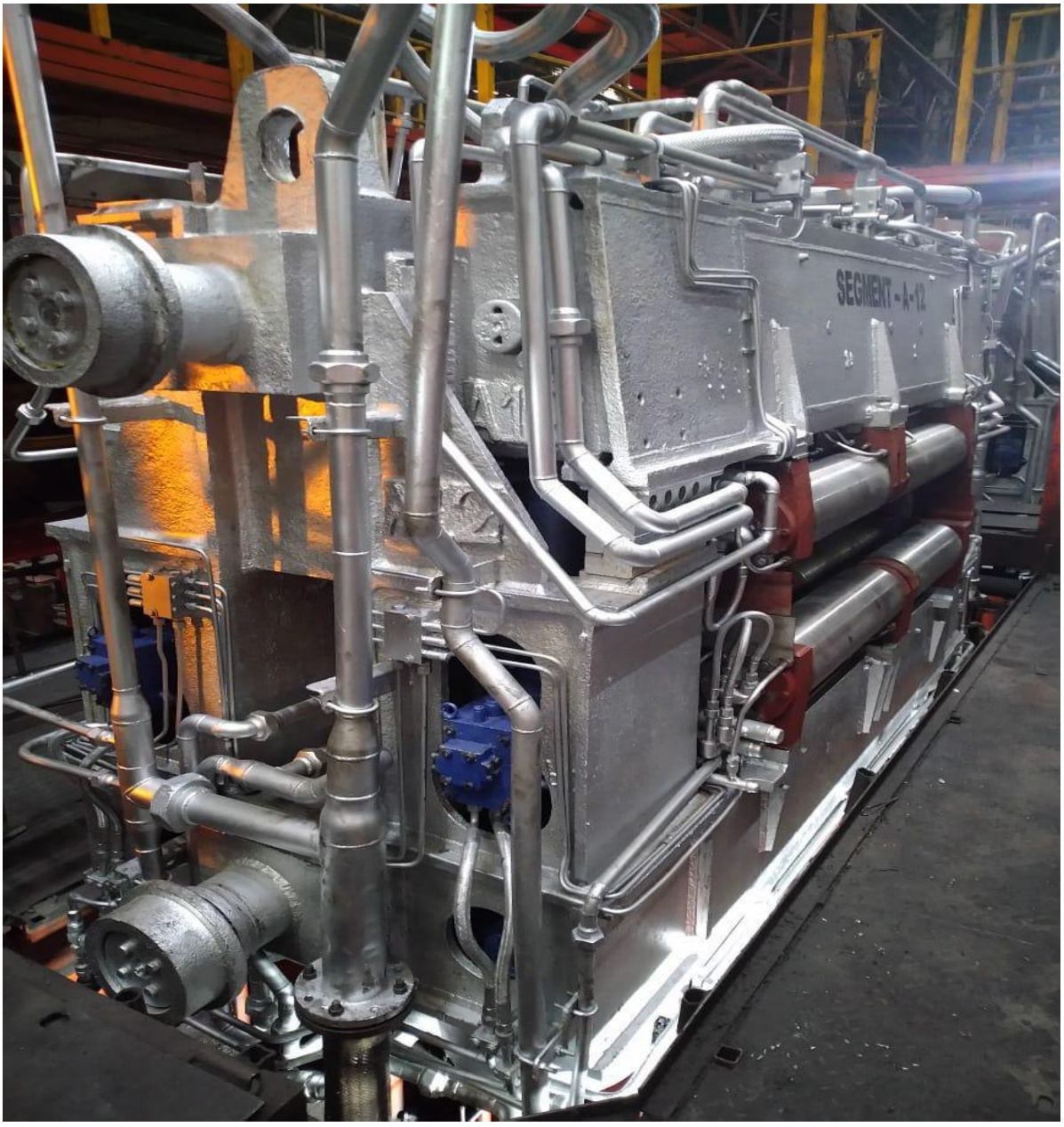
0.3–0.9% C, 0.05–0.1% Mn, 0.001–0.003% Si, 0.01–0.03% S and 0.005–0.03% P.

8. in this process the hot gas are produced by the vessel and and it is collected by duck fan system and then after cleaning and cooling have high calorific values (1700) gas are produced it is known as **LD gas.** It is used in the form of pure fuel.
9. The BOS vessel is tilted towards the slagging side and the steel is poured through a tap hole into a steel ladle with basic refractory lining. This process is called *tapping* the steel. The steel is further refined in the ladle furnace, by adding alloying materials to impart special properties required by the customer. Sometimes argon or nitrogen is bubbled into the ladle to make the alloys mix correctly.
10. After the steel is poured off from the BOS vessel, the slag is poured into the slag pots through the BOS vessel mouth and dumped.

Project : **Reliability of segments**

Area : **Caster**

SEGMENTS



A segment for support- or drive rolls of a continuous casting installation for casting a strand moving in a predetermined direction of travel along at least one guide path for the strand, a common pivotal yoke, two successive rollers following one another in the direction of travel of the strand located at the region of the at least one guide path in said common pivotal yoke, piston-cylinder means for moving said yoke substantially transversely with respect to a surface of the strand guided by said rollers, said yoke being provided with impact surfaces, support surfaces associated with each roller, a stationary frame, said support surfaces being provided at the stationary frame and limiting the path of application of the rollers with respect to the strand, the yoke provided with the impact surfaces can be applied by the piston-cylinder means in the direction of the support surfaces limiting the path of application of the rollers with respect to the strand.

DESIGN OF SEGMENTS

■ Engineered specifically for challenging continuous slab caster environment.

■ Available as full complement cylindrical or caged spherical roller bearings. The spherical bearing characteristics accommodate normal levels of misalignment. In cylindrical roller bearing assemblies, the housing accommodates misalignment.

■ “Half-outer” ring design reduces cap height to maximize clearance between the cast slab.

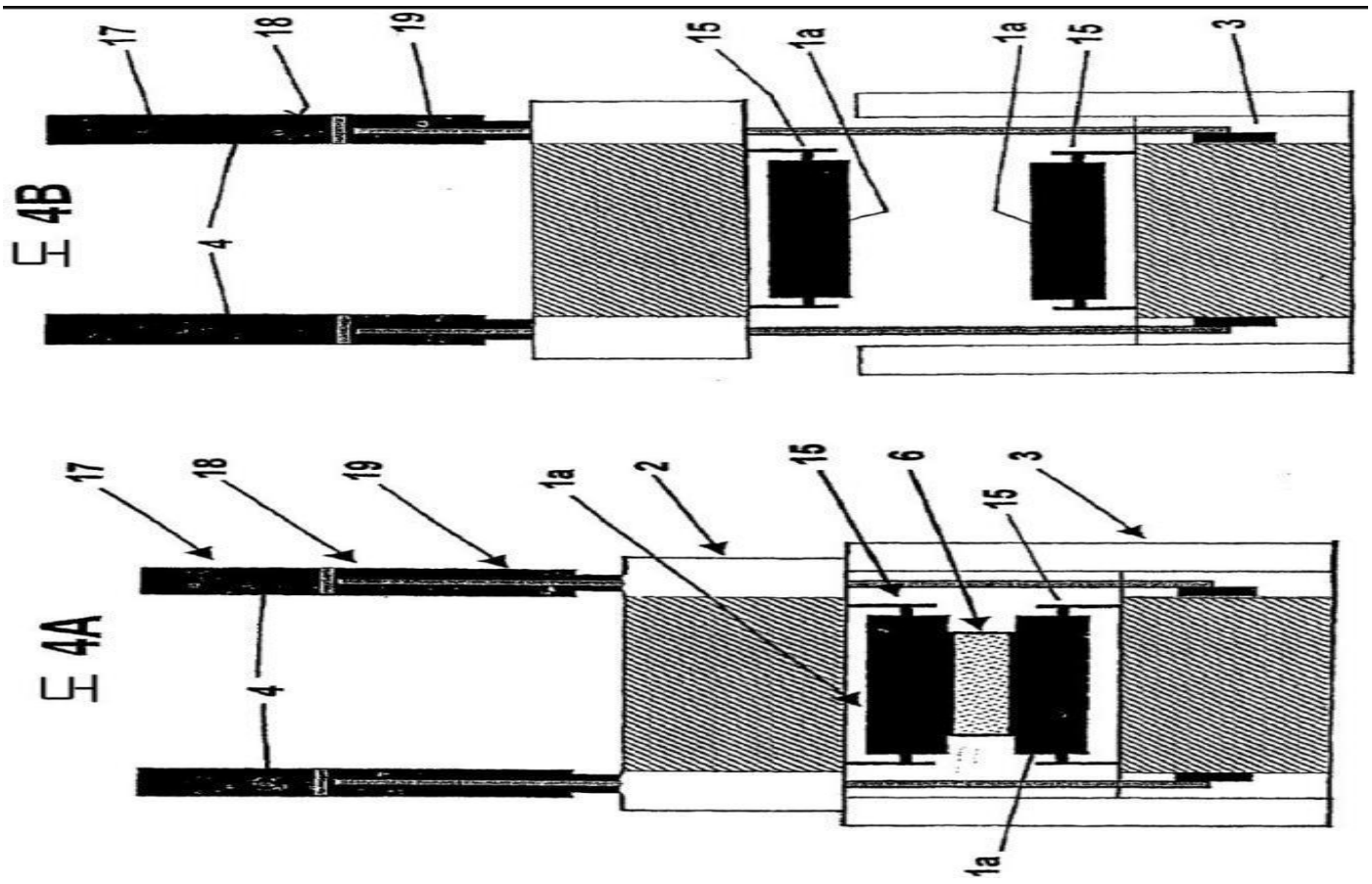
■ Water-cooled housings utilize Timken’s patented cooling chamber design, which maximizes the cooling area without introducing dead zones and subsequent hot spots.

■ Triple sealing elements protect the bearing from contamination while also allowing lubricant purging in centralized grease and air-oil type systems.

PARTS OF SEGMENTS

- A Segment Each Roll Is Mounted On Two Bearing Housings, Roll Jamming Is Caused Mostly Due To Bearing Failure.
- Jamming Of Rolls Leads To Scratch Marks On The Slabs Produced Because Of Rubbing Action Between Jammed Roll Surface And Slab, And Hence Deteriorates Product Quality. Slab Stuck Up Due To Roll Jam Leading To Caster Outage.

An improved guide segment assembly for a continuous casting machine includes a support frame and a guide segment that includes a bottom segment portion having a number of support rolls for engaging a bottom surface of a continuously cast strand, and a top segment having a number of guide rolls thereon for engaging a top surface of the strand. A force applicator is provided for urging the top and bottom segment portions toward one another against mechanical stops in order to provide support for the strand that is sufficient to counter ferrostatic pressure within the strand. A resilient mechanism is positioned between the support frame and the guide segment for permitting limited movement between

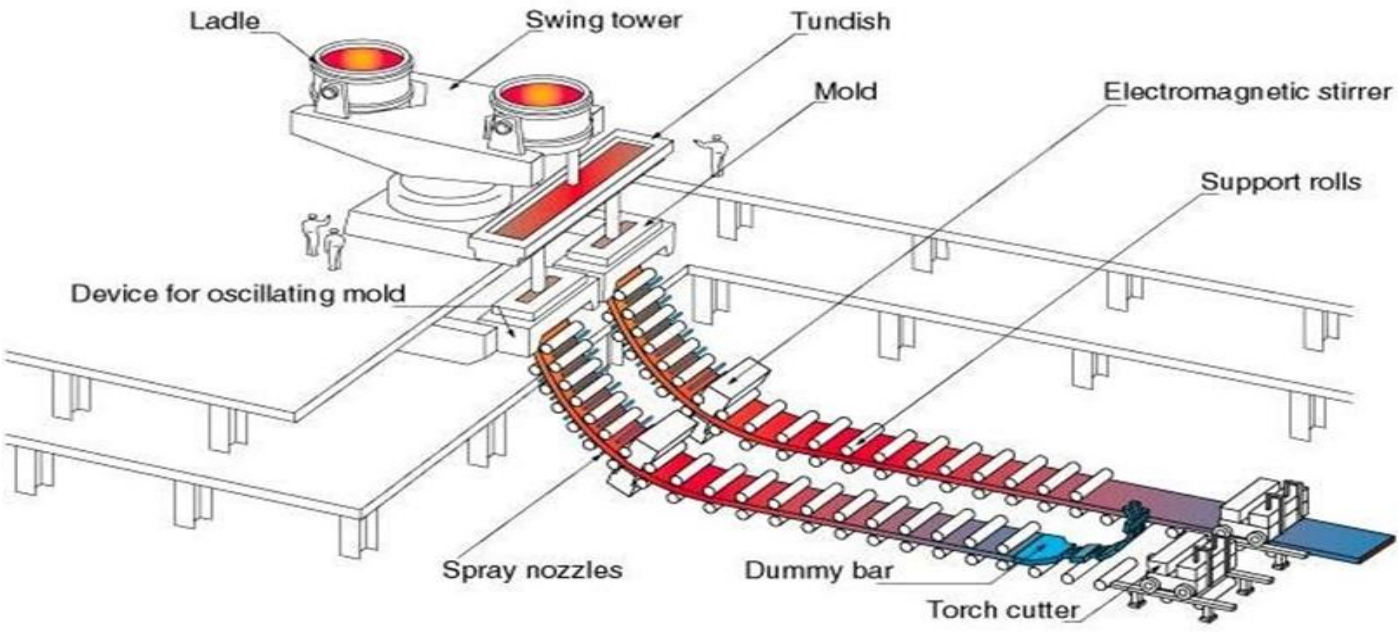


the support frame and the guide segment during abnormal casting conditions. As a result of the resilient mechanism, both the support rolls and the guide rolls will be amply protected against overload conditions during abnormal conditions such as cold withdrawals.

ROLLER

Rollers are the solid cylinders through which the hot slab is passed and cooled. These rollers are attached to the housing at both the end. There are total 40 housing bearings. These rollers are 20 in number, 10 rollers at top and 10 at bottom. The roller are centralized cooled buy soft water, the inlet and outlet of softwater pipe is fitted at one end.

In a continuous casting machine used in the roller , comprising a series of axially spaced roller sections and supported on a non-rotating shaft bearings inside, wherein each roller segment having a sleeve-shaped bracket with associated sealing means each roller segment is designed as a having an inner sleeve from the holding means, the inner sleeve is arranged with its inner envelope surface in contact with the shaft non-rotatably mounted on the shaft the roller segments each axial end provided with an annular groove at a position



outwardly of the inner envelope surface of the inner sleeve at a spacing on for accommodating bearings and sealing means.

OBJECT OF ROLLER

- To provide a new segment of a continuous casting machine with rollers, so that the important issues encountered in conventional solution is highly eliminated.
- To ensure that the roller segments assembled to the roller shaft sealing is not lost, and a support segment bearing assembly is not subject to scratching or other damage.
- To provide a roller segment with continuous casting machine, wherein damaged segment holder can be replaced individually without the need to replace the whole segment roller.

LUBRICATION

Proper lubrication is critical to bearing and machine performance. Timken application and environment specific grease lubricants have been developed from our knowledge of tribology, anti-friction bearings and how these two properties affect overall system performance. Timken offers a choice of premium ISO460 grease for continuous casters.

For continuous casters, the most widely used lubrication method is the centralized grease distribution system. Several separate systems are used serving a discrete caster section. These systems pump a relatively small amount of grease at frequent intervals to the bearing. The grease quantity is typically less than 5cc (0.3 in3), but

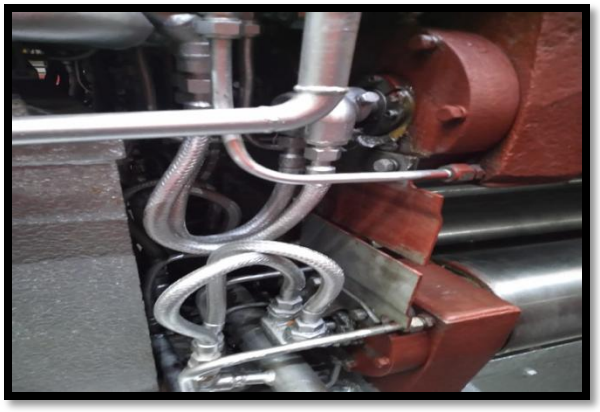
the frequency is typically six to 10 times per hour. This frequent cycle keeps the bearing full with fresh grease while also purging old grease and contaminants.

An alternative is the air-oil system, which uses compressed air to drive a film of oil through distribution pipes to the bearings. These systems operate continuously to keep fresh lubricant flowing while purging the bearing. The air-oil systems can operate with significantly reduced lubricant consumption. Consult with a Timken engineer for air-oil application.

The bearing positions associated with the support of the slab combine high loads and elevated temperatures with low rotational speed. This presents difficulties in creating a lubricant film between the bearing's rollers and raceways. A lubricant viscosity of more than 3000cSt/15000SUS would be required to maintain a lubricant film, but distribution systems are limited to a maximum of about 600cSt/2000SUS. High viscosity

Timken's bearing reclamation services can reduce your cost of operation by returning refurbished bearings to service.

base oil greases in the segment positions must also be selected to resist corrosion and aid in sealing as a result of continuous exposure to secondary cooling water spray and hard debris contamination.



BEARING

Roller bearing with a segmented cage for guiding the roller bodies, said cage comprising an inner ring on which a plurality of roller bodies can roll, and which can also roll on an outer ring which is concentric to the inner ring, a cage consisting of a plurality of webs which are distributed in a uniform manner over the periphery and which are aligned so as to be parallel to each other and to the longitudinal axis of the cage, and a plurality of lateral plates for joining the webs, two webs and two lateral faces being firmly connected to one another to form a cage segment, which forms a pocket for guiding a roller body and all cage segments are connected to one another in pairs to form an inherently closed cage.

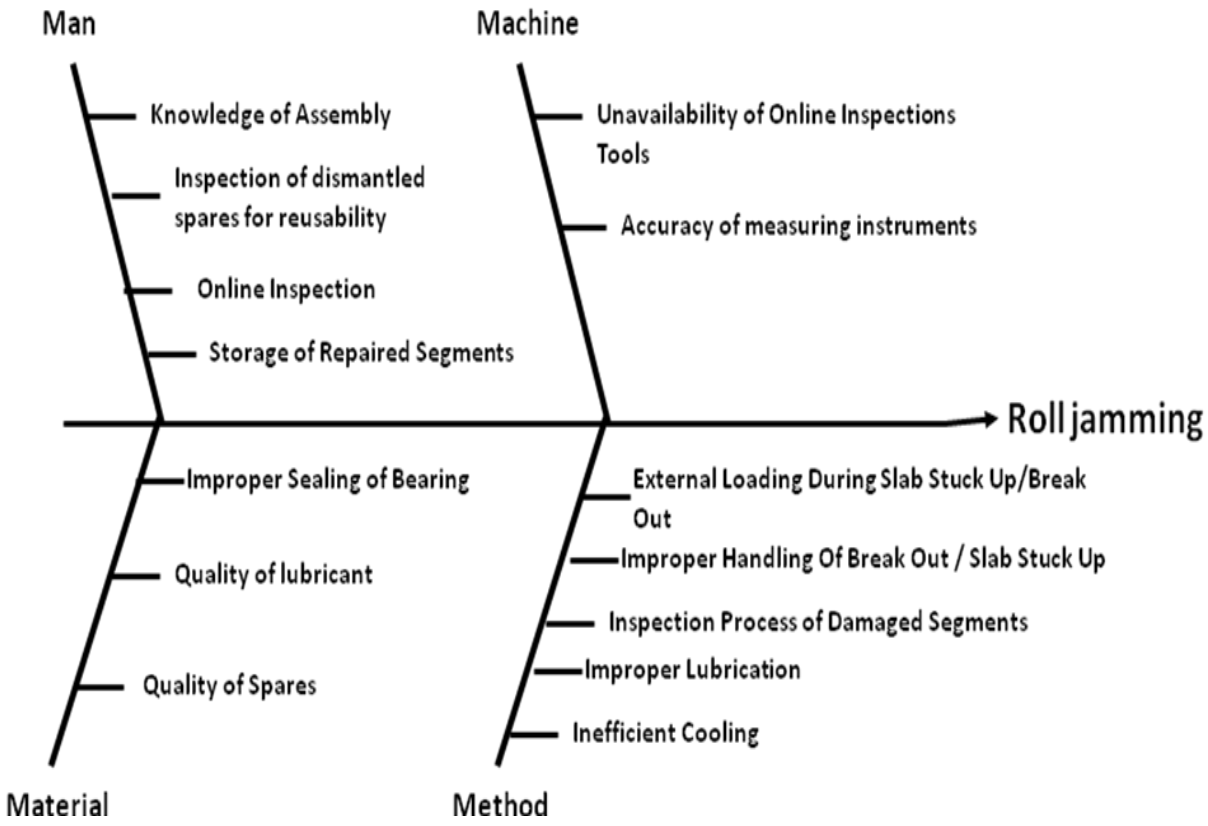
DRIVE RAISE LOWER MECHANISM

A drive mechanism of a segment of a slab continuous casting machine comprises an upper frame and a lower frame, wherein a screw-down hydraulic cylinder is arranged in the middle of the upper frame, a piston rod of the screw-down hydraulic cylinder is hinged with a walking beam inside the upper frame through a bearing, a row of upper driving rollers are arranged at the bottom of the walking beam, a row of lower driving rollers are arranged at the top of the lower frame, upper driving rollers and lower driving rollers are arranged up and down in a such way that upper driving rollers face lower driving rollers, and couplers are arranged on one side of upper driving rollers and on one side of lower driving rollers. The drive mechanism has the advantages of being reasonable in structural design, compact in arrangement and convenient to maintain. Driving rollers of the drive mechanism are arranged in the middle of frames, lifting of driving rollers is achieved through the hydraulic cylinder, the arrangement of

driving can ensure that the maximum traction force exists between driving rollers and a casting blank at any time, and driving rollers can be lifted individually during penetration of a dummy bar. Besides, the hydraulic cylinder of the drive mechanism has functions of a pressure sensor and a position sensor, remote control can be achieved after the hydraulic cylinder is connected with a computer, and the hydraulic cylinder is convenient to maintain.

COUPLING SHAFT

Causes of roll jamming



CONCLUSION

I have learned how science and engineering can interact in useful ways and lead to remarkable breakthroughs which can revolutionize the state of a country's overall technical advancement in general, and the ease and comfort of an individual in particular. I was lucky enough to work with a group of enthusiastic and communicative people, who enjoy in sharing what they are doing. The atmosphere at Tata Steel Ltd is unique was conducive to completing my project. The training enabled me to understand the underlying principles of some of the contemporary techniques, which in turn is an area where many of my skills can be greatly utilized. . I learnt on an overall basis how a machine works, what are the necessary steps in commissioning it and most importantly about safety to be maintained inside a plant. The **four weeks** of industrial training in Tata Steel Limited (Department of LD#2 & SLAB CASTER) has added a great value to the understanding of machines and its operations along with the jobs made by it. We recognized the real difference between the theoretical knowledge and the practical application which will prove to be a base in coming future as a production engineer.

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