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Hazard Identification of steel melting shop (SMS)

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Abstract - Hazard is a source or situation that has the potential for harm in terms of human injury, ill health, damage to property or the environment, or combination of these factors. It has got a short or a long terms effect on the work environment with considerable human and economic costs. It has also got a great demoralizing effect on the work place. Hazard is a potential cause to generate a disaster. It has got the potential to cause.

- Serious harm to the individual or the environment
- Harm, the severity of which depends on the extent and frequency of exposure to the hazard

Categories major hazards like

- Physical hazard
- Chemical hazard
- Radiation's hazard
- Ergonomic hazard
- Other hazards

Key Words: Hazards, Risk, Hazards Identification.

1.INTRODUCTION

Aiming at the safety first- it's a vital for the steel making industry to create a priority based environmental plan which is congenial and focused towards safety awareness in workplace, as steel melting and rerolling embraces hazards in each process activities. Industry becomes successful by not only meeting the production requirements but also should have high employee satisfaction by providing the safety requirements in the workplace. It is impossible to predict exactly when hazards will occur or the extent to which they will affect communities within the Work Area. However, with careful planning and collaboration, it is possible to minimize losses that can result from hazards. Mitigation of hazards adheres to appropriation of action taken, so as to minimize the loss of life as well as fixed assets by attenuating the impact of disasters. It is often considered the first of the four phases of emergency management; mitigation, preparedness, response and recovery

2. LITERATURE REVIEW

Industrial process and activities inherently pose hazards. There may be possible hazards to human beings, flora-fauna, all forms of property and the environment as a whole. Extreme care is essential in handling all of them in various stages of manufacturing. Vital element of industrial health and safety policy and implementation plan is the identification, evaluation, elimination and / or the control of hazards in the shop floor and place of work. Elimination of all hazards and its source is not possible; hence, the target is to eliminate and control the critical hazards with their emerging potential and to protect the interest of employees in the world of work.

Chemical hazards are one of the most dangerous hazards occurring in any industries that uses them. Several devastating effects like explosion, environmental pollution, asphyxiation, acid burns, and skin disorders, chronic and acute conditions of several diseases might occur due to the leakage of the poisonous chemicals. This project deals in the control of the chemical hazards in a Stainless-steel Plant using Risk assessment technique.

The steel sector is one of the most significant and pivotal sectors in the prominence and growth of a nation. It has been considered as the spine of civilization in the universe. The level of per capita consumption of steel is an important determinant of the socio-economic growth of a nation. This research Study focuses growth and development of Steel industries in India. The Steel industry in India is growing in a rapid speed with demand increment and opportunity creation and attraction to the international players.

This paper deals with, Identification of hazards present in the gas pipeline and storage of steel industries, to study about plant gas pipeline installation as per NFPA, OISD, norms, to study about available fire protection facilities, safety organization and safety system of the plant and to recommend better suggestions to enhance safety of the plant. Industrial safety is an important issue for operations managers — it has implications for cost, delivery, quality, and social responsibility. Minor accidents can interfere with production in a variety of ways, and a serious accident can shut down an entire operation. In this context, questions about the causes of workplace accidents are highly relevant. There is a popular notion that employees' unsafe acts are the primary causes of workplace accidents, but a number of authors suggest a perspective that highlights influences from operating and social systems.

3. PROCEDURE OF SMS

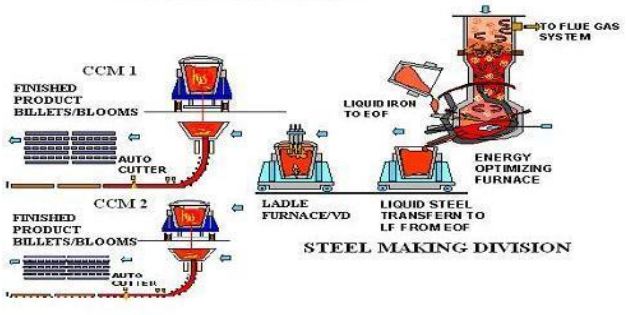

Fig -1: Process flow chart for Steel melting shop

3.1 Energy optimizing furnace (EOF)

Liquid hot metal received from Blast Furnace contains impurity elements such as Carbon (C), Silicon (Si), Sulphur (S), Phosphorous (P), and Manganese (Mn). Removal of these impurities is carried out in Steel Melting Shop (SMS) in different stages. Carbon, Manganese, Silicon & Phosphorous is removed in Energy Optimizing Furnace (EOF) by blowing oxygen and the impurities are removed by formation of respective metal oxides which are separated as slagging EOF the input material consists of liquid hot metal (80 %) from BF, in house solid steel scrap (20%) used as coolant, burnt lime and dolomite as flux, and crushed Slag as coolant. Oxygen is blown through Tuyeres, Injectors and Supersonic Lance. Flux addition in the form of calcined lime and dolomite ensures trapping of impurity element oxides and formation of slag during primary refining which takes care of dephosphorization. At the end of EOF process, three products are generated, viz., steel, slag, and by-products in the form of sludge. Continuous deslagging happens during the entire blowing process of 30 to 40 minutes. Continuous deslagging helps in achieving low phosphorus level. After blowing is completed in EOF, the liquid steel with oxygen 400- 800 ppm is tapped in the ladle through launder and then taken to Ladle Furnace.

32 Ladle furnace (LF) & Vacuum Degassing Station (VD)

In ladle refining furnace the oxygen is removed by using deoxidants like aluminum and silicon depending on the grade by forming oxides which go to slag phase. Lime and synthetic slag is added to make slag which are useful for desulphurization and inclusion removal. Chemistry adjustment as per grade and customer requirement is done here by adding ferro alloys like high carbon ferro-manganese, Ferro-silicon, Ferro-Chromium, Ferro-Molybdenum, etc. With the help of 3 top electrodes liquid metal is heated to get required temperature for casting. Argon purging through porous plug is used to homogenize chemistry and temperature. Calcium treatment is done to modify inclusion morphology and composition for better castability. After Ladle refining the liquid steel is taken to tank vacuum degassing station, where vacuum level less than 1 millibar is achieved to remove harmful gases like hydrogen and nitrogen. When the required chemistry and temperature is achieved the liquid steel is taken for continuous casting operation. Throughout the process of refining, steel sample is taken for chemistry analysis by optical emission spectrometer in spectrometer lab.

3.3 Continuous casting machine (CCM)

Both billet and bloom caster in Company is a 3 Strand caster with multi radius curved type one. In Continuous Casting the steel is poured in a buffer vessel called tundish from ladle through argon shroud. From tundish the liquid steel is transported to copper Mold through Submerged entry nozzle to prevent re-oxidation of the liquid metal. In the copper mold the initial solidification of metal takes place through primary cooling by water. Dummy bar is inserted into the mold to hold the initial liquid steel and which is used for withdrawing the steel in mold. The steel which is coming out of the mold has shell thickness of 10- 12 mm. The required bloom size is produced by using different mold sizes. Level of liquid steel in mold is controlled through Automatic Mold Level Controller with controlling the opening of stopper rod in tundish. The level of liquid steel in mold is monitored by radioactive Cobalt system. In the mold, mold powder is added for lubrication and mold is continuously oscillated for easy removal of the solidified steel. In the mold Electromagnetic stirrer is used to produce good macrostructure with no dendrites and homogenized steel. After the mold the steel is cooled by air mist cooling mixture which is called secondary cooling system. By using the withdraw rolls and straightening rolls, the cast steel is taken out and the required length of billet/bloom is cut with the auto gas cutter and transferred to cooling bed for natural cooling. Wherever surface defect or imperfection is their billet/bloom is manually ground with grinding machine. Billets/Blooms are fully ground with automatic billet grinding machine based on end application requirements.

4. HAZARD IDENTIFICATION

The above safety hazards are associated with varying levels of risks which may lead to injuries. It has categories the types of hazards they are

- Physical hazards
- Chemical hazards
- Ergonomic hazards
- Radiations hazards
- Others hazards

4.1 PHYSICAL HAZARDS

4.1.1 NOISE

Exposure to noise levels exceeding those set by the competent authorities may result in noise-induced hearing loss. Exposure to high noise levels may also interfere with communication and may result in nervous fatigue with an increased risk of occupational injury.

4.1.2 VIBRATION

Exposure of workers to hazardous vibration is mainly known as:

Whole-body vibration, when the body is supported on a surface that is vibrating, which occurs in all forms of transport and when working near vibrating industrial machinery; or

Hand-transmitted vibration, which enters the body through the hands and is caused by various processes in which vibrating tools or work pieces are grasped or pushed by the hands or fingers.

4.1.3 HEAT AND COLD STRESS

Risks arise in special conditions:

a) Temperature and/or humidity are unusually high.
b) Workers are exposed to high radiant heat.
c) High temperatures and/or humidity occur in combination with heavy protective clothing or a high work rate.
d) Temperature is unusually low.

4.1.4 LACK OF PROPER ILLUMINATION

Poor lighting affects the Occupational Safety & Working Conditions of people at work causing symptoms like eyestrain, migraine and headaches. Symptoms of this include headaches, lethargy, irritability and poor Concentration.

4.1.5 WORK EQUIPMENT AND MACHENIRY GUARDING

The use of work equipment, including machinery and hand and portable power tools, may result in accidents, many of which are serious and some fatal. Lack of guards or inadequate guards, interlocks, safety devices, improper maintenance, no adherence to SMPs etc. can lead to accidents caused by entanglement, sheering, crushing, trapping, cutting, etc.

4.1.6 CRANES AND HOISTS

All machinery used to lift and/or transport equipment, materials, molten metal or slag should be designed, constructed and erected, inspected, maintained and operated as specified by the manufacturer/ site specific SOPs/ SMPs which otherwise would lead to crane failure / overturning, failure of tools & tackles like slings etc.

4.1.7 CONTROL OF HAZARDOUS ENERGY

The iron and steel industry regularly uses different sources of energy (electric, mechanical, hydraulic, pneumatic, etc.).

4.1.8 FALLING OBJECTS

Failure to properly secure loose materials at height, maintaining proper stack heights, preventing unauthorized entry etc. leading to fall of objects and hitting a nearby person

4.1.9 SLIPS, TRIPS AND FALLS

Inadequate housekeeping, improper covers on opening, unsuitable platforms or walkways equipped with handrails and protective barriers etc. may lead slip & trip injuries. Fall from height may occur due to non-usage of fall arrest equipment.

4.1.10 RAIL & ROAD TRANSPORT

Internal transport, such as road and rail vehicles, transfer cars etc. used in the transport of raw materials, intermediates, products, waste etc.

4.1.11 FIRE & EXPLOSION

Steel Plants stores & handles number of flammable chemicals like tar, naphtha, benzol, fuel gases, oils, LPG, Propane, Oxygen etc. which possess potential fire & explosion hazards. Hot metal/ slag sparks, welding sparks, electrical short circuiting etc. can also lead to fire in surrounding areas if combustible materials are present.

4.1.12 CONFINED SPACES

Bin, silos, tunnels, ESPs, manholes, etc. examples of confined spaces where entry of persons & carrying out jobs requires special precautions. Toxic or flammable gases,
oxygen displacement and engulfment are the principal hazards.

4.2 CHEMICAL HAZARDS

4.2.1 CHEMICALS IN THE WORKPLACE

These substances may present a hazard as the result of contact with the body or absorption into the body. Absorption can occur through the skin, by ingestion or by inhalation.

a) Chemicals can have acute (short-term) and/or chronic (long-term) Health effects.

b) Chemicals may present a safety hazard as a result of their chemical and physical properties.

4.2.2 INHALABLE AGENTS (GASES, VAPOURS, DUSTS AND FUMES)

The production of iron and steel involves the consumption and generation of a variety of inhalable agents including, but not limited to, gases, vapours, dusts, fumes, smokes and aerosols. These agents comprise a variety of toxicological hazards including irritants, chemical asphyxiants, fibrogens, allergens, carcinogens and systemic toxicants.

4.3 RADIATION HAZARDS

4.3.1 IONIZING RADIATION

All exposure to ionizing radiation should be kept as low as possible, as there is evidence that damage caused by radiation may be permanent, and that there is a significant increase in the incidence of cancer and some types of malignancies, as a consequence of even low doses of ionizing radiation.

4.3.2 NON-IONIZING RADIATION

Non-ionizing radiation is usually referred to as ultraviolet (UV), visible and infrared (IR) radiation Absorption in the UV and visible portions of the spectrum produces photochemical reactions. In the IR region, all of the absorbed radiant energy is converted into heat. Exposure to some radio-frequency and microwave radiation can result in the formation of cataracts of the eye.

4.4 ERGONOMIC HAZARDS

These hazards are due to tool design, equipment design, job and task design, work station design, and manual handling etc.

4.5 OTHER HAZARDS

- Oil and Lubricant Room (spillage)
- Fine Coal Hoppers
- Coal Gasifier
- Coal Storage area,
- Electrical Short circuit
- Boiler

Table -1: Level of Hazard

1	Very high Hazards
2	High Hazard
3	Medium Hazard
4	Low Hazard

Table -2: Hazard Mapping Labels

COL0UR LABELS	COLOUR NAMES	TYPES OF HAZARD	PERCENTAGE
	Blue	Physical Hazards	75 %
	Red	Chemical Hazards	13 %
	Yellow	Radiation Hazards	7 %
	Green	Ergonomic Hazards	3 %
	Black	Other Hazards (specify)	2 %

Table -3: Examples Of Hazard Mapping Labels

HAZARD CODES AND LEVELS OF HAZARDS	
HAZARD CODES	LEVELS OF HAZARDS
	A number“1” inside an Orange Circle indicates “Class 1, Very high Hazard, Physical.”
	A number “2” inside a Green Circle indicates “Class 2, High Hazard, Chemical.”
	A number “3” inside a Blue Circle indicates “Class 3, Medium Hazard, Radiation.”
	A number “4” inside a Red Circle indicates “Class 4, Low Hazard, Ergonomic.”
	A number “3” inside a Black Circle indicates “Class 3, Medium Hazard, Other Hazard.”

The five most common causes of safety incidents in Steel Industry worldwide and preventive measures have been identified as follows:

1. Moving machinery – Isolate, lock or pin all energy sources before any machinery is accessed.
2. Working at heights – Provide regular training, appropriate harnessing equipment and ensure checks are in place when working at height.
3. Falling objects – Ensure regular checks are in place to remove or secure objects in risk areas.
4. On-site traffic – Ensure all traffic on the site is operated safely, including road, rail and pedestrians, and remove all unnecessary traffic.
5. Process safety incidents – Identify potential process safety hazards that could cause explosions or fires and take adequate precautions.

4. Result and Discussion

Table -4: Hazard Mapping in Steel Plant

The various hazards along with the areas of their presence are enumerated in the table below-

S.NO	TYPE OF HAZARD / RISK	MAJOR AREAS WHERE HAZARD IS FACED
1	Toxic gases (rich in Carbon monoxide)	All over the plant
2	Explosive Gases (Rich in Hydrogen and Methane)	All over the plant
3	Harmful Chemicals	Coal Chemicals plant, CRM
4	Liquid metal/ slag (burn, explosions)	Blast Furnace, SMS, Continuous casting, Foundries
5	Extreme Temperature (-180 OC to 1700 OC)	Coke Ovens, Blast Furnace, SMS, Continuous casting, Foundries, Rolling Mills and Cryogenic Oxygen Plant
6	Fire	All over the plant
7	Electric Shock, Electrocution, Flash over	All over the plant and project sites
8	Rail/ Road Traffic Movement	All over the plant and project sites
9	Moving/ Rotating machines (Hit, Caught, pressed etc.)	All over the plant and project sites
10	Working at Height	All over the plant and project sites
11	Dust, noise, heat and Vibration	All over the plant
12	Material Handling	All over the plant and project sites
13	Confined Space (suffocation/ gas poisoning)	Oil cellar, Conveyor/ cable galleries, Silos, etc.
14	High pressure Steam, Water & industrial gases	All over the plant

6. CONCLUSIONS

The first step for emergency preparedness and maintaining a safe workplace is defining and analyzing hazards. Hazard identification and mitigation measures are essential to loss prevention in steel industry. It has become more challenging to conduct hazard identification as the depth of technology has increased, which hazard assessment heavily replies on. Nothing is more important than the safety and health of people who work in the steel making units. Protecting health and safety of everyone who works in or around the steel industry is of vital importance to steel makers. The duty of care and social responsibility demands that everyone is able to work in a safe and healthy work environment. For any industry to be successful, it is necessary to identify the hazards to assess the associated risks and to bring the risks to tolerable level.

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