

# CRITICAL STUDY ON SAFETY IN ROUTINE MAINTENANCE OF STEEL INDUSTRY

Harshwardhan Tiwari<sup>a</sup>, Manish Kumar Mishra<sup>b</sup>, Sri Ram Krishna Mishra<sup>c</sup>

<sup>a</sup>M.Tech Scholar, Bhilai Institute of Technology, Raipur(Chhattisgarh)

<sup>b</sup>Associate Professor, Bhilai Institute of Technology, Raipur(Chhattisgarh)

<sup>c</sup>Professor, Bhilai Institute of Technology, Raipur (Chhattisgarh)

\*\*\*

**Abstract :** The research aims to identify the possible hazards underlying in steel industry during routine maintenance. Since steel producing processes are extremely energy demanding and encompassed of many intricate unit operations. The methodology adopted in this research is to analyze the survey and feedback data collected from 50 employees working in steel melting shop and coke oven unit. The data obtained through survey is then analyzed and on the basis of this recommendations are drafted for minimizing the risk associated with hazards in steel industry.

**Keywords:** Hazard identification; Steel melting shop; Steel industry

## 1. Introduction

The life of industrial workers is full of risk and hazards. Every year large number of industrial workers meets with accident owing to unsafe work condition or unsafe act by the employee or due to defective plant layout etc. thus safety of industrial worker is a major concern of the modern era. Before discussing on identification of hazards and its control, a thorough discussion on different aspects of cause and consequences of industrial accidents shall be of much relevance.

Hadden et.al, observed that with rare exception, an accident is defined explicated or implicitly, by the unexpected occurrence of physical or chemical damage to an animate or inanimate.

### 1.1 Consequences of Accident

Accidents are very costly & cause losses directly or indirectly. These losses are both visible & invisible; the invisible losses are measurable but cannot be valued in monetary terms. The various losses, which are management suffers because of the accidents, are as under.

#### a) Direct loss

That is the wages of employees, six to ten times the wages because the losses of goods & services, compensations & the cost of medical aid. Besides the cost incurred on training of a new worker is also very high. The loss due to waste of rough material, & loss of production & quality arising out of inexperience & lack of skill of new employee.

#### b) Indirect Loss

The indirect loss includes the following:

- 1) The cost which the Govt. incur because it has to maintain a large no. of factory inspector to check accidents, besides this the Govt. also spend on employee's health insurance and social security and benefit. All these cost are recovered by imposing higher taxes on the people.
- 2) The cost to the employee for the time he has been without work because of his accident.
- 3) The cost of the lost time, because other employee stop work out of curiosity out of sympathy with the injured employees, or because they have to assist the injured workers.
- 4) The cost of time lost by a supervisor and other executives for assisting the injured employee, investigating the cause of accident arranging for his replacement, selecting and training a new employee, preparing accident report and attending the hearing conducted by Govt. or other officials.
- 5) The cost incurred on the M/c on tools might have been damaged or the cost of the spillage of material when the accident occurred.
- 6) The cost incurred on account of wages paid to an employee during the period in which he was idle for his injury and up on his return to the work, when his production which would be much less than it was before the accident.
- 7) It is obvious that an accident causes a lot of suffering and loss to the employee, the employer, and the govt. and

even to the society. Accident lowers the moral of the fellow workers. They became increasingly aware of the hazardous nature of their work as a result of which they do not or cannot put their best effort to achieve optimum production. Thus accident increases the overall cost of production and adversely affect productivity and moral.

### 1.2 Analysis of Consequences of Accident:

A hazard assessment is complete only when the consequence of a possible accident is known. For this reason, the last step of a hazard assessment is to analyze the consequences that a potential major accident would have on the plant itself, on the employees, on the neighborhood and on the environment. The result of the analysis is used to finding system, binding system, alarm system or pressure relief systems have to be installed.

An accident consequences analysis should contain the following:

- a) A description of the accident (tank rupture, rupture of a pipe failure of a safety valve, fire).
- b) An estimate of the quantity of material released. (Toxic, flammable, explosive)
- c) A calculation of the dispersion of the natural released (gas or evaporating liquid)
- d) An estimate of the efforts (toxic, heat radiation, blast waves)
- e) While requirement (a) and (b) can be fulfilled using the result of the hazard assessment, models have to be applied to determine (c) and (d).

### 1.3 Phase in the Development of Safety:

#### Phase-I (up to 1920) Legislation:

The year 1889 is of great historical importance of sow the outbreak of French revolution and also ushered. In the era of industrial revolution. The philosophy of that time was that accidents are an inevitable byproduct of industrialization and those accidents is responsible for his own safety. However, in the year 1833 world's first factory act was executed in U.K. it was an important milestone in the evaluation of safety. The first successfully workman compensation law is executed in the USA in the year 1911 which was another leap forward for mankind. The factories act and workman compensation law constitute the first phase of safety.

#### Phase-II (1920 to 1935) Guarding of Safety Appliances:

There was a compensation for evolving scientific method for controlling, accidents. In 1929 H.W. Henrich put forth as famous theory of "foundation of a major injury" major breaks through was however made in 1931 when he published in revolutionary "Domino theory". The concept of safety guards and safety appliances took first at this stage.

#### Phase-III (1935 to 1960) Safety Propagandas Phase:

Domino theory clearly indicated that person not things caused accidents. It was natural that combined effort of good have keeping, safety guards and safety appliances did not succeed in achieving the ideal zero accident rates.

This safety promotional and propagandas techniques thus receiving a great boost.

#### Phase-IV (1960 Onwards) Managing Out Accident:

All the existing theories and techniques were the viewed to find out the "missing link".

- Now top management was held fully responsible for safety and act as catalyst.
- Line management is directly responsible for safety and must play or a direct and active role to promote and ensure safety of their man.

## 2. Methodology

In this research the Steel melting shop and coke ovens factory situated at Bhilai, Dist. Durg (C.G) is chosen for the safety study. Main sections of the factory are as follows: -

- Steel melting shop
- Coke ovens
- Sponge Iron unit including Rotary Kiln, Rotary Cooler, AFBC, WHRB Boiler, Control Room
- T.G. Building, Boiler, ESP & Chimney
- Site Office & Security Office
- General Store
- Melting Bay (Induction Furnace Bay)
- Charging Bay
- Billet Bay

- Control Panel & Motor Room etc.
- Lab Control Panel Room & D.G. Room
- D.M. Water Tank, Cooling Tower & Water Tank (Ground & H.H.T.)
- Urinal & Toilet.

Responses were collected through a survey from 50 employees working in the steel melting shop and coke oven unit for the analysis of the potential hazard.

### 3. Result

#### 3.1 Analysis of Primary Data and Major Findings

**Table 1:** Age distribution of employees in percentage

S.No.	Age of Employees	No. of Respondent	%
1	18 to 20	30	60
2	21 to 25	10	20
3	26 to 30	05	10
4	31 to 35	05	10

Major employee's i. e. 60% is young.

**Table 2:** Education qualification of employees in percentage

S.No.	Educational Qualification of the Employee	No. of Respondent	%
1	Under Matric	10	20
2	Matric	10	20
3	I.T.I.	20	40
4	Graduate/ Diploma	10	20

Most of the employees are I.T.I.

**Table 3** Categorization of workers

S.No.	Categories of Workers	No. of Respondent	%
1	Unskilled	10	20
2	Semi-Skilled	10	20
3	Skilled	20	40
4	Highly Skilled	10	20

Major employee's i.e.40% is skilled.

**Table 4 :** Emolument of employees

S.No.	Emolument of the Employees	No. of Respondent	%
1	2500-3000	20	40
2	3100-3500	15	30
3	3600-4000	10	20
4	4100-<4100	05	10

Major employees i.e. 40% are getting emolument Rs. 2500 to Rs.3000

**Table 5 :** Marital status of employees

S.No.	Marital Status of Employees	No. of Respondent	%
1	Married	30	60
2	Unmarried	10	20
3	Widow/ widower	05	10
4	Divorcee	05	10

Major employees i.e. 60% are married.

**Table 6 :** Responses for hazard awareness in employees

S.No.	Hazard Awareness in Employees	No. of Respondent	%
1	Management	30	60
2	Workers	15	30
3	Common	05	10
4	Unknown	00	00

Major hazards awareness 60% are found in management.

**Table 7 :** Responses for the role of individual in hazard identification in plant

S.No.	Hazards Identification in Plants	No. of Respondent	%
1	Management	30	60
2	Workers	15	30
3	Jointly	05	10
4	No procedure	00	00

The Management identifies major hazards i.e. 60%.

**Table 8 :** Responses against the arrangement to prevent fire hazards in conveyor

S.No.	Arrangement to Prevent Fire Hazards in Conveyor	No. of Respondent	%
1	Water Sprinkler Provided	40	80
2	Fire Extinguisher Provided	05	10
3	No Arrangement	03	06
4	Cannot say	02	04

According to 80% of the employees, water sprinkler is provided to prevent the fire hazards.

**Table 9 :** Responses for the requirement of light fitting clothing for workers

S.No.	Requirement of Light Fitting Clothing for the Person Working Near Conveyor	No. of Respondent	%
1	Yes	40	80
2	No	05	10
3	Not sure	05	10
4	Do not know	00	00

Major employees i.e.80% say light fitting, clothing is required for working near conveyor.

**Table 10 :** Responses for the clothing of workers near conveyor

S.No.	Clothing for the Person Working Near Conveyor	No. of Respondent	%
1	Own light fitting clothing	05	10
2	Company uniform	05	10
3	Own general clothing	35	70
4	No regular pattern of uniform	05	10

Major employees i.e. 70% are using own clothing while working near conveyor.

**Table 11 :** Responses for the arrangement of pull conveyor

S.No.	Arrangement of Pull Conveyor	No. of Respondent	%
1	Yes	40	80
2	No	05	10
3	No sure	05	10
4	Do not know	00	00

Manor employees i.e. 80% says that pull cord is arranged in conveyor.

**Table 12 :** Responses for the utilization of pull cord in conveyor

S.No.	Utility of Pull Cord in Conveyor	No. of Respondent	%
1	To prevent accident	40	80
2	To prevent trapping of clothing	05	10
3	To stop conveyor in emergency	05	10
4	Cannot say	00	00

Major employees i.e. 80% say pull cord is very useful in conveyor.

**Table 13 :** Responses for the presence of emergency switches in conveyor

S.No.	Presence of Emergency Switches to Stop Conveyor	No. of Respondent	%
1	Yes	40	80
2	No	05	10
3	Not sure	05	10
4	Do not know	00	00

Major employees i.e. 80% say that emergency switch is present to stop the convertor.

**Table 14 :** Responses for the presence of hooter siren in conveyor

S.No.	Presence of Hooter Siren in Conveyor	No. of Respondent	%
1	Yes	40	80
2	No	05	10
3	Not sure	03	06
4	Do not know	02	04

Major employees i.e. 80% say that the hooter siren is present in conveyor.

**Table 15 :** Responses against the necessity of hooter siren in conveyor

S.No.	Necessity of Hooter Siren in Conveyor	No. Respondent	of%
1	For alerting people	40	80
2	For preventing accident	05	10
3	For awareness	03	06
4	Cannot say	02	04

Major employees i.e. 80% say that hooter siren is necessary in conveyor.

**Table 16 :** Responses for presence of dust extraction system

S.No.	Presence of Dust Extraction System	No. Respondent	of %
1	Yes	04	80
2	No	05	10
3	Not sure	03	06

**Table 17 :** Responses for the utilization of dust extraction system

S.No.	Utility of Dust Extraction System	No. Respondent	of%
1	It reduces generation of dust	30	60
2	It prevent inhalation of dust	15	30
3	IT prevent occupational disease	10	20
4	Cannot say	05	10

Major employees i.e. 60%|says that dust extraction system is very useful in the plant.

**Table 18 :** Responses for the presence of concreted floor in stock yard

S.No.	Presence of Concreted Floor in Stock Yard	No. Respondent	of%
1	Yes	30	60
2	No	15	30
3	Not sure	05	10
4	Do not know	00	00

Major employees i.e. 60% say that stockyard floor is concreted.

**Table 19 :** Responses against the utilization of concreted floor

S.No.	Utility of Concreted Floor of Sock Yard	No. Respondent	of%
1	It prevents collapsing of floor	30	60
2	It can with stand heavy load	15	30
3	It prevents accident and spillage of material	05	10
4	Cannot say	00	00

Major employees i.e. 60% says that concreted floor of yard is very useful to prevent collapsing.

**Table 20 :** Responses for the different types of PPE's issued

S.No.	Different PPE 's Issued by Management	No. Respondent	of%
1	Helmet , face, guard ,dust ,mask etc.	05	10
2	Hand gloves, safety shoe, apron etc.	10	20
3	All of the above	30	60
4	None of the above	05	10

Major employees i.e. 60% says that hand gloves, safety shoe, apron etc. provided to their workers

**Table 21:** Responses for the satisfaction level of workers with the provided PPE

S.No.	Satisfaction with the Quality of PPE 's Issued	No. Respondent	of%
1	Yes	30	60
2	No	10	20
3	Cannot say	05	10
4	Do not know	05	10

Major employees i.e. 60% say that they satisfied with quality of the PPE's issued to then.

**Table 22 :** Responses for the safety training provided by management

S.No.	Safely Training for Workers by Management	No. Respondent	of%
1	Yes	02	04
2	No	38	76
3	Frequently	05	10
4	Often	05	10

Major employees i.e. 76% say that management to them dose does not impart safety training.

**Table 23 :** Responses for the necessity of safety training

S.No.	Necessity of Safety Training	No. Respondent	of%
1	It aware with the hazards	30	60
2	It prevents accident	10	20
3	It makes safety conscious	05	10
4	Do not know	05	10

Major employees i.e. say the safety training aware them with the hazards.

**Table 24 :** Responses for the presence of safety officer

S.No.	Presence of Safety Officer	No. Respondent	of%
1	Yes	02	04
2	No	38	76
3	Can not	05	10
4	Do not know	05	10

Major employees i.e. 76% say that safety officer is not present in the plant.

**Table 25 :** Responses for satisfaction level of workers regarding safety in plant

S.No.	Overall Satisfaction Level About Safety of Workers in the Plant	No. Respondent	of%
1	Highly satisfied	05	10
2	Satisfied	25	50
3	Dissatisfied	10	20
4	Highly dissatisfied	10	20

Major employees i.e. 50% say that they are satisfied about the safety of workers provided by the plant.

## Conclusions

- Maximum employees are young which indicate that physical manpower of the industry is very strong resulting more productivity.
- Maximum employees are under matric.
- Maximum workers are skilled. So quality of the production will be good.
- Maximum employees are getting lesser emoluments. So the cost of the manpower will be less.

- Maximum employees are married .so psychologically they stable which is good for the factory.
- Management is more aware with hazards, which indicate the concern of the management for safety of its employees.
- Maximum hazards are identified by the management. Which saves the time of employees?
- Management is more safety conscious. So provides the safely of the appliances.
- Maximum employees require light fitting clothing for working near conveyor.
- Maximum workers are using their own clothing 's while working near conveyor.
- Management is more safety conscious so full cord is provided.
- The pull cord is very useful to prevent the accident in conveyor.
- Emergency switches are preset in conveyor. To stop it at the time of emergency.
- Hooter siren is present in conveyor for alerting the people employees.
- Hooter siren is very necessary to prevent accident.
- Presence of dust extraction system is very useful to reduce the pollution.
- Dust extraction system is very useful to prevent the occupational disease.
- Concreted floor is very useful in stockyard.
- Concreted floor do not collapse and with stand heavy load. It prevents the accident and spillage of materials.
- Due to safely conscious management issue a lot of safety appliances Maximum employees are satisfied with the quality of the P.P.Es.
- Due to safety conscious safety training is imparted to workers by the management.
- Safety training is very essential to prevent accident.

- Safeties officers are requiring to trained and prevent the accident
- Generally, employees are satisfied to some extent and also dissatisfied with the facility of safety measures.

- 6) Bishnoi, V P.S., and Sharma, K D. Energy recovery and conservation measures in steel melting shop of Bokaro Steel Plant. India: N. p., 1980. Web.
- 7) Basha, S. A., & Maiti, J. (2013). Relationships of demographic factors, job risk perception and work injury in a steel plant in India. Safety science, 51(1), 374-381.

### Recommendations

- Management as well as employees also should be aware the hazards occurring in the factory. The management should take necessary action to increase the awareness of the employees towards different hazards present in the plant.
- For hazards identification management should courage participation of employees, which will make them more safety conscious.
- Light fitting clothing's are not supplied to employees by the management. So the care should be taken in this field.
- The management gradually provides a regular pattern of uniform to the employees. This will reduce the chance of accident working near machine in motion.
- The management must enhance qualities of P.P.Es.
- Safety training to every employee should give by the management to prevent the accident.
- To train and prevent accident every factory should employee a safety officer.
- Management should try to satisfy the employees in case of safety appliances quality.
- Management should always maintain the standard of safety.
- Management should balance the production and safety parallel.

### References

- 1) Dr. Tupakare R.H. and Tupakare V.R. (2003), "Iron Making", Dhanpat Rai, New Delhi.
- 2) Tarafdar N.K. and Tarafdar K.J. (2002), "Industrial Safety Management", Kitab Mahal, New Delhi.
- 3) Safety Guidelines for Iron & Steel Sector, Sg/28, Ministry of Steel, Govt. Of India
- 4) Sponge Iron Chronicle, Papuri Consultancy Pvt. Ltd
- 5) Biswas A.K. (1998), "Chemical Metallurgy-Principal & Practice", Mir Publisher, Mascow.