Evaluation of Hazards in Crusher and Material handling of Cement Industry

Naman Agrawal*, N.K. Jain and Praveen Patel
Department of Fire technology and Safety Engineering,
IES-IPS Academy, Indore (M.P), India

(Received 15 December, 2013 Accepted 27 December, 2013)

ABSTRACT: This paper analysis, is to identify the hazard in material handling and crusher section of the cement industry. This analysis gives various reasons of hazard during operations, with the help of hazard identification techniques in crusher section of cement industry i.e. with FTA and HAZOP and also gives the proper recommendation to minimize the hazards in material handling by Checklist method.

Keywords: FTA; HAZOP; Checklist

I. INTRODUCTION

Cement industry comes on 8th position of the schedule II [1] of the Indian Factories Act 1948. In every year lots of minor, major or fatal accidents are occurred due to material handling. Material handling and Crusher section are the two major sections of the cement industry. Hazard associated with these two sections in more as compared to the other section of cement industry. Every injury has a major effect on economy due to loss of productive hour, manpower losses, compensation to the victim’s. Therefore for reduction of all injuries/fatalities, corrective and preventive action should be taken.

In order of this, Hazard identification can play an important role. There are many methods for hazard identification techniques which are very effective for identifying and reducing the hazard associated with cement industries. We have paid our attention towards the hazard identification techniques for identifying the actual causes of hazard which may leads to minor, major or fatal accident hence to minimize it.

Therefore we have chosen the topic “Evaluation of hazard in crusher and material handling of cement”. This analysis is aimed to determine the hazards during operation, which may affect the productivity. Furthermore; the research pushes the management to adopt best practices to minimize the hazard at workplace.

II. MATERIAL AND METHODS

FTA (Fault Tree Analysis) [2] Fault Tree Analysis is used to determine the root cause and probability of undesired event.

Fault trees are the models which is developed with the help of logic gates and the effect and cause relationship. FTA have a cuts sets which help to the actual cause of failure. We can apply this technique on Stacker and Reclamier section of Crusher section and hence find the probability of failure.

HAZOP (Hazard and Operability Analysis) [4]. This technique is for identifying and analyzing hazard with the help of guide words which are applied on various system parameters [5]. Here we have taken the system parameters like Vibration, Electric Current and Crushing and guide word implemented on are More, Less, NO etc to find the variation on hopper of crusher section which may lead to hazard. Checklist method is the very effective means to prevent the accident in any cement industry. Various symbols are used in FTA like

- OR gate, - Primary failure,
- Secondary failure, - Transfer symbol

III. RESULTS

Cut sets are the key product, produced by FTA. Here we have taken, the cuts sets of Bending of Plates (G31).
Cut sets are the key product, produced by FTA. Here we have taken, the cut sets of Bending of Plates (G31). The cut sets Plate Bend are X, G3 and S. Let, Failure Probability based on the failure time per (100) hrs Therefore, As per OR gate expansion formula [3] 
\[ P(G_{19}) = P(X) + P(G3) - P(X,G3) = 7.19 \times 10^{-3} \] 
\[ P(G_{31}) = 7.48 \times 10^{-3} \]

<table>
<thead>
<tr>
<th>S. No</th>
<th>TEXT/NAME</th>
<th>FAILURE PROBABILITY</th>
<th>EXTENSION NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PLATES BEND</td>
<td>7.48 x 10^{-3}</td>
<td>G31</td>
</tr>
<tr>
<td>2.</td>
<td>JOINT FAILURE</td>
<td>7.19 x 10^{-3}</td>
<td>G19</td>
</tr>
<tr>
<td>3.</td>
<td>HEAVY MATERIAL</td>
<td>3 x 10^{-3} (APO)</td>
<td>S</td>
</tr>
<tr>
<td>4.</td>
<td>LOOSENING OF NUTS AND BOLTS</td>
<td>7 x 10^{-3} (APO)</td>
<td>X</td>
</tr>
<tr>
<td>5.</td>
<td>WEAR AND TEAR</td>
<td>2 x 10^{-3} (APO)</td>
<td>G3</td>
</tr>
</tbody>
</table>

Similarly we have found the cuts sets and failure probability of each and every gate. At last we got the failure probability of both the Stacker and Reclaimer which can be given.

Checklist for the safe work practices for preventing the hazard arises due to interaction of man, machine and material in material handling of cement industry-
1. Are the material are delivered as close as possible to where they will be used. (Y/N)
2. Are the Loads are split up to reduce weight. (Y/N)
3. Are the Walkways are kept clear to allow use of material handling (Y/N)
4. Are the Mechanical devices or team lifting techniques are used for heavy loads whenever possible. (Y/N).
5. Before lifting and carrying heavy objects, workers plan the task, including resting points if necessary. (Y/N).

6. Are the Workers use the correct grip, test the load before lifting and lift and hold the load close to the body. (Y/N).
7. Are the Loads are lifted and lowered gradually. (Y/N).

Worksheet of HAZOP, in Hopper of Crasher section of cement industry is given below:

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Function/ Purpose</th>
<th>Parameter</th>
<th>Consequences</th>
<th>Cause</th>
<th>Hazard</th>
<th>Risk</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vibrater in hopper</td>
<td>To transfer material from hopper to machine</td>
<td>Vibration</td>
<td>Material not forwarded.</td>
<td>Motor not working; Vibrostfeder not working</td>
<td>Loss of System</td>
<td>2D</td>
<td>Provide emergency backup, regular inspection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Material not forwarded with normal speed.</td>
<td>Motor not working; Vibrostfeder not working properly.</td>
<td>Loss of energy loss of system</td>
<td>2C</td>
<td>Provide emergency backup, regular inspection</td>
</tr>
<tr>
<td>2</td>
<td>Electric power</td>
<td>To provide electricity for motor , vibrostfeder etc.</td>
<td>Electricity</td>
<td>Loss of Power to operate motor, vibrostfeder etc.</td>
<td>Power failure, Circuit breaker trip</td>
<td>Loss of System operation</td>
<td>2D</td>
<td>To provide emergency backup</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Trip Circuit Breaker</td>
<td>Power surge</td>
<td>Loss of system operation ,Equipment damage</td>
<td>2C</td>
<td>Provide fault detection and isolation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Insufficient power to adequately operate system component</td>
<td>Power Grid fault</td>
<td>Equipment damage</td>
<td>2D</td>
<td>Provide source of emergency backup</td>
</tr>
<tr>
<td>3</td>
<td>Reduce (crush)</td>
<td>Crushing of stone</td>
<td>Crushing</td>
<td>Motor not working, vibrostfeder ,rotor, Empty of hopper, jamming of crasher hammer not working</td>
<td>Voltage problem, vibration is less, wear and tear of hammer</td>
<td>Loss of System operation</td>
<td>2C</td>
<td>Regular maintenance, emergency backup</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Voltage problem, vibration is less, wear and tear of hammer</td>
<td>Loss of system operation</td>
<td>2C</td>
<td>Regular maintenance, emergency backup</td>
</tr>
</tbody>
</table>
IV. CONCLUSION

Methodology (FTA) concluded that the cut sets we have found along with their probabilities can play a major part in the failure of both i.e. Stacker and Reclaimer because, the sum of both of their probabilities is nearly equal to 1. This shows that the failure of any part of both the machines can cause due to the various reasons we have taken into account. It means that failure of 1 hour will occurs in working of 100 hrs. HAZOP. This concluded that the Vibration, electricity, and crushing are the major parameter of hopper which are affected by the various guide words such as No, More and less due to this failure of hopper are duly accrued. Checklist-The hazard are more in the material handling which can easily recognized and eliminated with the help of checklist method. Check list is the way to find out the hazard in any system and give their corrective action for controlling the hazard. So as to provided the safe work practices for working.

REFERENCES

[1]. The Indian Factories Act 1948.


