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Evaluation of Hazards in Crusher and Material handling of Cement Industry

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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. METERIAL AND METHODS

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

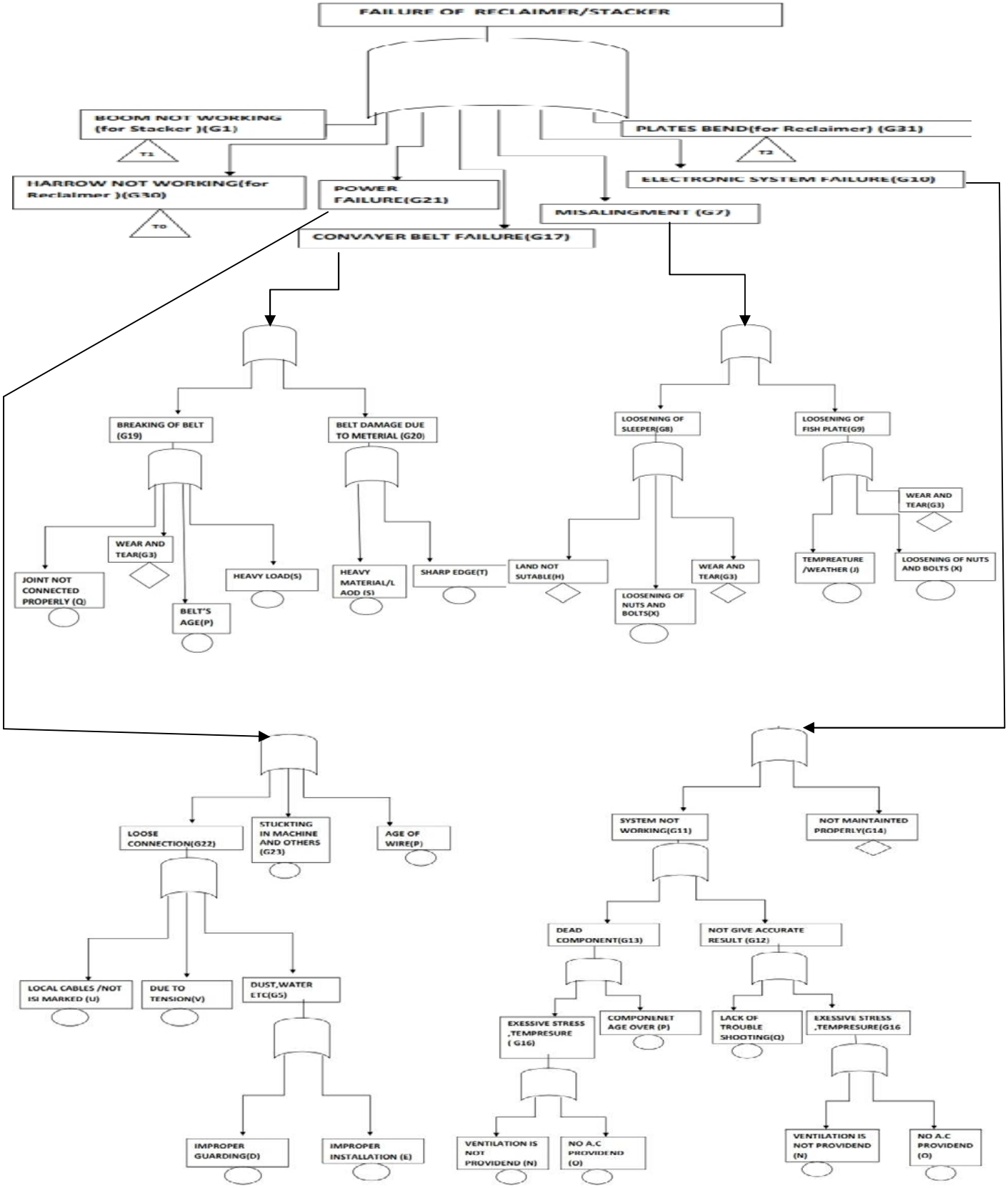
Fault trees are the models which is developed with the help of logic gates and the effect and cause relationship. FTA have a cuts sets which help to the actual cause of failure. We can apply this technique on Stacker and Reclamier section of Crusher section and hence find the probability of failure.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

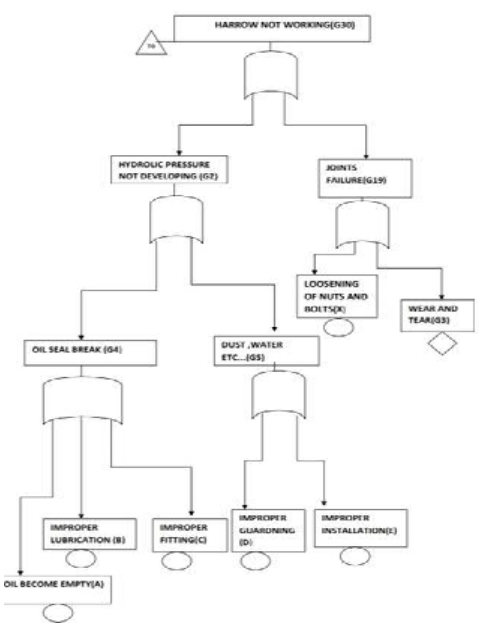
 -OR gate,  - Primary failure,

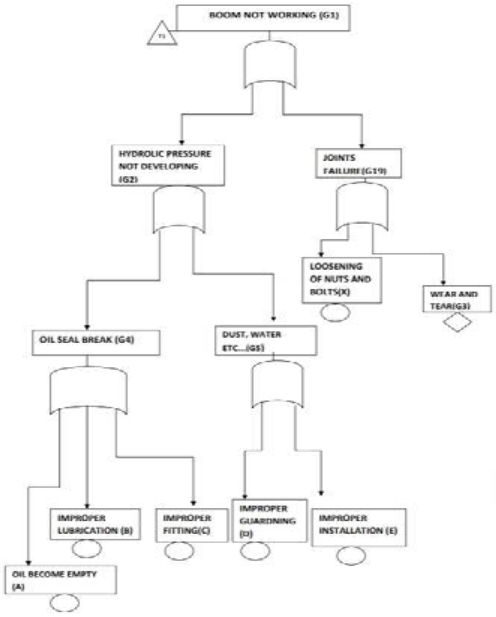
 -Secondary failure, - Transfer symbol

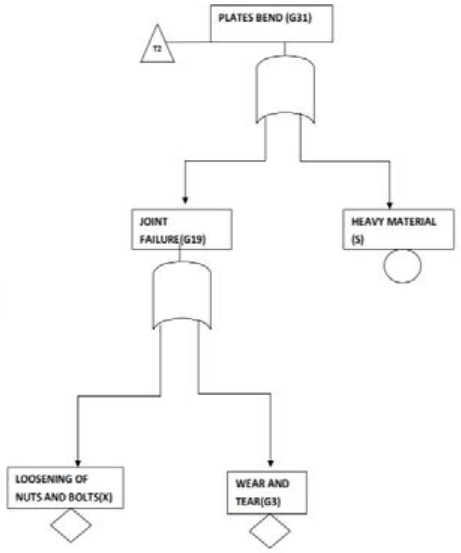
III. RESULTS

Cut sets are the key product, produced by FTA. Here we have taken, the cuts sets of Bending of Plates (G31).


FAILURE OF RECLAIMER/STACKER
BOOM NOT WORKING (for Stacker)(G1)
T1
PLATES BEND(for Reclaimer) (G31)
T2
HARROW NOT WORKING(for Reclaimer)(G30)
T0
POWER FAILURE(G21)
ELECTRONIC SYSTEM FAILURE(G10)
MISALINGMENT (G7)
CONVAYER BELT FAILURE(G17)
BREAKING OF BELT (G19)
BELT DAMAGE DUE TO METERIAL (G20)
LOOSENING OF SLEEPER(G8)
LOOSENING OF FISH PLATE(G9)
WEAR AND TEAR(G3)
JOINT NOT CONNECTED PROPERLY (Q)
WEAR AND TEAR(G3)
HEAVY LOAD(S)
BELT'S AGE(P)
HEAVY MATERIAL/LAOD (S)
SHARP EDGE(T)
LAND NOT SUTABLE(H)
LOOSENING OF NUTS AND BOLTS(X)
WEAR AND TEAR(G3)
TEMPREATURE /WEATHER (J)
LOOSENING OF NUTS AND BOLTS (X)
LOOSE CONNECTION(G22)
STUCKTING IN MACHINE AND OTHERS (G23)
AGE OF WIRE(P)
LOCAL CABLES /NOT ISI MARKED (U)
DUE TO TENSION(V)
DUST,WATER ETC(G5)
IMPROPER GUARDING(D)
IMPROPER INSTALLATION (E)
SYSTEM NOT WORKING(G11)
NOT MAINTAINTED PROPERLY(G14)
DEAD COMPONENT(G13)
NOT GIVE ACCURATE RESULT (G12)
EXESSIVE STRESS ,TEMPRESURE (G16)
COMPONENET AGE OVER (P)
LACK OF TROUBLE SHOOTING(Q)
EXESSIVE STRESS ,TEMPRESURE(G16
VENTILATION IS NOT PROVIDEND (N)
NO A.C PROVIDEND (O)
VENTILATION IS NOT PROVIDEND (N)
NO A.C PROVIDEND (O)







Cut sets are the key product, produced by FTA. Here we have taken, the cuts 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] $P(G19) = P(X) + P(G3) - P(X, G3) = 7.19 \text{ X } 10^{-3}$ and $P(G31) = 7.48 \text{ X } 10^{-3}$

S. No	TEXT/NAME	FAILURE PROBABIL -ITY	EXTEN -SION NAME
1.	PLATES BEND	7.48×10^{-3}	G31
2.	JOINT FAILURE	7.19×10^{-3}	G19
3.	HEAVY MATERIAL	3×10^{-4} (APO)	S
4.	LOOSENING OF NUTS AND	7×10^{-3}(APO)	X
5.	BOLTS WEAR AND TEAR	2×10^{-4}(APO)	G3
	APO = As Per the Information obtained from Operator, working in Cement Factory, (M.P), India		

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.

S.No	TEXT/NAME	FAILURE PROBABI-LITY	EXTEN SIN NAME
1.	ELECTRONIC SYSTEM FAILURE	9.81×10^{-4}(C)	G10 G7
2.	MISALINGMENT	0.0124(C)	G17
3.	CONVAYER BELT FAILURE	1.0013×10^{-4}(C)	G30
4.	HARROW NOT		G21
5.	WORKING POWER FAILURE	$8.7X10^{-4}$(C)	G31
6.			G1
7.	PLATES BEND BOOM NOT	3.48×10^{-3}(C)	**FC**
8.	WORKING **FAILURE OF**		**RC**
9.	**STACKER FAILURE OF RECLIAMER**	7.48×10^{-3}(C) 8.7×10^{-4}(C)	
	C = Probability calculated as per above formula	**1.0014** **1.0048**	

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

HAZOP Analysis[6]

No	Item	Function/ Purpose	Parameter	Guide word	Consequences	Cause	Hazard	Risk	Recommendation
1	Vibrati-on in hoppe-r	To transfer material from hopper to machine	Vibration	No	Material not forwarded.	Motor not working; Vibrofedder not working	Loss of System	2D	Provide Emergency backup, regular inspection
				Less	Material not forwarded with normal speed.	Motor not working; Vibrofedder not working properly.	Loss of energy ,loss of system	2C	Provide Emergency backup, regular inspection
2	Electri-c Power	To provide electricity for motor ,vibrofedder etc.	electricity	No	Loss of Power to operate motor, vibrofedder etc.	Power failure ,Circuit breaker trip	Loss of System operation	2D	To provide emergency backup
				More	Trip Circuit Breaker	Power surge	Loss of system operation ,Equipment damage	2C	Provide fault detection and isolation.
				Less	Insufficient power to adequately operate system component	Power Grid fault	Equipment damage	2D	Provide source of emergency backup
3	Reduce (crush)	Crushing of stone	Crushing	No	Motor not working, vibrofedder ,rotor, Empty of hopper ,jamming of crasher hammer not working	Voltage problem, vibration is less, wear and tear of hammer	Loss of System operation	2C	Regular maintenance, emergency backup
				Less	Motor not working, vibrofedder ,rotor, Empty of hopper ,jamming of crasher hammer not working	Voltage problem, vibration is less, wear and tear of hammer	loss of system operation	2C	Regular maintenance, emergency backup

IV. CONCLUSTION

Methodology (FTA) concluded that the cut sets we have found along with their probabilities can plays 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.

REFRENCES

[1]. The Indian Factories Act 1948.

[2]. LI Xiangyang, Zhan Jing, Jiang Fuliang, Wang Shuyun, Cause analysis of bridge erecting machine tipping accident based on fault tree and the corresponding countermeasures, Procedia Engineering **45** (2012) 43 – 46.

[3]. Yang Zhi-Ling, Wang Bin, Dong Xing-Hui, Liu Hao, Expert System of Fault Diagnosis for Gear Box in Wind Turbine, *Systems Engineering Procedia* **4**(2012) 189–195.

[4]. Iraj Mohammadfam, Amene Sajedi, Shahram Mahmoudi, and Farhad Mohammadfam, Application of Hazard and Operability Study (HAZOP) in Evaluation of Health, Safety and Environmental (HSE) Hazards, *International Journal of occupational hygiene*, 2008-5435/12/42-69-72.

[5]. Clifton A. Ericson II, Hazard Analysis Techniques for System Safety (book).

[6]. S.P. Kao, C.R. Chen, F.Z. Hsiao, J.P. Wang, Safety Management for The Cryogenic System Of Superconducting of System, Proceedings of 2005 Particle Accelerator Conference, Knoxville, Tennesse.