

# Hazard Identification using Risk Assessment for A Tyre Manufacturing Process

Raj Pradeesh T, Venkumar P, Saravanamani M

**Abstract**—Today's industries play a major role to develop and create new innovation products in manufacturing domain. The aim of this project is to identify the hazards, assess the risk and its root cause and to develop a control measures so that the major and minor hazards can be controlled in the tyre manufacturing industry and the workers will be working in a hazard free and safety environment. Material handling is the biggest cause of reportable accident in rubber industry and also hit by moving objects, falling objects, Noise, Fire etc... This can be identified and controlled by using the technique called HIRARC .By using these techniques the risks can be identified and the best safety measures can be implemented in the industry

**Keywords**— HIRARC, Hazards, Risk Assessment, Tyre Industry

## I. INTRODUCTION

Tyre manufacturing industry comprising of operations like Raw material handling, weighing, Mixing, Milling, Extruding, calendaring, assembly, curing, finishing and inspection. Due to the various processes in tyre manufacturing industry the hazards are very high. Employees working in industrial processing and working with rubber products leads to hazards like physical, chemical, biological etc...The data's has been collected at Tyre Manufacturing located in Madurai, by interacting with around 20 peoples who are all working in different units in the tyre manufacturing plants. TVS SRICHAKRA is a member of TVS groups, the largest auto ancillary group in India. It is the No.1 in Motorcycle tyres, is a leading manufacturer of tyres and tubes for two and three Wheelers in India. The Main objective of this work focus towards: To identify types of Hazard in work area, To make Risk Assessment, To suggest Risk Control to Organization, To implementing Risk Controls, To review Risk Controls.

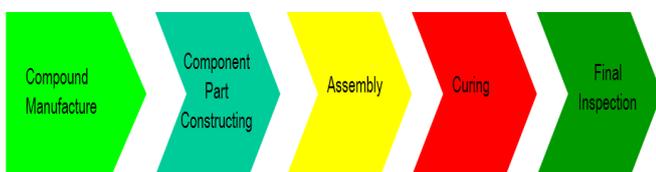


Figure 1: Process of Operation

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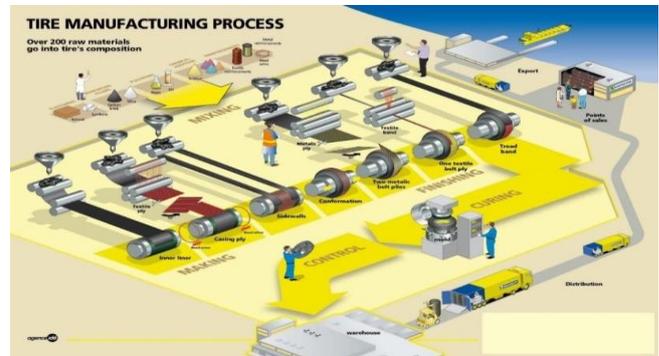


Figure 2 Overall Process Simulation

The common processes of Tyre manufacturing are: Mixing, Milling, Extruding, Calendaring, Bead making. Building (Fabrication), Vulcanizing, Finishing.

## II. LITERATURE REVIEW

Weijun Li et al. [1] proposed the proactive risk assessment control process for an industrial process by applying the JHA technique (Job Hazard Analysis) Techniques and Resilience Engineering Techniques. The outcome of the risk identification are minimize the risk and hazards present in the workplace that can lead to improve the safety culture in Industrial sectors

Sanchez et al [2] approach the risk reduction techniques to maintain a health and safety environment in the workplace. In this paper the author focusing the hand arm vibration as the critical factors in the workplace. Finally the author concluded the outcome of hazards identification is very minimal and the corresponding risk can be reduced. The author proposed the method used as the model for development of industrial environments to maintain a safety culture.

Rita Lamboglia et al [3] this investigation represents the causes of hazards and risk parameters that are related with the organizational factors. Behind that study it represents following relations to the organizational factors for risk management process and check the implementation level for the presence of surrounding factors related and added in the webpages of organization. The systematic approach conclude that mitigation of hazards and risk level in the workplace. Syaza I. Ahmad et al [4] develop the hazard assessment methodology for erection of chemical plants. The methodology shows the development of process hazard analysis techniques in early stage in terms of design concepts. The outcome of the analysis techniques are similarity difference studies between early stage case study incident analysis. Mira Hidajat et al [5] develop the matrix for the material analysis in rubber manufacturing industries. The results shows the matrix correlation of the various rubber manufacturing chemical particles that are present in the industries.

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Pascal Petit et al [6] conducted the investigation about the exposure of hydrocarbons of various industries and causes of lung cancers for the industrial workers. The study concludes and give the following outcomes are risk estimation of lung cancer diseases, Decrease the hazards and maintain the health environment.

Ruru Han et al [7] conducted the case study on atmosphere disasters happened in china. The case study concluded that manmade habitats and climatic change are the causes of Natural disasters. This method is one of the model to predict the factors caused by the monsoon disaster parameters.

Yongbo Li et al [8] conducting risk assessment in thermal power plants by applying the ISM methodology (Interpretive Structural modelling). The outcome of the risk assessment insulation failure is the potential factors that may cause accidents inside the power plants and can be precautions can be implemented based on the available potential failures levels.

Shahidul Islam et al [9] identify the fire hazards encountered in garment industries. The assessment was primarily conducted out built on Initial workers Questinarraie surveys. Next part information carried out with all necessary sources by relating with the previous data's collected. The analysis conclude that this industry is very poor compared with the other garment industry located in by near the filed in mitigating and identification of fire accidents.

## III. METHODOLOGY

The Hazards has to be identified based on the process in each plant and then its severity has to be noted, risk has to be assessed and it has to be noted for tabular representation. Then the control and effective measures have to be identified and taken for further proceeding. The HIRARC table has to be made for Mixing and Extruder so that the problem can be easily identified, its control measures are noted and then optimization tool AHP is carried out for the same process for further clarity regarding the Hazards. The purpose of this guideline is to provide a systematic and objective approach to assessing hazards, its associated risks that will provide an objective measure of an identified hazard as well as provide a risk controlling method. Occupational Safety and Health Act 1994 (Act 514) for the employer to provide a safe workplace to their employees and other related person is prescribed as the general duty

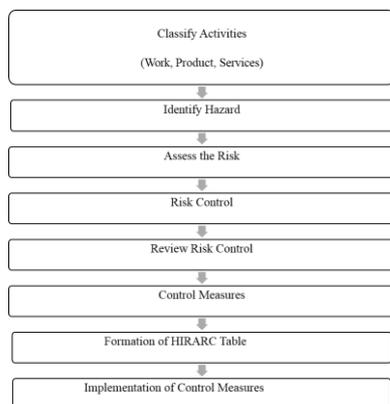


Figure 3:HIRARC Flow Diagram

## A. About Risk

Risk is the combination of the occurrences of accidents in possible ways and impact of incident may be major or minor of a quantified dangerous occurrence encountered. In general, risk can be calculated by the following equation.

$$\text{Risk} = \text{Likelihood} \times \text{Severity}$$

The reasons of conducting HIRARC for the following methodologies behind on every industry: - To categorize all the influences that may origin injury to workers and others assets to machineries (hazards, risks), To permit occupiers to strategy, familiarize and point out protective points to ensure that the risks are adequately controlled at all times. The purpose of hazard identification is to highlight the critical operations of tasks, that is, those tasks posing significant risks to the health and safety of employees working conditions or activities performed.

## B. Risk Estimation

Risk estimation is the resolve the probability of accident occurrences and sources, impact of the reliable coincidence/event orders, to identify the direction of sources of the events and to importance known risks. It can be done by qualitative, quantitative or semi quantitative method.

TABLE I RISK EVALUATION MATRIX TABLE

LIKELIHOOD OF HAZARDS	SEVERITY OF HAZARDS				
	INSIGNIFICANT (1)	MINOR (2)	MODERATE (3)	MAJOR (4)	FATAL (5)
RARE (1)	1	2	3	4	5
UNLIKELY (2)	2	4	6	8	10
POSSIBLE (3)	3	6	9	12	15
LIKELY (4)	4	8	12	16	20
ALMOST CERTAIN (5)	5	10	15	20	25

The purpose of hazard identification and risk assessment is to highlight the critical operations of tasks that poses significant risks to the health and safety of employees as well as highlighting those hazards pertaining to certain equipment due to energy sources, working conditions or activities performed. Identifying required corrective action to minimize the risk or eliminate the hazard.

TABLE: II Risk Level Table

RISK LEVEL	
1 to 2	LOW
3 to 6	MEDIUM
7 to 12	HIGH
More than 12	EXTREME

**IV. RISK ASSESSMENTS FOR MIXING PLANT AND EXTRUDER OPERATIONS**

The Problems identified in the tyre manufacturing industry based on the previous incident analysis, lesson learning techniques, Accident reporting techniques and Job Safety analysis. Study all the overview process and identify the serious potential hazards present in workplace. This study focus the high hazards present in the new mixing plants and extruder plants. Although with the reference of risk assessment procedures methodology, initially select the process of the tyre manufacturing and activities performed by the workers. Next categorize and identify the hazards based on the activities. Conduct the Risk assessment for marking the probability of occurrence a, severity ranges and risk ratings.

The sample activities shows the amount of hazards present in the workplace. The corresponding probability of occurrences, severity ranges and risk rating is shown in Table III for reference. The Risk rating is calculated based on the risk evaluation matrix shown in Table II for reference.

**TABLE III HIRA TABLE FOR TWO OPERATIONS**

S. No	Process	Hazard	Risk Assessment		
			Likelihood	Severity	Risk
1	Unloading of Raw Materials from the Lorry	Manual unloading of Materials	4	3	12
		Spillage/Leakage of chemicals	3	2	6
2	Movement of raw material from unloading point to chemical loading area	Material fall & hit the person	4	3	12
		Caught hand between the doors	3	2	6
3	Dump Mill	Hand knife are used to cut the rubber in dump mill	4	2	8
4	Removal of fallen compound under the Roller using Hand	Struck of Hand while removing of Compound	2	2	4
		Inhalation of Rubber Fumes	5	3	15
5	Unloading of FB Compound Trolley using Forklift	Mechanical (Forklift)	4	3	12
6	Feeding of FB Compound into the Extruder	Machinery (Roller mill)	4	2	8
7	Movement of tread from Die to Inner Roller	Mechanical (Conveyor)	2	2	4

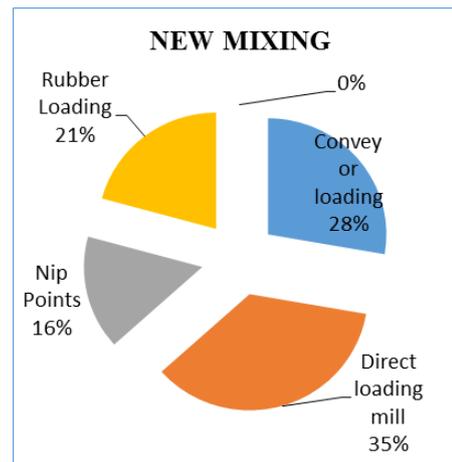
**V. RESULT AND DISCUSSION**

Direct Loading Mill has the highest risk factor in mixing process. Over 35% of risk is due to direct falling of mixed

rubber into the dump mill. Safety mask can be provided so that the chances of inhaling a carbon present the heated rubber will be minimum

**TABLE IV: Comparison Risk Scores for Each Activities**

SNO	PROCESS	RISK SCORES
1.	Unloading of Raw Materials from the Lorry	9
2.	Movement of raw material from unloading point to chemical loading area	8
3.	Weighing & Mixing of Chemicals	9
4.	Loading of Raw Rubber & mixed chemicals into the Banbury using Conveyors	8
5.	Dump Mill	15
6.	Removal of fallen compound under the Roller using Hand	15
7.	Warming Mill	6
8.	Dipping of compound in Soap Oil solution	8
9.	Wig wag	4
10.	Movement of MB Compound trolley from Wig wag to FB Banbury	10
11.	Loading of FB Compound trolley to the tractor	8
12.	Movement of Tractor to Extruder, Bead Winding, Calendaring	6



**Figure 4 Risk Analysis for New Mixing Operation**

Improper faulty is the highest risk factor in extruder process. Over 46% of risk is due to the loading of FB rubber into the extruder. When the rubber get stuck in the die inside the extruder, during cutting of excess rubber there is a chances of hand getting stuck un the hopper and chances of hand gets broken.



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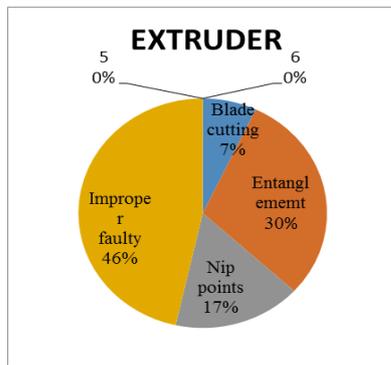


Figure 5 Risk Analysis for Extruder operation



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## VI. CONCLUSION

Around 40% of report in Health Safety & Environment is based on rubber industries material handling causage. In Tyre Industries accidents are undertaken via falling/moving of objects, Slips and Trips, Rubber dust, Fire, etc. It can be overcome by using a technique named HIRARC. This technique is used to identify the Hazard, Types of Hazards to be implementing, and Risk Assessment to be made with the support of Risk Controls Units.

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## AUTHORS PROFILE



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