

ASSESSMENT OF FIRE RISKS IN RUBBER MANUFACTURING INDUSTRY IN SRI LANKA

Mura Mudalige S L

219295N

MSc. in Occupational Safety & Health Management

Department of Building Economics
Faculty of Architecture

University of Moratuwa
Sri Lanka

October 2025

ASSESSMENT OF FIRE RISKS IN RUBBER MANUFACTURING INDUSTRY IN SRI LANKA

Mura Mudalige S L

219295N

Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree

MSc. in Occupational Safety & Health Management

Department of Building Economics
Faculty of Architecture

University of Moratuwa
Sri Lanka

October 2025

DECLARATION

I declare that this is my own work, and this thesis/dissertation does not incorporate without acknowledgment any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature:

Date: 18th October 2025

The above candidate has carried out research for the master's dissertation under my supervision. I confirm that the declaration made above by the student is true and correct. Name of the supervisor: Dr. Uthpala Rathnayake

Signature of the supervisor:

Date: 18th October 2025

ABSTRACT

The rubber manufacturing industry in Sri Lanka plays a vital role in the national economy as a key contributor to global supply chains, particularly through the export of natural rubber and rubber-based products. However, the sector inherently faces a heightened risk of fire due to the flammable nature of raw rubber compounds, chemicals, and associated materials used in production. This research aims to assess fire-related hazards within the rubber manufacturing industry in Sri Lanka, identifying the root causes and evaluating the effectiveness of existing safety measures.

A mixed-methods approach was adopted, incorporating both quantitative data analysis of past fire incidents and qualitative insights gathered through structured interview with industry personnel. The study identifies critical fire risk factors, including material handling practices, inadequate fire suppression systems, and lapses in regulatory compliance. Furthermore, the global context underscores similar challenges, as rubber manufacturing is widely recognized as a high-risk sector for fire incidents.

Based on the findings, this research proposes a set of practical, industry-specific mitigation strategies aimed at enhancing fire prevention, emergency preparedness, and overall occupational safety. The outcomes are expected to support policy formulation and strengthen fire risk management frameworks across Sri Lanka's rubber manufacturing sector.

ACKNOWLEDGMENT

I would like to give my warmest gratitude to my supervisor Dr. Uthpala Rathnayake, who guided me throughout the research. Your support and advice encouraged me to accomplish this task simply.

Further, some individuals were on my back to success in this. My colleagues from the university and my workplace were in a top place since their courageous words made me strong as well as it was easy to find the information as well. I take this chance to thank them from the bottom of my heart.

And I have no sufficient words to express how I am grateful to have my parents and family members on the completion of this task.

Above all, I am profoundly thankful to my beloved wife, whose unwavering support, patience, and encouragement have been my greatest strength. Her love and belief in me made this achievement possible.

Last but not least I would like to extend my heartfelt gratitude to all who helped me to succeed in my research.

CONTENT

DECLARATION	i
ABSTRACT.....	ii
ACKNOWLEDGMENT.....	iii
CONTENT.....	iv
LIST OF TABLES.....	vi
LIST OF FIGURES	vii
ABBREVIATIONS	viii
01 BACKGROUND	1
1.1 Introduction.....	1
1.2 Problem Statement.....	2
1.3 Aim and Objectives.....	3
1.4 Methodology	4
1.5 Chapter Summary	5
02 LITERATURE REVIEW	6
2.1 Introduction.....	6
2.2. What is Fire?	6
2.2 Fire risk mitigation.....	7
2.3 Consequences of fire accidents in the rubber manufacturing industry	8
2.4 Importance of mitigating fire accidents for maintaining sustainability	10
2.5 Impacts of fire accidents on workers of the rubber manufacturing industry ...	10
2.6 Hazards associated with fire accidents in the rubber manufacturing industry.	12
2.7 Codes and Standards related to mitigating fire accidents in the rubber manufacturing industry	14
2.8 Significance of maintaining mitigating techniques to reduce the rate of fire accidents.....	16
2.8.1 Improving Road access	16
2.8.2 Sprinkler system components	17
2.8.3 Automatic testing	17
2.8.4 Fire pump testing	17
2.8.5 Significance of annual inspections of sprinklers	17

2.9 The challenges faced while mitigating fire incidents in the rubber manufacturing industry	18
2.10 Root causes for hazards	19
2.10.1 Organizational reasons	19
2.10.2 Behavioral reasons	19
2.10.3 Managerial reasons	20
2.10.4 Technical reasons	20
2.11 Rubber manufacturing industry in Sri Lanka.....	20
2.12 Literature Gap	21
2.13 Summary	21
03 RESEARCH METHODOLOGY	23
3.1 Introduction.....	23
3.2 Methods and Material	23
3.2.1 Expert Survey.....	23
3.2.2 Case Study	25
04 FINDINGS AND DISCUSSION.....	27
4.1 Results from interviews	27
4.2 Results of collected past data	32
4.2.1 Data collection referring to the past data	32
4.3 Results Summary	51
4.4 Discussion	57
4.5 Chapter Summary	59
05 CONCLUSION AND RECOMMENDATIONS	60
5.1 Conclusion	60
5.2 Recommendations.....	61
5.3 Summary	62
LIST OF REFERENCES	63
APPENDIX 1: Interview Guideline.....	69
Covering Letter for Interview	69
Interview guideline	70

LIST OF TABLES

Table 3.1 - Details of interviewees	24
Table 4.1 - Results of interviews	27
Table 4.2 - Root cause analysis for incident 2019 No. 01	33
Table 4.3 - Root cause analysis for incident 2019 No. 02	33
Table 4.4 - Root cause analysis for incident 2019 No. 03	34
Table 4.5- Root cause analysis for incident 2019 No. 04	34
Table 4.6 - Root cause analysis in 2019 fire incidents	35
Table 4.7 - Root cause analysis for incident 2020 No. 01	36
Table 4.8 - Root cause analysis for incident 2020 No. 02	37
Table 4.9 - Root cause analysis for incident 2020 No. 03	37
Table 4.10 - Root cause analysis for incident 2020 No. 04	38
Table 4.11 - Root cause analysis for incident 2020 No. 05	40
Table 4.12 - Root cause analysis for incident 2020 No. 06	41
Table 4.13 - Root cause analysis for incident 2020 No. 07	41
Table 4.14 - Root cause analysis for incident 2020 No. 08	42
Table 4.15 - Root cause analysis for incident 2020 No. 09	43
Table 4.16 - Root cause analysis for incident 2020 No. 10	43
Table 4.17 - Root cause analysis for incident 2020 No. 11	44
Table 4.18 - Root cause analysis in 2020 fire accidents	45
Table 4.19 - Root cause analysis for incident 2021 No. 01	46
Table 4.20 - Root cause analysis for incident 2021 No. 02	46
Table 4.21 - Root cause analysis for incident 2021 No. 03	47
Table 4.22 - Root cause analysis for incident 2021 No. 05	48
Table 4.23 - Root cause analysis for incident 2021 No. 06	49
Table 4.24 - Root cause analysis in 2021 fire accidents	49
Table 4.25- Summary of fire incidents in 3 years.....	55
Table 4.26 - Mitigation Plan for Accidents in 2019	55
Table 4.27 - Mitigation Plan for Accidents in 2020	56
Table 4.28 - Mitigation Plan for Accidents in 2021	57

LIST OF FIGURES

Figure 2.2 - Hierarchy of control	7
Figure 2.3 - The rate of fire fatalities faced by employees in the rubber manufacturing industry	11
Figure 2.4 - An average annual rate of self-reported workplace fire accidents related to injury in the UK (2016-2019) by industry	12
Figure 2.5 - Flash points and boiling points of rubber in the rubber manufacturing industry	13
Figure 2.6 - Hazard system provided by NFPA.....	15
Figure 2.7 - Codes and Standards proposed by NFPA	16
Figure 2.8 - A proposed color combination of different gases to avoid fire accidents in the manufacturing industry	18
Figure 4.1 - Common Root Causes for fire incidents in 2019.....	35
Figure 4.2 - Fire on the electrical breaker switch.....	38
Figure 4.3 - Fire under press machine bed area.....	39
Figure 4.4 - Fire under press machine bed area.....	39
Figure 4.5 - Fire in changing room.....	40
Figure 4.6 - Damaged chair by fire.....	40
Figure 4.7 - Electrical braker damaged by fire.....	41
Figure 4.8 - Common Root Causes for fire incidents in 2020.....	45
Figure 4.9 - Common Root Causes for fire incidents in 2021.....	50
Figure 4.10 - Fire related near misses in the three years.....	55

ABBREVIATIONS

NFPA	National Fire Protection Association
PAT	Portable Appliance Testing
EDB	Export Development Board
PPE	Personal Protective Equipment
HIRA	Hazard Identification and Risk Assessment
FMEA	Failure Mode and Effect Analysis
ERT	Emergency Response Team
DMS	Daily Management System
SOP	Standard Operating Procedure
BCP	Business Continuity Plan
HW	Hot Work
FGS	Finished Goods Store
OSL	Outsourced Labor
PM	Preventive Maintenance
PDM	Predictive Maintenance
PCB	Printed Circuit Board
ATEX	Atmosphères Explosibles (European directive for equipment in explosive atmospheres)