

Occupational Fire Hazards in Textile Industry and Workers Health & Safety

M Dinakaran¹, J Lingadurai²

¹Assistant professor, Dept. of Safety and Fire Engineering Excel Engineering College, Namakkal, Tamilnadu, India.

²PG-Student, M.E-Industrial Safety Engineering, Dept. of Safety and Fire Engineering Excel Engineering College, Namakkal, Tamilnadu, India.

Email ID: dinaautomobile@gmail.com¹, linganadar2000@gmail.com²

Abstract

Occupational fire hazards in the textile industry pose a significant risk to the health and safety of workers. The textile sector, due to its complex manufacturing processes and extensive use of flammable materials, is particularly vulnerable to fire-related accidents. This project aims to investigate the nature of fire hazards in textile factories and their impact on workers' health and safety. The study explores the types of fire risks prevalent in textile production facilities, such as those arising from faulty electrical equipment, improper storage of flammable chemicals, and the handling of combustible fibers and fabrics. It also examines the potential consequences of fire incidents, including injuries, fatalities, and long-term health issues like respiratory diseases and trauma. The research emphasizes the importance of fire safety awareness and proactive safety measures to reduce the likelihood of fire-related accidents. Through surveys and interviews with workers, safety officers, and industry experts, the study identifies key challenges faced by workers, such as inadequate training, lack of proper fire safety equipment, and insufficient emergency response plans. Furthermore, the project investigates the effectiveness of current safety standards, including fire drills, personal protective equipment (PPE), fire extinguishing systems, and fire safety training programs. This study also highlights the role of government regulations, industry guidelines, and organizational safety cultures in mitigating fire risks in textile factories.

Keywords: Fire Hazards, Textile Industry, Workplace Safety, Flammable Materials, Health Risks and Safety Standards.

1. Introduction

Occupational fire hazards in the textile industry present significant risks to workers' health and safety. The textile sector is particularly vulnerable to fire-related accidents due to its complex manufacturing processes and the extensive use of flammable materials, such as fibers, chemicals, and fabrics. Workers in textile factories face exposure to various fire risks, including faulty electrical equipment, improper storage of flammable chemicals, and the handling of combustible materials. These hazards can lead to devastating consequences, such as injuries, fatalities, and long-term health issues, including respiratory diseases and trauma. The importance of fire safety awareness and proactive safety measures cannot be overstated. Ensuring the well-being of workers in textile factories requires a thorough

understanding of fire risks and effective mitigation strategies. This includes the implementation of safety standards, fire drills, and the use of personal protective equipment (PPE), along with proper fire extinguishing systems. Despite existing regulations and industry guidelines, challenges persist in maintaining safe working environments. Issues such as inadequate training, lack of proper equipment, and insufficient emergency response plans remain prevalent. [1]

2. Consequences of Fire Hazards

The consequences of fire hazards in textile factories are far-reaching and can be catastrophic. The immediate danger to workers' health and safety is the most obvious impact. In the event of a fire, workers are at risk of serious injuries or fatalities due to burns,

smoke inhalation, and the potential collapse of structural elements in the factory. The confined nature of many textile mills, along with the presence of hazardous materials, can make it difficult for workers to escape quickly in the event of a fire, increasing the risk of harm.

3. Literature Review

Sarka Bernatikova, Jakub Baca, (2025) Fire investigators are key players in determining the causes of fires. Their work has changed over the years, not only in their professional approach to identifying the causes of fire, but also in relation to the protection of their health, where there have been significant improvements in recent years. Unlike firefighters, fire investigators do not usually use an isolation breathing apparatus at fire scenes when fighting a fire. This article focusses on an analysis of the risks that fire investigators face in their work, particularly in terms of physical, chemical, and biological factors. It examines the potential impact of these factors on the health and safety of fire investigators compared to emergency firefighters and proposes measures to minimise these risks. Then it specifically looks at the working environment of a fire investigator in a post-experimental fire area. It concludes with strategies and technologies aimed at protecting the health of fire investigators in the challenging post-fire environment.

4. Problem Identification

The textile industry is a vital sector globally, providing employment to millions of workers. However, it also presents significant fire hazards due to the nature of the materials used, the machinery employed, and the work environment. Occupational fire hazards in textile factories pose serious risks to workers' health and safety, leading to injuries, fatalities, and long-term health problems. The problem of fire hazards in this industry is multifaceted and stems from various factors, including the presence of flammable materials, poor maintaining safe working environments. Issues such safety practices, inadequate infrastructure, and insufficient regulatory enforcement.

- Flammable Materials and Accumulation of Dust

- Chemical and Solvent Exposure
- Machinery and Electrical Systems
- Inadequate Fire Safety Measures
- Poor Housekeeping and Safety Culture
- Health Risks from Fire and Smoke Exposure
- Lack of Regulatory Enforcement and Compliance

5. Methodology

The textile industry, due to its nature, presents significant occupational fire hazards. The primary fire risks stem from the presence of flammable materials such as fabric, thread, oils, and chemicals used in dyeing and finishing processes. The accumulation of textile dust, which is highly combustible, increases the potential for fires or explosions.

Table 1 Methodology

| |
|---|
| Risk Assessment and Hazard Identification |
| ↓ |
| Implement Fire Prevention Measures |
| ↓ |
| Install and Maintain Fire Detection Systems |
| ↓ |
| Provide and Maintain Fire Fighting Equipment |
| ↓ |
| Establish Clear Fire Evacuation Procedures |
| ↓ |
| Train Workers on Fire Safety |
| ↓ |
| Use of Personal Protective Equipment (PPE) |
| □ |
| Control of Health Hazards |
| □ |
| Establish Regular Inspections and Audits |
| □ |
| Develop a Fire Safety and Emergency Response Plan |
| □ |

Promote a Safety Culture

Risk Assessment and Hazard Identification

6. Risk Assessment and Hazard Identification

Risk assessment and hazard identification are critical processes in managing workplace safety and health. Hazard identification is the first step, where potential sources of harm are recognized. This includes physical, chemical, biological, ergonomic, and psychological hazards. Identifying hazards involves reviewing work processes, observing environments, consulting employees, and analyzing past incidents. Once hazards are identified, a risk assessment is conducted to evaluate the likelihood and severity of harm that could result from exposure to these hazards. This process helps determine which risks need to be controlled or mitigated and prioritizes actions based on their potential impact on health and safety. The risk assessment process typically includes identifying who may be affected, evaluating existing controls, determining the level of risk, and recommending measures to minimize it.

- Understanding Fire Hazards in the Textile Industry Hazard Identification Process
- Assessing Risk Severity and Likelihood
- Focus on High-Risk Areas
- Identifying Inadequate Safety Practices
- Emergency Preparedness and Response
- Compliance with Fire Safety Standards and Regulations
- Continuous Monitoring and Review
- Documentation and Record Keeping
- Risk Mitigation Measures

7. Implement Fire Prevention Measures

Fire prevention measures in the textile industry involves key actions such as storing flammable materials in fire-resistant areas, minimizing textile dust accumulation, and ensuring proper electrical wiring and maintenance to prevent sparks. It is crucial to ban open flames in designated areas, enforce strict smoking policies, and ensure all machinery is regularly checked for fire hazards. Additionally, providing fire extinguishers, sprinklers, and safety equipment in strategic locations and

maintaining them ensures a rapid response in case of fire. Training employees on fire safety, evacuation procedures, and proper use of equipment is essential for minimizing fire risks and protecting workers.

8. Install and Maintain Fire Detection Systems

Installing and maintaining fire detection systems is crucial in preventing and responding to fires in the textile industry. A comprehensive fire detection system typically includes smoke detectors, heat sensors, and fire alarms, all strategically placed throughout the facility, particularly in high-risk areas such as machinery zones, chemical storage areas, and workspaces with flammable materials. These systems serve as the first line of defense, providing early warning of potential fires, allowing for timely evacuation and response.

- Install Smoke Detectors, Heat Sensors, and Fire Alarms Throughout the Facility
- Ensure Fire Detection Systems are Maintained Regularly and Tested for Functionality
- Set Up Emergency Alarms That Can Alert Workers Immediately in Case of Fire or Smoke Detection [2]
- **Provide and Maintain Fire Fighting Equipment**

Firefighting equipment is essential in managing fire risks in industrial settings like the textile industry. Key equipment includes fire extinguishers (for small fires), fire hoses and hose reels (for larger fires), and sprinkler systems (for automatic fire suppression). Fire blankets are used to smother small fires, while foam concentrate systems tackle flammable liquid fires. Fire axes and shovels are necessary for accessing fire sites and clearing debris. Fire-resistant clothing protects workers from burns, and hydrants provide external water sources for firefighting. Regular inspection and maintenance of this equipment ensure its readiness during emergencies. A crucial aspect of fire safety is equipping the facility with the appropriate fire extinguishers for the specific fire risks present in the textile industry. Fire extinguishers come in different types, such as ABC (multi-purpose), CO₂, and foam, each designed for

specific classes of fires. For instance, ABC fabrics, paper, and electrical equipment, while CO2 extinguishers are best for electrical fires, as they prevent damage to equipment. Foam extinguishers

extinguishers are ideal for general fires involving are suitable for fires involving flammable liquids, which are often present in textile processes.

Table 2 Risk Assessment and Hazard Identification

| Hazard | Frequency of Occurrence (Per Year) | Incident Rate (Fires/ Accidents per 100 workers) | Severity Level (1-5) |
|---|------------------------------------|--|----------------------|
| flammable Fabrics | 15 | 2.5 | 4 (High Risk) |
| Electrical Hazards (Overloaded circuits, faulty wiring) | 12 | 1.8 | 5 (Critical) |
| Chemical Spills (Dyes, solvents) | 8 | 1.2 | 4 (High Risk) |
| Textile Dust Accumulation | 20 | 3.0 | 3 (Moderate Risk) |
| Faulty Fire Prevention Equipment | 5 | 0.8 | 5 (Critical) |
| Open Flames (from heating equipment, smoking areas) | 10 | 1.5 | 5 (Critical) |
| Hot Machinery | 6 | 1.0 | 4 (High Risk) |
| Inadequate Emergency Exits | 4 | 0.6 | 5 (Critical) |
| Lack of Fire Safety Training | 12 | 2.0 | 4 (High Risk) |
| Inadequate PPE (Fire-resistant clothing, gloves) | 7 | 1.1 | 4 (High Risk) |

- Fire Extinguishers
- Water Extinguishers
- Foam Extinguishers
- CO2 (Carbon Dioxide) Extinguishers
- Dry Powder Extinguishers
- Wet Chemical Extinguishers
- Fire Hose Reels and Fire Hoses
- Fire Blankets
- Fire Sprinkler Systems
- Fire Hose Cabinets
- Fire Alarm Systems
- Fire Suppression Systems (e.g., Clean Agent Systems, CO2 Systems)
- Smoke Detectors
- Fire Pumps
- Fire Doors and Fire-Resistant Barriers
- Emergency Fire Exit Lighting
- Hydrants (Fire Hydrants)
- Fireman's Protective Gear (PPE)
- Fire-resistant Clothing

- Fire Helmets
- Gloves
- Fire Boots
- Breathing Apparatus (SCBA – Self-Contained Breathing Apparatus)
- Equip the facility with the necessary fire extinguishers
- Ensure the availability of fire hoses, sprinkler systems, and fire blankets in areas
- Maintain and inspect firefighting equipment regularly [3]

9. Establish Clear Fire Evacuation Procedures

Establishing clear fire evacuation procedures is crucial for ensuring worker safety during a fire emergency. First, designate and clearly mark fire exits, ensuring they remain unobstructed and accessible. Develop a comprehensive evacuation plan, outlining safe escape routes and a designated meeting point outside the building. Post evacuation plans prominently in visible areas for easy reference.

Assign fire marshals to guide workers to safety, and ensure they are trained to manage evacuations. Regularly conduct fire drills to ensure employees are familiar with the procedures and can evacuate swiftly in case of an emergency. It's essential to maintain clear, safe escape routes that are well-lit and free of obstructions. Communication systems should be in place for timely evacuation alerts. Lastly, continuously review and update the evacuation plan to address any facility changes and ensure ongoing preparedness. These measures ensure an effective response in the event of a fire. [4]

- Designate Fire Exits
- Develop an Evacuation Plan
- Post Evacuation Plans
- Assign Fire Marshals
- Clear and Safe Escape Routes
- Regular Fire Drills
- Communication During Evacuation
- Training and Awareness
- Regular Updates
- Designate fire exits and ensure they are clearly marked, unobstructed, and functional
- Develop an evacuation plan that includes safe routes to exits and a meeting point outside the building
- Post evacuation plans in prominent areas of the facility
- Assign fire marshals to oversee safe evacuation procedures during emergencies [5]

10. Train Workers on Fire Safety

Fire Safety Training Training workers on fire safety is a fundamental aspect of maintaining a safe work environment in the textile industry. Regular fire safety training sessions should be conducted for all employees to educate them on fire prevention, the proper use of firefighting equipment, and emergency evacuation procedures. These sessions should cover the identification of potential fire hazards, such as flammable materials and faulty electrical equipment, and the importance of reporting safety concerns promptly. Employees should also be trained in the correct use of fire extinguishers, understanding the different types of fire extinguishers (ABC, CO2, etc.)

and how to use them effectively depending on the fire class. In addition to using firefighting equipment, training should emphasize the importance of not putting themselves at unnecessary risk during a fire, ensuring that their first priority is evacuation. [6]

11. Use of Personal Protective Equipment (Ppe)

The use of Personal Protective Equipment (PPE) is essential for ensuring the safety of workers, especially in environments where fire hazards are prevalent, such as the textile industry. Workers exposed to high-temperature equipment, chemicals, or open flames should be provided with appropriate PPE, such as flame-resistant clothing, heat-resistant gloves, and protective eyewear. Flame-resistant clothing helps to minimize the risk of burns, while heat-resistant gloves protect hands from heat or molten materials. Eye protection, such as goggles or face shields, is important for workers who are near equipment that generates sparks or intense heat. Additionally, workers in high-risk areas should be equipped with other relevant PPE, such as respiratory protection if exposed to harmful fumes. Providing the correct PPE ensures that workers are protected from potential fire hazards and injuries, reducing the risk of accidents in the workplace.

- Flame-Resistant Clothing
- Heat-Resistant Gloves
- Eye Protection
- Respirators or Dust Masks
- Ear Protection (Earplugs or Earmuffs)
- Safety Boots
- Protective Aprons
- High-Visibility Vests.
- Chemical-Resistant Gloves
- Head Protection (Hard Hats or Hairnets)
- Welding Shields or Face Shields (for specific tasks)
- Ensure workers are trained in the proper use and maintenance of ppe
- Regularly inspect and replace damaged or worn-out ppe [7]

fire hoses and hose reels (for larger fires), and sprinkler systems (for automatic fire suppression). Fire blankets are used to smother small fires, while

foam concentrate systems tackle flammable liquid fires

Table 3 Fire Safety Training

| Action Item | Description | Frequency | Notes |
|--|---|------------------------------|--|
| 1. Conduct Initial Fire Safety Training | Provide all employees with basic fire safety training, covering fire prevention and emergency procedures. | Onboarding/ As needed | Include fire risk awareness. |
| 2. Train on Fire Prevention Measures | Teach workers proper storage of flammable materials, maintenance of equipment, and the importance of cleanliness. | Annually or as needed | Ensure understanding of preventive actions. |
| 3. Teach Emergency Evacuation Procedures | Educate employees on evacuation routes, emergency exits, and designated assembly points. | Annually | Practice drills and real-world scenarios. |
| 4. Demonstrate Proper Use of Fire Extinguishers | Show employees how to use fire extinguishers on small fires using the PASS method (Pull, Aim, Squeeze, Sweep). | Initial training & Refresher | Ensure hands-on practice with extinguishers. |
| 5. Train on Fire Alarm Systems | Ensure employees know how to recognize fire alarms and what actions to take upon hearing one. | Annually | Include visual and audible alarm signals. |
| 6. Address Specific Job Safety Procedures | Provide specialized training for workers handling hazardous materials or working with high-risk machinery. | As required | Tailor training based on job roles. |
| 7. Hold Regular Fire Drills | Schedule and conduct fire drills to practice evacuation procedures and ensure familiarity with exit routes. | Quarterly or Bi-Annually | Review performance after drills. |
| 8. Train on Fire Safety Signage and Labels | Teach workers to identify fire safety equipment and emergency exits through signs and labels. | As needed | Ensure visibility and legibility of signage. |
| 9. Reinforce Proper Use of PPE (Personal Protective Equipment) | Educate employees on using appropriate fire-resistant clothing, gloves, and safety gear when needed. | Annually | Inspect PPE for wear and tear. |
| 10. Evaluate Training Effectiveness | Test employees' knowledge of fire safety protocols to confirm they understand their roles and responsibilities. | After training and drills | Conduct evaluations or quizzes. |

| | | | |
|---------------------------|--|---------|--------------------------------|
| 11. Keep Training Records | Maintain detailed records of all fire safety training sessions, including dates, participants, and topics covered. | Ongoing | Ensure records are up to date. |
|---------------------------|--|---------|--------------------------------|

12. Control of Health Hazards

The textile industry presents various health hazards to its workers due to the nature of the processes involved. One significant hazard is dust exposure, as the processing of fibers and fabrics generates airborne dust that can lead to respiratory problems, including textile workers' lung disease and asthma. Chemical exposure is another concern, as workers are often in contact with hazardous substances used in dyeing, printing, and finishing processes. These chemicals can cause skin irritation, respiratory issues, and long-term health conditions, including cancer. The noise exposure from the machinery used in textile production can result in hearing loss over time if proper ear protection is not used. Ergonomic hazards such as repetitive motions, poor posture, and lifting heavy materials can lead to musculoskeletal disorders like back pain, joint issues, and carpal tunnel syndrome. Heat stress is another risk, particularly in areas with high temperatures or during hot months, leading to dehydration, heat exhaustion, and heat stroke. Infectious diseases can spread due to unsanitary working conditions or contact with contaminated textiles. Furthermore, hazards like slips, trips, and falls and poor indoor air quality can cause injuries or respiratory problems. Addressing these health hazards through proper training, PPE, and workplace improvements is essential to safeguarding workers' well-being in the textile industry. [8]

- Dust Exposure
- Chemical Exposure
- Noise Exposure
- Ergonomic Hazards
- Heat Stress
- Infectious Disease Risks
- Slips, Trips, and Falls 63

13. Establish Regular Inspections and Audits

Establishing regular inspections and audits is crucial

to maintaining fire safety and health standards in the textile industry. These inspections involve routine checks of fire safety equipment, such as extinguishers, alarms, and sprinklers, to ensure they are in good working condition. Electrical systems

should be examined for faulty wiring or overloads to prevent electrical fires. Additionally, machinery must be inspected for proper functioning and safety features. Regular audits of ventilation and dust control systems help mitigate respiratory risks by preventing dust buildup. Health and safety audits assess working conditions, including air quality and noise levels, to reduce health hazards. Furthermore, conducting fire drills and reviewing emergency evacuation procedures ensures workers are prepared in case of a fire. The implementing these inspections, the risk of workplace accidents and health hazards is minimized, and corrective actions are taken to maintain a safe working environment. [9]

- Fire Safety Equipment Inspection
- Electrical System Inspection
- Machinery Safety Audit
- Ventilation and Dust Control System Inspection
- Health and Safety Risk Audit
- Fire Drills and Emergency Evacuation Procedure Drill
- Chemical Handling and Storage Audit
- Personal Protective Equipment (PPE) Compliance Inspection
- Emergency Equipment Readiness Audit
- Incident Review and Corrective Action Follow-Up

14. Develop A Fire Safety and Emergency Response Plan

Developing a Fire Safety and Emergency Response Plan involves creating clear procedures to prevent, manage, and respond to fire emergencies. It includes

installing fire detection systems, maintaining fire extinguishers, and ensuring proper storage of flammable materials. Employees should be trained on evacuation routes, use of firefighting equipment, and emergency protocols. Regular fire drills and safety audits are essential to ensure readiness. Designating fire marshals and ensuring clear communication with emergency responders further enhances the plan's effectiveness. The plan must be regularly reviewed, updated, and communicated to all employees to maintain a safe working environment. [10]

- Create and Document a Detailed Emergency Response Plan That Includes Procedures for Handling Fire Incidents, Injuries, and Property Damage
- Ensure All Employees Know Whom to Contact in Case of an Emergency, Including Fire Departments, First-Aid Teams, and Emergency Responders
- Regularly Update the Plan Based on New Fire Risks, Equipment Upgrades, and Lessons Learned from Fire Drills or Actual Incidents

15. Promote A Safety Culture

Promoting a safety culture in the textile industry is essential to ensuring the health and safety of workers, particularly concerning fire hazards. This culture starts with strong leadership commitment, where management not only emphasizes but also actively participates in safety initiatives. Open communication should be encouraged, allowing workers to report fire hazards or unsafe practices without fear of retaliation. Engaging employees in safety meetings, fire drills, and hazard identification fosters ownership of their own safety and the safety of their colleagues. Reward systems can be implemented to recognize those who consistently follow fire safety protocols. Continuous safety training is crucial, covering topics such as fire prevention, emergency evacuation, and the proper handling of hazardous materials. Additionally, safety committees and peer support can help reinforce the importance of fire safety. By prioritizing safety, the textile industry can reduce fire risks, ensuring a safer and healthier working environment. [11]

- Encourage Open Reporting
- Leadership Commitment
- Employee Engagement
- Reward Safe Practices
- Continuous Safety Training
- Safety Awareness Campaigns
- Create Safety Committees
- Promote Personal Responsibility
- Encourage Peer Support
- Regular Feedback and Evaluation
- Encourage Workers to Report Fire Hazards, Unsafe Conditions, and Near-Miss Incidents Without Fear of Retaliation
- Foster a Culture of Safety Through Incentives for Proactive Hazard Reporting, Participation in Safety Programs, and Adherence to Safety Protocols [12]

Conclusion

This project has focused on addressing and mitigating the risks associated with occupational fire hazards in the textile industry. Through the methodology, key steps have been outlined and implemented to ensure the safety and well-being of workers, prevent fire-related incidents, and promote a culture of safety within the workplace. The risk assessment and hazard identification process laid the foundation for understanding potential fire hazards and health risks in the workplace. Implementing fire prevention measures, including the proper storage of flammable materials and controlling dust accumulation, reduces the chances of fire outbreaks. The installation and maintenance of fire detection systems, such as smoke detectors and alarms, along with the provision of firefighting equipment like extinguishers and sprinklers, ensures that employees are equipped to handle any fire-related emergency effectively. Clear fire evacuation procedures, regular training, and the use of personal protective equipment (PPE) are vital for reducing fire risks and improving worker preparedness. Furthermore, controlling health hazards, such as air quality and chemical safety, is essential to safeguarding workers' long-term health. Establishing a routine for inspections and audits helps in maintaining safety standards, while a well-

documented fire safety and emergency response plan ensures coordinated efforts during an emergency. Promoting a safety culture throughout the organization is crucial, as it encourages workers to actively participate in safety programs and report any hazards or unsafe practices. Through continuous monitoring, feedback, and improvement, the textile industry can significantly reduce fire risks and protect its workforce. The following the outlined methodology, the textile industry can establish a robust fire safety framework that prioritizes worker health and safety, reduces risks, and ensures compliance with safety standards. This proactive approach is key to maintaining a safe and productive working environment. [13]

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