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Analysis Of Occupational Safety And Health (OSH) Risk Level Of Pt. Guerra Foam Indonesia Employees Using The Hazard And Operability Study (HAZOP) Method

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Abstract

This study aims to identify, understand, and provide recommendations for improving Occupational Safety and Health (OSH) based on risk levels through the Hazard and Operability Study (HAZOP) method. The results of the study explain that PT. Guerra Foam Indonesia is exposed to 37 types of risks in 19 production process flows, namely 43% low risk, 38% medium risk and 19% high risk with hazard classifications caused by worker attitudes, materials, and work environment conditions. Based on this, recommendations can be given, one of which is that the company needs to provide the use of Personal Protective Equipment (PPE), in accordance with Visual Display and Standard Operating Procedure (SOP). The goal is to avoid undesirable things.

Keywords: OSH, HAZOP, Visual Display, PPE, SOP

INTRODUCTION

Human Resources (HR) are the primary asset in establishing company goals. Without the role of human resources, company operations cannot function properly. According to Febrina, I, (2024), human resources make a significant contribution, both individually and collectively, and are essential within a company because they can provide the most important asset for achieving goals. Humans always play an active role in a company, therefore, it is crucial for companies to provide protection in the form of health and safety.

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Occupational safety and health are crucial factors in ensuring smooth production in a company. Occupational safety and health is a systematic approach aimed at protecting workers and preventing accidents and occupational diseases in the workplace (Aprilia et al., 2023). Creating a safe and healthy work environment is a primary responsibility to protect employees from potential risks that could lead to injury, illness, or even death.

Every company always faces the risk of accidents. Therefore, risk identification is necessary through the Hazard and Operability Study (HAZOP) method, a risk analysis technique used to prepare safety decisions in situations facing potential hazards. The goal is to identify, understand, and provide recommendations for improving Occupational Safety and Health (OSH) based on the level of risk through risk assessment. Specifically, at PT. Guerra Foam Indonesia, employees during the production process did not wear PPE, as illustrated below:



Figure 1: Condition of employees not wearing PPE in the production area

He absence of the use of personal protective equipment by workers, can indirectly increase accidents or illnesses in the work environment of PT Guerra Foam Indonesia. Based on data from the Social Security Administering Agency of the Republic of Indonesia, the number of work accidents in 2022 was 297,725 cases to 356,383 cases in mid-2024 (Priono, 2025). This indicates serious attention to Occupational Safety and Health (OSH) as regulated in the regulation of the Minister of Man power of the Republic of Indonesia Number 11 of 2023 concerning occupational safety and health in confined

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spaces, that confined spaces are workplaces that have risks to the safety and health of workers/laborers, therefore protection is needed for workers/laborers, which is regulated by Law Number 1 of 1970 concerning occupational safety as the legal basis for the implementation of Occupational Safety and Health (OSH) in Indonesia (Yuliandi & Ahman, 2019).

This study correlates with previous research in the use of the Hazard and Operability Study (HAZOP) method for risk analysis. The fundamental difference lies in the object and context of the study (Rahmanto et al., 2022) which focused on the risk of work accidents at PT PJB Services PLTU Tembilahan, which has specific hazard characteristics of the power generation industry. Meanwhile, this study focuses on the analysis of Occupational Safety and Health (OSH) risks at PT. Guerra Foam Indonesia. By identifying these similarities and differences, it is hoped that the research results can present accurate field data.

The study was conducted because PT. Guerra Foam Indonesia, as a company, does not yet have an in-depth occupational safety and health risk analysis, even though Occupational Safety and Health (OSH) is important to protect the company's main asset, namely human resources. Therefore, based on this, the main objective of this study is to identify, understand, and provide recommendations for improving Occupational Safety and Health (OSH) based on the level of risk through the Hazard and Operability Study method (HAZOP). Based on the background, the researcher is interested in researching "Analysis of Occupational Safety and Health (OSH) Risk Level of PT. Guerra Foam Indonesia Employees Using the Hazard and Operability Study (HAZOP) Method", to directly see the risks that occur in the company and provide recommendations for improvements to minimize risks and avoid losses incurred.

RESEARCH METHOD

This study uses the Hazard and Operability Study (HAZOP) analysis tool. Hazard and Operability Study (HAZOP) was chosen because it is easy to understand and systematic in obtaining research results (Rahmanto & Ihsan Hamdy, 2022), which is based on qualitative methods that describe and explain conditions, situations, and research phenomena according to events as documented, interviewed, and observed (Sugiyono, 2023). The following things need to be considered in implementing a Hazard and Operability Study (HAZOP), namely determining the Risk Level by considering the Likelihood (L) and Consequences (C) as follows:

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Table 1: Criteria Likelihood

Level	Criteria	Description	
		Qualitative	Semi Qualitative
1.	Rare	Can be thought of not only in extreme circumstances	Less than 1 time in 10 years
2.	Unlikely	Has not happened yet but may appear at some point	Occurs once every 10 years
3.	Possible	It should happen to appear here or somewhere else	1 time per 5 years to 1 time per year
4.	Likely	It can happen easily or may appear in the most unlikely circumstances	More than 1 time per year to 1 time per month
5.	Almost Certain	Often occurring or appearing in the most common circumstances	More than 1 time per month

Source: (UNSW, 2021)

Table 2: Criteria Consequence

Level	Criteria	Description	
		Severity of Injury	Working days
1.	Negligible	Does not cause harm or injury to humans	Does not cause of work
2.	Low	Causes minor injuries, small losses and impact on the business	Can stillv work on the same day/shift
3.	Moderate	Serious injury and hospitalization, no permanent disability, moderate financial loss	Lost work days under 3 days
4.	High	Causes serious injury, permanent disability, major financial loss and has a serious impact on business continuity.	Missed days of work, 3 days or more
5.	Extreme	Resulting in fatalities and severe losses can even stop business forever	Lost days forever

Source: (UNSW, 2021)

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The calculation for determining the Risk Rating or Risk Level is as follows:

R = C x L

Description:
R = Risk Level
C = Consequences
L = Likelihood
The following is the risk matrix table:

Table 3: risk matrix

Consequences			Negligible 1	Low 2	Moderate 3	High 4	Extreme 5
Likelihood	Almost Certain	5	5	10	15	20	25
	Likely	4	4	8	12	16	20
	Possible	3	3	6	9	12	15
	Unlikely	2	2	4	6	8	10
	Rare	1	1	2	3	4	5

Source: (UNSW, 2021)

Risk level descrition:

Negligible, with a risk value 1
Low, with a risk value 2 – 4
Moderate, with a risk value 5 – 8
High, with a risk value 9 – 15
Extreme, with a risk value 16 – 25

RESULTS AND DISCUSSION

The following are the results of observations and interviews at PT. Guerra Foam Indonesia, which are explained in the following table:

Table 4: Observation and Interview Results

Production Process Flow	
Observation Results	The production process begins with raw material preparation, followed by foaming and maturation. After

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	that, the mattress fabric is cut and sewn, followed by quality control and packaging, and finally, product distribution.
Question	Based on the identification, in your opinion, which area is the most risky for workers?
Interview Results	The most critical point is the foam production stage, from preparation to curing, as workers interact directly with chemicals. Furthermore, during the cutting stage, workers are at risk of exposure to residues such as dust or foam residue.

Risk Assessment

Observation Results	The identification results showed that there were 45 potential hazards and risks originating from worker attitudes, materials, and work environment conditions.
Question	1. Of all the risks we have discussed together, which risk worries you the most in the production process work area? 2. In your opinion, what causes accidents in the workplace? Is it unclear SOP, pure human error, or the pressure of production targets?
Interview Results	1. Exposure to chemicals can cause respiratory problems, shortness of breath, and coughing. Furthermore, spills that are not promptly cleaned up can cause workers to slip and suffer physical injuries. 2. Risks are dominated by negligence and low worker safety awareness. This is exacerbated by the lack of PPE use, written SOP, or OSH training since the company began operating three years ago.

Improvement Recommendations

Observation Results	Recommendations for the use of personal protective equipment (PPE), the creation of standard operating procedure (SOP) for PPE use, and visual displays.

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Question	The analysis recommends the use of PPE, standard operating procedures, and visual displays. What are your views on these recommendations? Are they practical to implement in this context?
Interview Results	Recommendations for improvement are very helpful, but their success depends on the company's commitment.

Source: Primary Data

1. Production Process

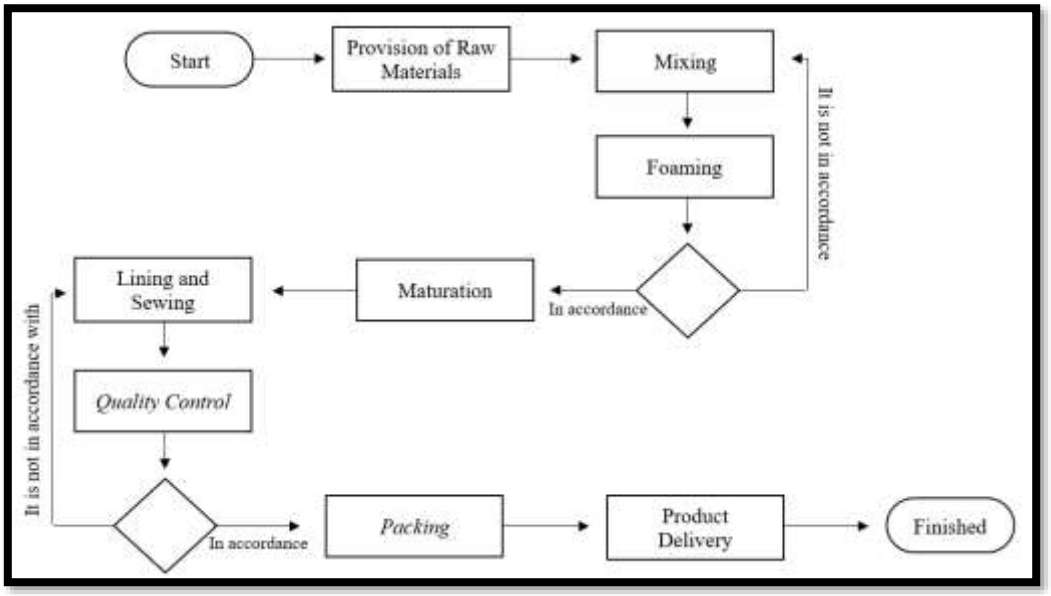


Figure 2: Production Process

2. Risk Assessment

Based on observations and interviews, the company identified 45 potential hazards and risks resulting from worker negligence. One such risk is respiratory problems due to chemical exposure, indicating a vulnerability in the company's operational system. Without written SOP, the use of PPE, or OSH training, the use of the Hazard and Operability Study (HAZOP) method becomes crucial.

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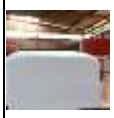
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Table 5: Worksheet Hazard and Operability Study (HAZOP)

o	Work Process	Picture	Potential danger	Risk	Source				L
.	Acceptance of chemicals		Drum/ container leak substance Chemistry	Work slips	Materials				
			Chemicals on the skin	Skin irritation	Work Attitude				
			Chemicals in eyes	Eye irritation	Work Attitude				
			Exposure chemicals	Respiratory disorders	Work Attitude				
.	Raw materials storage area		Raw materials stored exceeds capacity	Drum/ Container explodes	Work Attitude				
			Excessive room temperature	Fire	Working Environment Condition				
.	Handling of raw materials		Chemicals spilled	Work slips	Work Attitude				
			Chemicals on the skin	Skin irritation	Work Attitude				
			Chemicals in eyes	Eye irritation	Work Attitude				
			Exposure to chemicals	Respiratory disorders	Work Attitude				
.	Raw materials		Physical injury	Back injury	Work Attitude				

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o	Work Process	Picture	Potential danger	Risk	Source				L
	are taken to the production prosess		Worker falls	Worker hit by a drum/ container	Work Attitude				
			Chemicals spilled	Work slips	Work Attitude				
			Chemicals on the skin	Skin irritation	Work Attitude				
			Chemicals in eyes	Eye irritation	Work Attitude				
			Exposure to chemicals	Respiratory disorders	Work Attitude				
.	Mixing raw materials		Chemicals spilled	Work slips	Work Attitude				
			Chemicals on the skin	Skin irritation	Work Attitude				
			Chemicals in eyes	Eye irritation	Work Attitude				
			Exposure to chemicals	Respiratory disorders	Work Attitude				
.	Foaming		Exposure to chemical vapors	Respiratory disorders	Work Attitude				
.	Foam maturation		Excessive temperature stress	Explosion/ fire	Working Environment Condition				
.	The foam is lifted on a cutting machine		Physical injury	Back injury	Work Attitude				

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o	Work Process	Picture	Potential danger	Risk	Source				L
.	Foam cutting		Physical injury	Scarthed/ cut hand	Work Attitude				
			Foam flakes	Eye irritation	Materials				
			Foam particles	Respiratory disorders	Materials				
			Mower noice	Hearing n workers disturbed	Work Attitude				
0.	Machine electrical system		Cabel frayed	Electric shocks that affect workers	Work Attitude				
			Short circuit	Explosion/ fire	Work Attitude				
1.	Handling of remaining foam pieces		Remaining foam scattered on the floor area	Workers stumble	Materials				
			Foam flakes	Eye irritation	Materials				
			Foam particles	Respiratory disorders	Materials				
2.	Foam gluing		Exposure to glue vapors	Respiratory disorders	Work Attitude				
3.	Fabric preparation and sewing process		Physical injury	Scarthed hands knife/ scissors or stabbed hearing	Work Attitude				

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o	Work Process	Picture	Potential danger	Risk	Source				L
			Sewing machine noise	Neddle workers are distracted	Work Attitude				
4.	Foam mattress packaging		Physical injury	Hand scratched by plastic cutting tool	Work Attitude				
5.	Removal of foam mattress big into the warehouse		Physical injury	Back injury	Work Attitude				
			Worker falss	The worker was crushed by a foam mattress	Materials				
6.	Arrangement and storage of products in the warehouse		Mattresses are stacked	The foam mattress fell on the worker	Materials				
7.	Warehouse ventilation		Dust accumulates in the warehouse area	Eye irritation	Work Attitude				
			Dust particles	Respiratory disorders	Work Attitude			2	
8.	Loading products into pickup trucks/		Physical injury	Back injury	Work Attitude				
			Worker falls	The worker was	Work Attitude				

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o	Work Process	Picture	Potential danger	Risk	Source				L
	delivery trucks			crushed by a foam mattress					
9.	Delivery foam and foam mattresses to retail stores or consumers		Pickup truck/car load exceeds capacity	Loss of stability	Work Attitude				
			Car tires leaking/bursting	Accident	Work Attitude				

Source: Primary Data

The Hazard and Operability Study (HAZOP) worksheet assessment indicates the company is exposed to 37 indicated accident or illness risks. These 37 risks are categorized as 16 low risks, 14 medium risks, and 7 high risks, as shown in the following Risk Level Pie Chart:

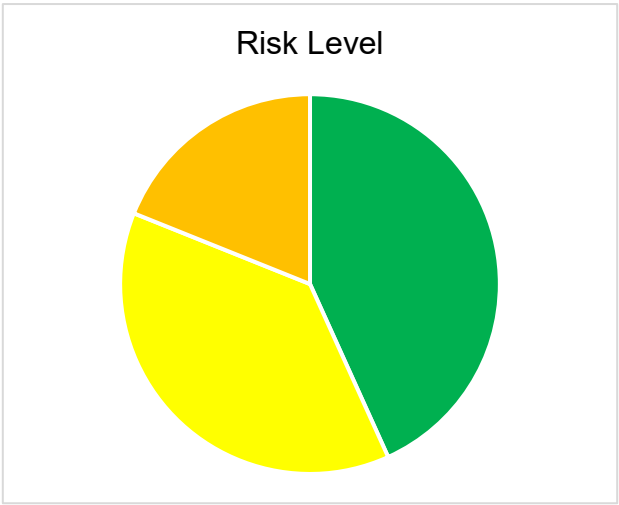


Figure 3: Pie Chart Risk Level
Source: Primary Data

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Low = 16 / 37 x 100% = 43%
Medium = 14 / 37 x 100% = 38%
High = 7 / 37 x 100% = 19%

Based on the risk assessment above, there are 3 types of risk, namely high risk, medium risk and low risk, which are described as follows:

a. Workers in production areas are frequently exposed to chemicals, both during the mixing and foaming processes. This can lead to respiratory problems for workers because they don't wear personal protective equipment (PPE) such as masks during these processes.
b. During the foam cutting process, workers in the area failed to clean up the remaining foam pieces, causing them to trip and fall. This resulted in physical injuries requiring medical attention.
c. The warehouse storage area is rarely cleaned, in addition, the ventilation in the warehouse is closed, which results in dust accumulating. As a result, workers in the area are actually. Exposed to dust particles resulting in respiratory problems.
d. Chemical spills in production areas are rare, but when they do occur, they impact workers in the area, causing them to slip and suffer physical injuries requiring medical attention. This occurs because workers do not wear PPE, such as shoes, in the area.
e. Lifting raw materials, lifting foam blocks, lifting foam mattresses in the warehouse, or transporting foam mattresses for delivery. Repeated use of this can result in physical injury to workers.
f. Workers in the foam cutting area do not wear PPE in the form of glasses and masks, which causes workers to experience eye irritation and respiratory problems due to foam debris or particles.
g. Workers often ignore the dust that accumulates in the warehouse area, which can cause eye irritation.
h. In the process of delivering goods to retailers or direct consumers, the transportation department often carries foam mattresses exceeding capacity, which impacts stability, especially if during delivery the vehicle's tires leak or burst, which can result in accidents.

Even after analysis, the company must continue to monitor the risk, as risks can occur at any time or unexpectedly, which will certainly impact workers. According to Soekarto, risk is the uncertainty of an event occurring (Subagyo et al., 2020). The 37 risk

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findings in the foam and mattress manufacturing process, including delivery, were caused by three sources of hazard:

Table 6: Classification of Hazard Sources

No	Classification of Hazard Types	Persentase (%)
1.	Work Attitude	29 / 37 x 100% = 78%
2.	Materials	6 / 37 x 100% = 16%
3.	Working Environment Conditions	2 / 37 x 100% = 6%

Source: Primary Data

Worker attitudes have a fairly large percentage in each production process until the product is delivered, with this percentage proving Heinrich's theory (1941), that the cause of accidents generally (85%) occurs due to human factors and unsafe working conditions ((Peruzzi et al., 2020).

3. Recommendations for Improvement

Extreme risks should be prioritized for immediate remediation, but all types of risks, whether low, medium, or high, require remediation to prevent undesirable outcomes. Recommendations are designed based on the source of the hazard. This aims to identify and address the existing hazards. The following are proposed improvements for PT. Guerra Foam Indonesia to mitigate the indicated risks:

a. The provision of Personal Protective Equipment (PPE) represents the company's concrete commitment to implementing a risk control hierarchy to protect employees from physical and chemical hazards in production areas. Optimizing workforce protection through the provision of standardized PPE tailored to production risk zones.
b. Creating a Standard Operating Procedure (SOP) is a fundamental step in creating a safe and standardized framework for all employees in the face of risk. SOP are not merely administrative documents, but are designed as technical guides that provide step-by-step instructions for completing tasks.
c. The creation of visual displays functions as a visual communication medium that provides direct instructions or early warnings to workers in areas that have risks.
d. Providing Occupational Safety and Health (OSH) training is a strategic company investment in building employee capacity and awareness of risks in the workplace.

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The training aims to transform work behavior from unsafe to disciplined and in accordance with safety standards.

e. Creating a schedule for the use of Personal Protective Equipment (PPE) serves as a managerial control tool to ensure consistent employee compliance. With a structured schedule, companies can monitor employee discipline while ensuring that each use of Personal Protective Equipment (PPE) provides maximum protection for the specific work unit.

f. Inspection of vehicles (pick-up trucks or trucks) before the processfoaming does not settle in the room.

All of these recommendations aim to reduce the level of identified occupational safety and health risks, which research shows still pose a 19% high risk that could threaten employee safety and health and the continuity of company operations. Furthermore, compliance with government regulations is essential for the comfort and well-being of workers.

CONCLUSION

The results and discussion described conclude that PT. Guerra Foam Indonesia has not implemented a risk analysis, this absence makes the company unable to implement an Occupational Safety and Health (OSH) management system in accordance with regulations. The existence of the Hazard and Operability Study (HAZOP) method helps the company analyze potential hazards, risks and sources of hazards. The company indicated 37 risks, namely 43% low risk, 38% medium risk and 19% high risk, with worker attitudes being at 78% of the causes of the risk. Because of this, the recommendations given are the provision of Personal Protective Equipment (PPE), the creation of Standard Operating Procedures (SOP), the creation of visual displays, the provision of Occupational Safety and Health (OSH) training, the creation of a schedule for the use of Personal Protective Equipment (PPE), checking the condition of vehicles, moving and arranging unused materials, and improving the ventilation system so that air can enter and exit properly.

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