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Assessment of Safety Hazards for Condenser Manufacturing Process

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Abstract: A manufacturer is a producer who makes finished goods from raw materials using a variety of tools, equipment, and processes and then sells those goods to consumers. Condenser manufacturing area was selected for this studied to evaluate the safety hazards associated with the daily process of activities. The objectives of this studied were to determine the potential safety hazard associated with the risk of the job process for condenser manufacture and determine the risk of the job processes at the condenser manufacture as low, medium, or high risk and suggested controlled measures and made recommendations for improvement to minimize the associated risk. The study reveals that the condenser manufacturing area was exposed to some hazards during the process of condenser manufacture. This includes physical hazards, ergonomic hazards, psychosocial hazards and chemical hazards. Out of 31 identified hazards, 0% posed a high-level risk, another 13% posed a medium-level risk and 87% of a low-level risk. The major hazard found was physical hazard which contributes to 67% of the medium-level risk. Finally, for the hazard, the control measures are proposed in accordance with the hierarchy of risk control (elimination, substitution, engineering control, administrative control and personal protective equipment).

Keywords: HIRARC, Potential Hazard, Hierarchy

1. Introduction

Occupational Safety and Health in Malaysia has progressed to the point that more employers and workers are aware of their roles and responsibilities in identifying, assessing, and controlling workplace hazards [1] If carried out appropriately, these obligations will undoubtedly help to avoid workplace events that result in injury, disease, death, environmental degradation, and property damage. It is also an important and beneficial component in an organization's economic development and productivity.

Identifying hazards and analyzing risks are critical for reducing the likelihood of accidents and should be prioritized. This idea is critical when making judgments or choices about which activities to

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do first to reduce the risk of dangers. Because of the level of danger that each hazard poses, many hazards in the workplace demand prompt attention, resources, and effort. The objective of hazard identification, risk assessment, and risk Control (HIRARC) is to reduce any possible risk to an operation's safety, health, environment, and business elements. To reduce the likelihood of accidents in the workplace, it is crucial to have the support of upper management and the participation of all workers in the creation and implementation of safety initiatives.

This study was conducted at the production division of manufacturing industry during condenser manufacturing process can identified and calculated based on the level of risk in the work area or machine identified based on previous records and assessments performed [2]. Risk assessment provides a means to identify and measure the potential impacts of industrial activities on human health and the environment and is used to predict likelihood, to estimate hazard levels and to select appropriate mitigation courses or control measures [3]. High risk is reduced by improving control measures such as reducing the exposure of certain work measures that will cause potential hazards. The research was conducted to Assessment of Potential Safety Hazards And Exposure To Workers During Condenser Manufacturing Process among manufacturing industry during condenser manufacturing process workers.

There is some importance gained in conducting these studies for assessment of potential safety hazards and exposure during condenser manufacturing process. This study can identification the risk assessment of workers. To reduce or eliminate risks, it is necessary to identify those most exposed and the specific hazards to which they are exposed.

Other than that, this study can determine the risk of the job processes at the condenser manufacture as low, medium or high risk. Likelihood of risk refers to the probability that a risk is occur, and may be measured by a value from low, medium or high risk [3]. Risk Severity, also known as risk impact, is the level of potential damage that might result from the occurrence of a risk. The risk likelihood, together with the risk severity, makes up the risk assessment (or Risk Diagram), a tool used to identify, analyse, and make control measure to eliminated the hazard or reduce [4].

Finally, Control measures and risk assessments will reduce or eliminate accidents a condenser manufacture and for better improvement to all worker. Considering the importance of hazard identification, risk assessment and risk control (HIRARC), this study should be conducted with the following objectives in mind to determine the potential safety hazard associated with the risk of the job process for condenser manufacture, to assess and determine the risk of the job processes at the condenser manufacture as low, medium or high risk, to recommend the current risk control measures and make recommendations for improvement to minimize the associated risk

2. Methods

2.1 Method of risk assessment

The purpose of risk assessment is to quantify the likelihood and severity of accident/event sequences so that the scale and priority of recognized risks may be measured. Quantitative, qualitative, or semi-quantitative methodologies may be used to evaluate risk. For better outcomes, this investigation is conducted quantitatively. In contrast to qualitative and semi-quantitative analysis, quantitative analysis assigns a numerical number to risk. Data from sources such as prior accidents and near misses, as well as the outcomes of scientific investigations, are used to assign severity and likelihood ratings.

We may calculate severity by modelling the consequences of events or groups of occurrences, or extrapolating from existing data or experimental studies. Severity may be measured in terms of money, technology, or human effect, among other things. The risk levels are expressed as a mix of severity and likelihood expressions.

2.2 Likelihood of an occurrence

The value in this study area was determined by the likelihood of an incident occurring. Workers' experience, analysis, and measurement were used to assess likelihood in the industry. The degrees of probability varied from "most likely" to "inconceivable." Refer to Table 1, which details several likelihood ranges and their ratings.

Table 1: Likelihood of an occurrence

Likelihood	Situation	Rating
Most likely	The most likely result of hazard	5
Possible	As good a chance of occurring and is not unusual	4
Conceivable	Might be occur at sometimes in the future	3
Remote	Has not been known to occur after many years	2
Inconceivable	It's practically impossible and has never occurred	1

2.3 Severity of hazard

There are five different levels of severity. Severity was measured by the level of risk to an individual's health, the environment, or personal property. Refer to table 2 for an example of how to rate severity levels.

Table 2: Severity of hazard

Severity	Situation	Rating
Catastrophic	Numerous fatalities, irrevocable property damage and productivity	5
Fatal	Approximately one single fatality major property damage if the hazard is realized	4
Serious	Nonfatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasions, bruises, cuts, first aid type injury	1

2.4 Risk assessment

Risk might be presented in a variety of ways depending on the findings of the study to assist risk management decision-making. Presenting findings in a risk matrix is an effective technique to present the risk in a workplace for risk analysis that used likelihood and severity in the quantitative method. To get the risk value, look at table 3, which shows an example of a risk assessment matrix.

Risk is calculated using the following formula:

L x S = Relative Risk

L = Likelihood

S = Severity

Table 3: Risk score (S ´ L)

Risk Score		**LIKELIHOOD (L)**				
		1	2	3	4	5
SEVERITY (S)	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

The relative risk value may be used to priorities critical activities in successful workplace risk management. Refer to table 4, which shows the risk level in different values.

Hazards classified as "High " need immediate action to eliminate or minimize the threat to human life and/or the environment. Follow-up inspections should be performed by personnel responsible for taking appropriate action to ensure the efficacy of the installed control measures.

Table 4: Relative risk value versus necessary action for managing hazard

RISK	DESCRIPTION	ACTION
15 - 25	**HIGH**	• Immediate action is compulsory • Should be mitigated with engineering and/or administrative controls within specified period e.g. 6 months
5 - 12	**MEDIUM**	• Requires a planned approach • Should be mitigated with engineering and/or administrative controls within a longer period of time e.g. 1 year
1 - 4	**LOW**	• May be considered as acceptable • No mitigation is required • Risk may be solved quickly and efficiently

2.5 Risk control methods

In this study, five key kinds of risk management approaches are used to regulate, minimize, or avoid hazards: elimination or substitution at the source of danger, engineering control, administrative control, and the use of personal protective equipment. The specifics of the methods of control are shown in Figure 1.

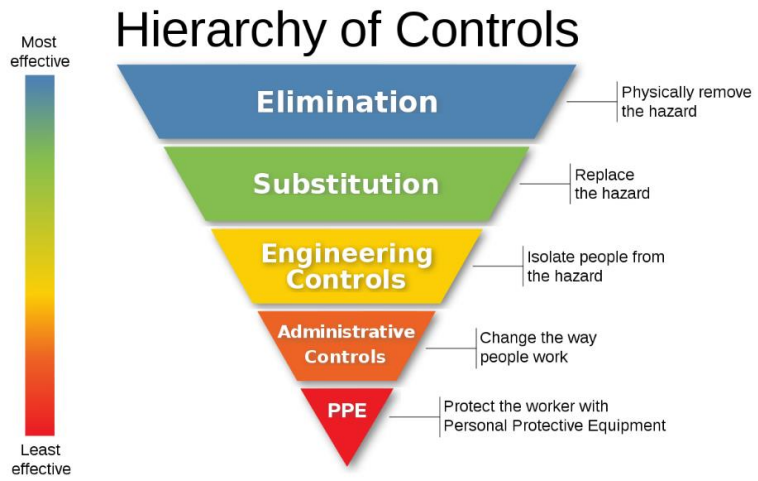

Figure 1: Hierarchy of controls

3. Results and Discussion

3.1 Results risk assessment

A total of 31 hazards focusing on condenser manufacture area. The hazards were identified through, observation, classifying work activities, identifying the hazard, risk assessment and risk control action plan. Risk assessment method was used to classify the hazards into three categories as low, medium and high. The figure 2 below shows the results of the risk assessment.

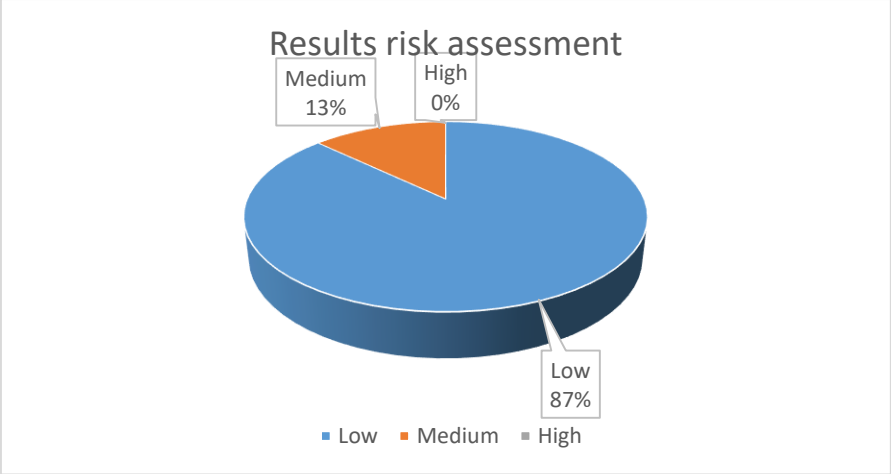

Figure 2: Results of risk assessment

From the total results in the previous figure 2, for 31 hazards identified, the risk score shows that, 13% percentage of the hazards are with medium-risk level followed by 87% with low-risk level and 0% with the high-risk level. Overall, only a high risk has a 0% for risk score

A total of 31 hazards were identified during the condenser manufacturing work activity. These hazards were categorized into safety hazards comprised of physical hazards, ergonomic hazards, physiological hazard and chemical hazards. From the 31 hazards identified, there are 12 physical hazards, 10 ergonomic hazards, 8 physiological hazard and 1 chemical hazards. The results are shown in the figure 3 below of the hazard classification.

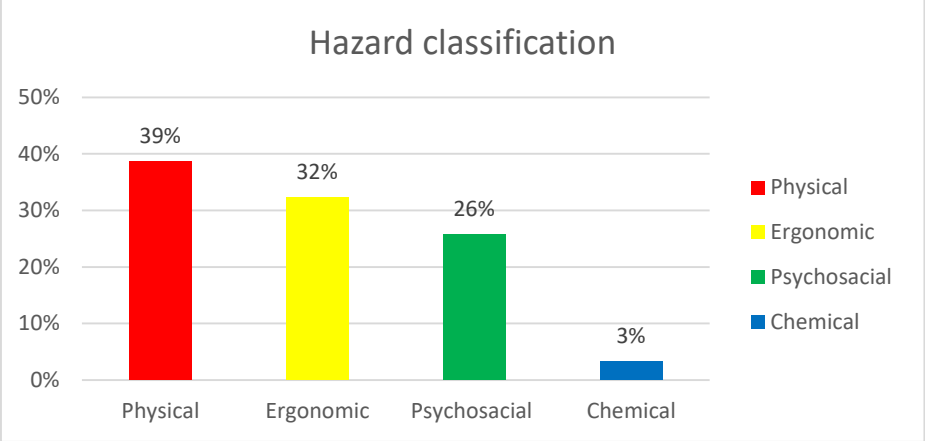

Figure 3: Results of hazard classification

Based on the results above, the physical hazard is the highest percentage, with a total of 39% percentage for physical hazards. Following is the ergonomic hazard at 32% percentage, physiological hazard at 26% percentage, and lastly chemical hazard, that contributed only 3% of the total percentage showing that chemical hazard is the minimum hazard in the condenser manufacturing area.

According to the results for each type of hazard class at the condenser manufacturing area shows in HIRARC: Risk assessment values, the figure 4 below shows the risk level rating specifically for each type of hazard classification.

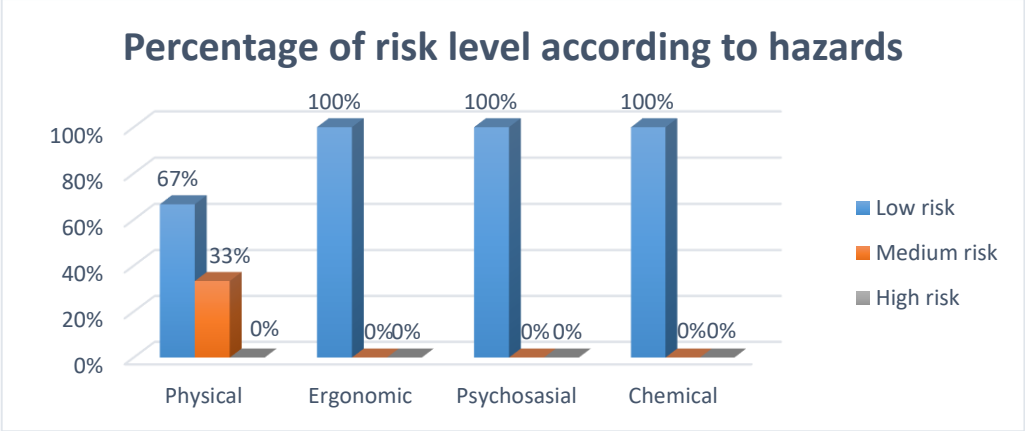

Figure 4: Percentage of risk level according to hazards

In accordance with the results across all hazard categories, at the condenser manufacturing area, 39% for physical hazard with 67% for low risk, 33% for medium risk and 0% for high risk. For the ergonomic hazard, which is 32% of the total of hazards, 100% shows as a low risk, medium risk, and high risk are 0%. Other than for psychosocial, which is 26% of the total of hazard, 100% shows as a low risk, medium risk, and high risk are 0%. Finally, for the chemical hazard, which is 3% of the total of hazard,100% shows as a low risk, medium risk, and high risk are 0%.

For the overall of the result, the most have risk control action plans in the condenser manufacturing area is a physical hazard because the physical hazard only has a medium risk of 33%. Meanwhile, all the other, ergonomic hazards, psychosocial hazards, and chemical hazards found pose low risk.

3.2 Control measures

Several recommended actions may be categorized according to the evaluation of the high risk and severe risk risks using the findings of the risk assessment data processing using the HIRARC methodology. Table 4.10 detail suggested improvements to the condenser manufacturing area.

Table 5: Control measures

No.	Task/ activity	Cause	Consequence	Action
1	Raw material set up	Sharp material	Finger cut	**Elimination:** - **Substitution:** 1. Replace dangerous material or less risky procedures with replace **Engineering Control** 1. Custom built the machine so worker not use hand. 2. Using the foam padding to minimize harsh, sharp, and painful direct contact. 3. Provide safe working platform **Administrative Control** 1. Conducting safety briefing on safe work practice before working 2. Training should be provided to give exposure about risk involved 3. Provide SOP for safety at working with Sharp material. **Personal Protective Equipment** 1. Provide appropriate Personal Protective Equipment (PPE)
2.	Insert plate header			
3.	Tank & separator caulking			

Table 5: Control measures (continued)

4	TIG Bracket Welding	Excess welder (spark)	Skin burn	**Elimination:** - **Substitution:** - **Engineering Control** 1. Inspect the work area to ensure that protection, area cleaning, locking / marking, immersion of flammable materials with water protected from all sources of fuel and ignition. 2. Ensure adequate ventilation 3. Prepare a fire extinguisher in an immediate or ready-to-use condition. **Administrative Control** 1. Conducting safety briefing on safe work practice before working 2. Training should be provided to give exposure about risk involved 3. Provide SOP for safety at working with fire. 4. Provide safe working platform **Personal Protective Equipment** 1. Provide appropriate Personal Protective Equipment (PPE)

4. Conclusion

As for the conclusion, condenser is one of the most dangerous in manufacturing industry that, have many hazards and high potential of risk in their safety. Employees can injure themselves. identify the hazards have been, that are important factors to consider that it indicates to low the potential of hazard and eliminates the risk to employers. Employers should be taking any precautions such as, instruct, train, and supervise to low the risk and control the hazard and always remind employees of safety working because, condenser is handling with variety of dangerous machine. Employers need to have training and understand the manual first before operating it. Machines used in condenser are extremely dangerous as it mainly used to sharp material hence, they are especially dangerous, and employees need to have proper precaution in prevention for injuries from bruises, cuts, punctures, nicks, and gashes by having proper safeguards. Therefore, employers should be training the employees on how to recognize all types of hazards that related to their assigned job tasks by knowing principal hazards of condenser manufacturing industry that can be categorized as safety hazards.

Next, hazard identification has been done to determine whether some specific circumstance, object or event that could cause harm to the employees because they are always exposed to risk and hazards in their workplace. Need to determine what is hazard, risk assessment and risk control, as all of these items are form part of a risk management system. By identifying the source of hazards and the potential of hazard to the employees and also assessing the risks involved in the workplace and develop strategies to control or eliminate risks, impact or likelihood of illness, injury and death can be reducing.

Besides, the control measures have been identified, is the main thing that need to focus after identifying the hazard to reduce or eliminate the hazard. Determine whether the hazard can be eliminating or substitute because these two factors are the most effective, and then after that can decide to do the engineering controls, administrative controls and choose the right personal protective equipment to low the risk of hazard. It can be concluding that risk control is a method of detecting possible loses by an organization and designing techniques to minimize or avoid losses.

Finally, by following the hazard identification, risk assessment, risk control (HIRARC) that is the base of occupational safety and health, employers can avoid from bringing harm to employees and implement proactive steps to ensure that the risks are always handled sufficiently. By following HIRARC thoroughly can get lot of advantages such as they can cut the cost for accidents or health insurance of employee. This can prevent or at least lessen the possibility for any mishaps to happened at the workplace. It can deepen the trust and loyal feeling of the employee hence it will lead to their good work quality and benefit the company later.

Acknowledgement

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