WCEJ

WORLD CHEMICAL ENGINEERING JOURNAL

Journal homepage: http://jurnal.untirta.ac.id/index.php/WCEJ

Risk Analysis Using HIRADC Method (Hazard Identification Risk Assessment and Determining Control) in the Palm Oil Processing Plant of PT. Perkebunan Nusantara VII Unit Bekri Lampung Tengah

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ARTICLE HISTORY

Received 21 June 2023
Received in revised form 17 December 2023
Accepted 4 January 2024
Available online 29 June 2024

ABSTRACT

The palm oil processing plant of PT. Perkebunan Nusantara VII Unit Bekri Lampung Tengah is subject to various risks that need to be identified and assessed for effective control measures. This research aims to conduct a comprehensive risk analysis using the HIRADC (Hazard Identification Risk Assessment and Determining Control) method in the palm oil processing plant. The study involves the identification of hazards, assessment of risks associated with these hazards, and the determination of appropriate control measures. Data for the risk analysis are collected through literature review, field observations, interviews, and questionnaire surveys. The results of the analysis highlight the identified risks and their corresponding risk levels. The risk analysis reveals 10 work areas with 4 types of risk hazards and 84 risk identifications, categorized as 22 high-level risks, 13 medium-level risks, and 49 low-level risks By applying the HIRADC method, suitable control measures are recommended based on the hierarchy of risk control, including hazard elimination, engineering controls, administrative controls, and the use of personal protective equipment. This research provides valuable insights into risk management practices in the palm oil processing industry, specifically in PT. Perkebunan Nusantara VII Unit Bekri Lampung Tengah, and can serve as a foundation for improving occupational safety and health in similar industrial settings.

Keywords: *Hazard Risks, Risk analysis, Risk Control, HIRADC Method*

1. INTRODUCTION

Risk analysis is an essential action in the safety policies of any organization, with the main goal being to eliminate any potential damage in the production process, while risk assessment is the most vital part of the entire process of evaluating hazards, risks, unwanted situations, and unsafe conditions in the workplace, including the production process (Marhavilas, 2022). There are various methods of risk analysis, one of which is the HIRADC method. The HIRADC method is chosen because it aligns with the use of OHSAS 18001:2007 and ISO 45001:2018, which indicate that the implementation of Occupational Health and Safety Management Systems (SMK3) is a method used by companies to analyze risks (Kemenaker, 2021). Through risk analysis, companies can understand the stages of work and the risks involved in each job, as well as analyze work-related hazards early on to reduce workplace accidents Barry, 2013; Ginting, 2018). Effective implementation of risk analysis can help organizations make better decisions and reduce the likelihood of losses or undesirable incidents. Risks can arise at any time and manifest in all aspects of human life (Kemenaker, 2021), including palm oil production stations, which have dynamic work systems and operate 24 hours a day, with a connection between the machinery used to produce products and human labor (Suwika and Pranata, 2022). Activities in the production process in the industry have dominant types of hazards that can result in work accidents. These hazards include physical,

mechanical, ergonomic, and electrical hazards (Barry, 2014; ILO, 2013). The purpose of this study is to identify hazards and risks in the production process of a Palm Oil Processing Plant in Central Lampung, determine risk assessment using a risk assessment matrix, and recommend risk control measures based on the risk control hierarchy

2. METHODS

This study utilizes a quantitative descriptive approach to provide a general description of the variables under investigation based on the collected data. The identification of risks is obtained through secondary data from hazard identification and occupational health and safety aspects provided by the company, as well as through interviews with the P2K3 secretary and direct field observations using observation sheets as instruments. Risk assessment is conducted using the assessments obtained from likelihood and severity questionnaires distributed to 70 workers operating machinery or equipment in the plant. The statements in the likelihood and severity questionnaires are derived from the variables of identified risk hazards developed with choices based on HIRADC criteria to be filled out by the workers (Adinda, 2021). The filled-out questionnaires are processed by combining the likelihood and severity of the risks, and the risk values are determined using the risk assessment matrix.

(Risk Level)							
(*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
Skor			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Catastrophic
			Keparahan Risiko (*Severity/Consequences*)				

Fig. 1. Risk assessment matrix

To determine the control measures, clustering based on the risk assessment matrix is used to establish the risk level (BPDP Sukabumi, 2020) In the process of determining control measures, reference is made to the risk control hierarchy, which includes elimination, substitution, engineering controls, administrative controls, and personal protective equipment (noviyanti, 2020). The validity of the data obtained through the questionnaire is tested to determine its reliability. The validity test is conducted using the SPSS software (Statistical Program for Social Science Version 23) with a significance level of <0.05. A reliability test is performed to demonstrate the consistency of an index score with the data. To measure reliability, the SPSS software (Statistical Program for Social Science Version 23) is used, with Cronbach's Alpha coefficient (α) > 0.6 (Wiratna and Retani, 2019).

3. RESULT

3.1. Hazard Identification in Palm Oil Processing Plant

Hazards can be defined as actions or situations that have the potential to cause work accidents, injuries, or illnesses (Kemenaker, 2021). In the production process, machines and workplaces used to generate a product always contain potential hazards that, if not given special attention, can lead to work accidents (Bayu *et al.,* 2017). Based on observations, a total of 84 hazard risk identifications were obtained, divided into 4 types of hazards, namely ergonomic, electrical, physical, and mechanical hazards from 10 workstations in the palm oil processing plant. The most common type of hazard found was physical hazards, with 67 findings, as physical hazards arise from various factors in the workplace, including vibration, temperature/climate, noise, pressure, and others (Ramadhan, *et al.,* 2021). For the physical hazard type in Figure 2, the highest number was found in the boiling station work area, with 12 identified hazard risks. This is because the boiling station involves more job descriptions and has more potential hazard factors, such as noise from the boiling machines, direct contact with the boiling vessel causing temperature hazards, and an unpredictable work environment due to the natural and wet floor conditions during rain or steam release from the boiling tank lorries.

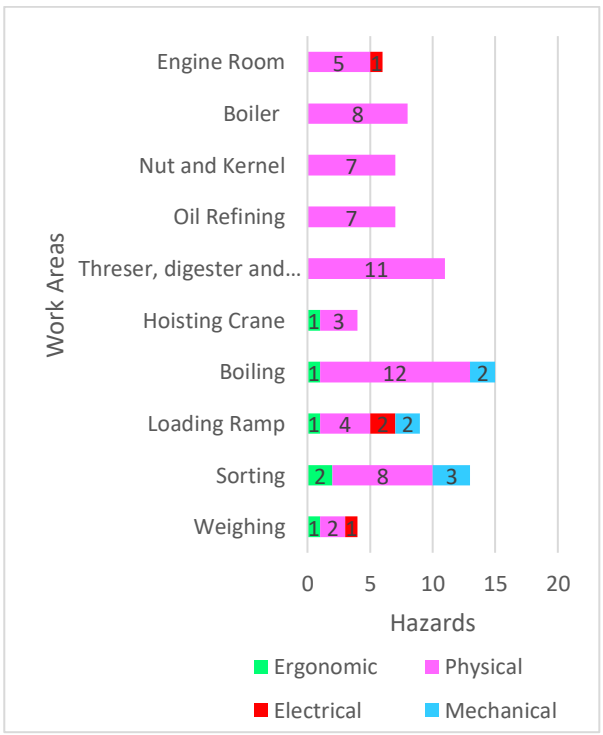

Fig. 2. Identification of types and quantities of hazards based on work areas in the palm oil processing plant

Mechanical hazards rank second highest with a total of 7 identified risk hazards in the work areas of the sorting station, loading ramp station, and boiling station due to their direct association with equipment operated by workers. The use of tools operated by workers includes a hook tool for sorting Fresh Fruit Bunches (FFB) at the sorting station, a chain tool for lorries at the loading ramp station, and a bridge tool connecting the boiling vessel track and boiling vessel door at the boiling station. The use of these tools can pose mechanical hazards originating from equipment operated by workers, which can result in injuries or wounds (Dharma, *et al.,* 2017).

Ergonomic hazards account for 6 findings of risk hazards in the work areas of the weighing station, sorting station, loading ramp station, boiling station, and hoisting crane station. Ergonomics relates to the principles of tools, machinery, workplaces, or processes that are designed to match the abilities and limitations of the individuals using them. Repeated movements and prolonged static positions can lead to muscle/joint injuries for workers (Maharani, 2019). One of the tasks that falls under ergonomic hazards is at the weighing station, where workers sit for 12 hours to input FFB data into the computerized system. At the boiling station, workers manually push/move the bridge tool that connects the boiling vessel track.

There are 4 findings for electrical hazards, which are present in the work areas of the weighing station, loading ramp station, and engine room. This is because there is a possibility of electrical hazards, and workers directly interact with electricity in their work. Electricity itself is generated from energy sources (Maharani, 2019). The energy source in the processing plant is generated through the engine room station. In other stations, the tasks performed by workers do not involve electricity, as they use energy generated from the steam boiler to power the palm processing machines.

3.2. Risk Assessment Results in the Palm Oil Processing Plant

Risk assessment is obtained from the likelihood and severity values obtained from observations and questionnaires of workers in the palm oil processing plant, and it is divided into three categories of risk hazards: low, medium, and high (Figure 3). The data analysis results indicate a total of 84 risk hazards from 10 workstations in the palm oil processing plant, consisting of 49 risk hazards classified as low, 13 risk hazards classified as medium, and 22 risk hazards classified as high. The boiling station is the station with the highest number of risk hazards, totaling 15 risks, including 14 low-risk hazards related to relatively simple tasks such as opening and closing the boiling tank door, and 1 medium-risk hazard, which is the risk of hearing impairment due to a noise level of 50.4 dB from the plant's machinery during working hours, which increases when the steam chimney emits steam from the boiled TBS (Saputra, 2022). In addition, at the Hoisting Crane Station, all risk hazards in that area are classified as low because the crane operators have seated positions and observe break times and shift changes.

The Sorting Station is the station with the highest number of high-risk hazard categories, totaling 8 hazards. This is mainly due to the majority of tasks performed using sharp tools such as hooks. The task of sorting TBS using hooks poses a high-risk hazard of muscle or joint injuries due to manual handling during 12-hour shifts, as the sorting is done manually by hand relying solely on the workers' physical strength. Manual handling tasks can impact the body, requiring greater exertion of energy, forced body posture, and repetitive movements that can cause muscle or joint injuries (Rini, *et al.,* 2022). The Nut and Kernel Station has only one high-risk hazard category, indicating that all tasks performed in that station pose high-risk hazards, such as the possibility of head injuries due to the limited and conveyor-filled workspace (Ikhsan, 2022). There is a risk of falling from heights as the nut and kernel area has equipment and machinery installed above, increasing the possibility of workers falling. There is also a risk of slipping in the workspace due to fallen nuts and kernels, which can make the floor slippery.

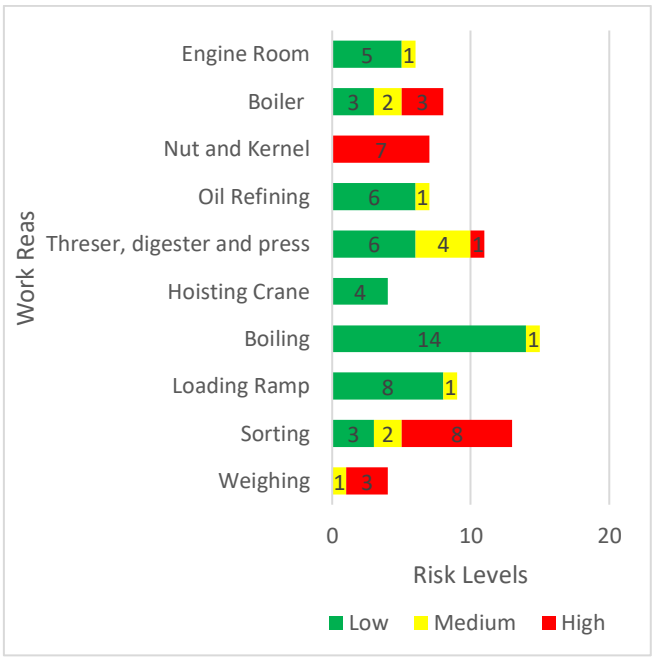

Fig. 3. Risk Assessment Results Based on Activity Types in Work Areas

As for the medium-risk hazard category, the highest number is found in the Thresher, Digester, and Press Station, with 4 hazards. These hazards include the risk of slipping on the ladder in the digester work area due to oil splatters on the floor, the risk of burn injuries from oil splatters while operating the digester machine, and the risk of slip injuries during the cleaning of the thresher work area.

3.3. Risk control determination based on the level and risk control hierarchy in the Palm Oil Processing Plant

Risk control determination based on the risk control hierarchy, consisting of Personal Protective Equipment

(PPE), administrative controls, engineering controls, substitution, and elimination, is conducted after identifying and assessing risk hazards using the risk assessment matrix (Figure 4). Risk control efforts that can be implemented by the company based on risk assessment in the 10 workstations of palm oil processing have yielded results in the low-risk category, with 39 administrative control efforts identified in 8 workstations, excluding the nut and kernel station and weighing station. Administrative controls that can be implemented include safety briefing and the addition of hazard signs, as well as the use of ear muffs/ear plugs for workers in the boiling station, which is identified as the station with the highest number of administrative and low-risk PPE efforts (Yantoz, 2022). Engineering control efforts in the low-risk category include modifying the hydraulic system for the door of the boiling vessel in the oil purification station.

For the moderate-risk category, a total of 13 control efforts were identified, consisting of 8 administrative controls, 2 PPE efforts, 2 engineering controls, and 1 substitution effort. Administrative controls can be implemented by adding hazard signs in the work area. As for PPE efforts, they include the use of safety shoes for workers and the use of ear muffs/ear plugs. Engineering control can be achieved by providing a barrier cover for the digester machine. Substitution efforts involve relocating power outlets/cables away from workers in the weighing station.

In the high-risk category, a total of 22 control efforts were identified, including 14 administrative controls, 6 PPE efforts, 1 engineering control, and 1 substitution effort. The highest number of administrative controls was found in the sorting station, with 6 control efforts. These include implementing rotation work schedules and break times [Ratih, *et al.,* 2020), as well as setting time for muscle stretching to reduce ergonomic risks in the workplace (Maksuk, *et al.,* 2021). PPE efforts in the sorting station involve the use of eye protection (radiation glasses) to minimize direct screen radiation to the eyes, as well as the use of safety shoes, safety helmets, and face masks (Taofiq, 2019). Engineering control efforts include using screen filters for monitors to reduce eye fatigue (Suardana, 2017). Substitution efforts involve replacing chairs with more ergonomic options for workers. Ergonomic chairs have adjustable features that allow for various angles. Ergonomics is related to optimizing efficiency, comfort, and occupational health and safety in the workplace, thus requiring suitable and safe chairs for work (Sokhibi, 2017)

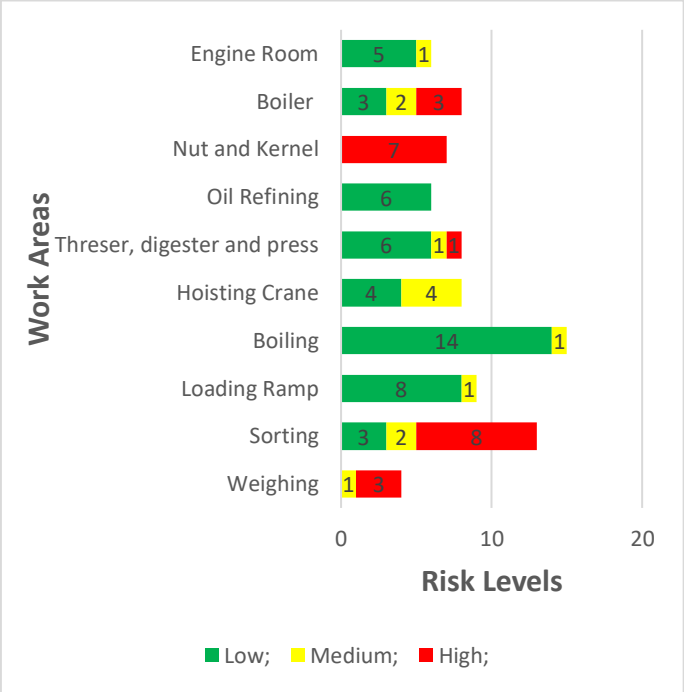

Fig. 4. Risk control determination based on the level and risk control hierarch in Work Areas

4. CONCLUSION

There are four types of hazards identified in the area, namely 67 physical hazards, 7 mechanical hazards, 4 electrical hazards, and 6 ergonomic hazards, with a total of 84 hazards and risks found in the palm oil processing plant (PPKS). The risk assessment results for the palm oil processing plant indicate that there are 22 high-risk hazards, 13 moderate-risk hazards, and 49 low-risk hazards. In terms of risk control determination based on the hierarchy of risk control, recommended measures include substitution, engineering controls, administrative controls, and the use of personal protective equipment (PPE)

5. ACKNOWLEDGMENTS

There are no acknowledgements here

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