

Analysis of Potential Hazards at Press Stations Using the Hazard and Operability Study (Hazop) Method at XYZ Palm Oil Mill

Azhar Basyir Rantawi ^{a,1,*}, Ahdiat Leksi Siregar ^{a,2}, Hendra Saputra ^{a,3}, Istianto Budhi Rahardja ^{b,4},
Ayu Putri Rayhan ^{c,2}

^a Oil Palm Plantation Product Processing, Citra Widya Edukasi Oil Palm Polytechnic, l. Gapura No.8 Rawa Banteng, Bekasi, 17520, Indonesia

^b Mechanical Engineering, Vocational School, PLN Technology Institute, l. Jl. Duri Cengkareng Raya, RT.1/RW.1, Duri Kosambi, Cengkareng District, West Jakarta City, Special Capital Region of Jakarta 11750

^c Students Oil Palm Plantation Product Processing, Citra Widya Edukasi Oil Palm Polytechnic, l. Gapura No.8 Rawa Banteng, Bekasi, 17520, Indonesia

¹ azharbr@gmail.com; ² aleksiregar@gmail.com *; ³ endsaputra11@gmail.com, ⁴ istianto@itpln.ac.id

*corresponding author

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ABSTRACT

A preventive approach in identifying potential hazards in satian presses in palm oil mills is very important to prevent work accidents. This study aims to analyze potential hazards at press stations in palm oil mills using the Hazard and Operability Study (HAZOP) method, identify the causes and impacts of each potential hazard found, determine the level of risk based on the results of risk assessments, and prepare appropriate control recommendations as an effort to improve occupational safety and health in the mill environment. The results of the study showed that the level of risk at the press station varied from the Medium category (exposure to hot steam/oil and scratches on the work tools), High (slipping on the floor/slippery stairs and electric shock), to the Extreme category which is very critical in the form of the potential for workers' hands to be pinched on the screw press machine during cleaning (possibility: 3, severity: 5). As an effort to improve work safety, integrated control recommendations were formulated which include the implementation of strict cleaning SOPs, the implementation of the Lockout/Tagout (LOTO) system on machines and electrical panels, housekeeping improvements with the installation of anti-slip step nosing materials, and the obligation to use standard PPE in a disciplined manner.

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I. Introduction

Palm oil mills are one of the industries that process raw materials into semi-finished materials with a large production capacity. The production process in palm oil mills uses large-capacity machine machines, high-pressure systems, and large energy sources. Potential hazards that can result in work accidents can occur if not managed systematically. To increase productivity and protect the workforce for the sustainability of production operations, the implementation of an occupational safety management system is very important and main.

Identifying potential hazards from the beginning of production is important to minimize the occurrence of work accidents, this is a risk-based preventive approach. One of the risk analysis methods in supporting work safety in the factory environment is the Hazard and Operability Study (HAZOP). This method is able to describe in a concise manner the potential hazards that can occur in industrial processes.

The process of processing fresh fruit bunches into palm oil involves a fairly long production process, such as the boiling process (sterilization), the digestion process, the pressing process, the clarification process, and the product storage. One of the stations that has a high level of risk is the



press station. The *press* station in the palm oil mill serves to separate the solid fraction from the liquid fraction from the palm fruit buds. The solid fraction produced in the process at the *press* station is in the form of crude fiber (*Nut*) of palm oil, while the liquid fraction produced from the *press* station is in the form of crude palm oil that is still mixed with water.

This study aims to analyze potential hazards at *press* stations at palm oil mills using the *Hazard and Operability Study* (HAZOP) method, identify the causes and impacts of each potential hazard found, determine the level of risk based on the results of the risk assessment, and prepare appropriate control recommendations as an effort to improve occupational safety and health in the factory environment

II. Literature studies

Occupational health and safety (K3) is the application of science in preventing accidents in work activities. K3 protects workers in carrying out their work through efforts to control potential hazards in the work environment so as to create a safe work environment, work becomes smooth, work results are more productive, this will certainly reduce the risk of losses for the Company [1].

Hazard is anything, condition, or situation that has the potential to cause loss, damage, injury, or adverse impact on people, property, or the environment [2]. In palm oil mills when the processing process is carried out, potential adverse impacts can occur.

The *Hazard And Operability Study* (hazop) process basically uses the principle that a group approach will be more effective than an individual approach in identifying problems [3]. In this study, the data obtained from observations was carried out to find the source of danger at the *press* station in the palm oil factory.

Table 2.1 Likelihood Criteria

Level	Criteria	Description	
		Qualitative	Semi-qualitative
1	Rare	Can be thought of not only when the circumstances are Extreme	Less than 1 time in 10 years
2	Unlikely	It hasn't happened yet but it could appears /occurs at a time	Occurs 1 time per 10 years
3	Possible	It should have happened and may have happened/appeared here or elsewhere	1 time per 5 years once 1 time per year
4	Most likely	It can occur easily, it may appear in the circumstances of the most common occurrence	More than 1 time per year to 1 time per month
5	Almost certainly	Often, it is expected to appear in a situation that most common occurrence	More than 1 time per month

Source : Felik Andhika Thesar Lubis 2021

Table 2.2 Severity (*consequences*)

Level	Description	Description	
		Severity of injury	Weekdays
1	Insignificant	Occurrence no cause loss or injury to humans	Not missing a working day
2	Small	Causes minor injuries, minor losses and does not cause serious impact on Business continuity	Can still work on the same day/shift
3	Medium	Seriously injured and hospitalized, does not cause permanent disability, Moderate financial losses	Loss of working days under 3 days
4	Weight	Causing severe injury and permanent disability and substantial financial losses and causing serious impacts on Business continuity	Missing 3 or more working days
5	Disaster	Resulting in death and severe losses can even stop activities Forever Endeavor	Losing a working day forever

Source : Felik Andhika Thesar Lubis 2021

After determining the *likelihood* and *consequences* of all potential hazard factors, the next step is to multiply the likelihood and *consequences* values so that the risk *level* is obtained in the *risk matrix*.

Table 3. *Risk Matrix*

Scale		Consequences (Keparahan)				
		1	2	3	4	5
Likelihood (kemungkinan)	5	5	10	15	20	15
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

Description :

Remarks

1	Extreme	:	
2	High risk:		
3	Moderate risk:		
4	Low risk:		

The *risk matrix* functions to calculate the value of the risk level of potential danger. The color used to distinguish the value of each risk. Red color (*extreme*), yellow color (high risk), green color (medium risk), blue color (low risk)

III. Method

The research was carried out by direct observation in the field to obtain data from the Palm Oil Mill. So that the writer can explain or describe the object. Additional methods used include:

- a. Literature Study: Conducting data collection by searching books, journals and references related to the k3 system in PKS. As a comparison between theory and actual problems in the field.
- b. Observation: The method of announcing data by conducting direct observations in the field. The purpose of direct observation is to make the data obtained more effective and accurate.
- c. Interview Method: a question and answer process with operators, foremen and process assistants to obtain data and related information about k3 at the press station.
- d. Documentation Study: data collection by collecting data and recording related data on safety and health in MSMEs.

IV. Results and Discussion

A. Factors Causing Work Accidents

Table 4. Occupational Safety Hazards

Yes	Occupational Safety Hazards	Risks
1	Mechanical Hazards	Cut, fall, slip, cut, Hit and pinched
2	Chemical Hazards	Irritation, fire and blasting
3	Electrical Hazards	Electrocution, short contact and Fire

Table 5. Occupational Health Hazards

N0	Occupational Health Hazards	Risks
1	Physical Hazards	Radiation, air pressure, lighting, and weather
2	Chemical Hazards	Chemical poisoning (inhaled/ingested)
3	Biological Hazards	Exposed to bacteria, infected with viruses (flu, HIV and <i>hepatitis</i>)
4	Psychological Dangers	Irregular working hours, violence in the workplace and an overly heavy workload.

B. Types of Work Accidents

Table 6. Types of work accidents

Yes	Job activities	Risks	Risk Matrix			Risk Level
			L	C	S	
1	Fiber out of <i>the press machine</i>	Exposed to hot steam and fiber	3	2	6	Medium risk
2	Setting the open and close <i>valve</i>	Exposure to hot oil	1	3	3	Medium risk
3	Press station cleanliness	Slipping and falling	4	2	8	High risk
4	Repairs <i>Bearing Press</i>	Hit by a hammer	1	3	3	Medium risk
5	Press station cleanliness	Clamped <i>screw press</i>	3	5	15	Extreme
6	Turn on the panels on the station <i>Press</i>	Electrocution	3	3	9	High risk
7	Walk on the stairs of the <i>digester press</i>	Slipped and fell	3	3	9	High Riskp

Potential hazards in the work environment are grouped into two main categories, namely safety hazards and health hazards [5]. The potential for safety hazards to cause direct injury due to the interaction of workers with machines, equipment, and the work environment, the forms of hazards that occur include burns, cuts, hard objects, falls, and fatal accidents that lead to death. While health hazards occur due to exposure to physical, chemical, biological, ergonomic, and psychosocial factors, this has the potential to cause work-related diseases in the short and long term.

The safety hazard that occurs at the *palm* oil mill press station occurs due to the use of mechanical and hygiene equipment from the location area. Some examples of potential hazards found at press stations include workers at risk of falling when climbing or descending stairs to *digester* and *screw press machines*, hands being pinched on parts of the machine that are operating or during the repair process, and injuries due to being hit by a hammer while carrying out maintenance activities. These risks are generally influenced by working environment conditions, non-compliance with standard operating procedures (SOPs), suboptimal use of personal protective equipment (PPE), and weak implementation of technical and administrative controls.

Potential electrical hazards can also occur at press stations in palm oil mills. This happens due to the use of electrical installations and equipment, especially on the control panel of the machine. Risks can occur if there is a short circuit, damage to the cable insulation, or procedural errors when operating the electrical panel. Meanwhile, the potential for chemical hazards in the *press* station is relatively low because the pressing process does not involve the use of hazardous chemicals directly.

Health hazards are all forms of potential hazards in the work environment that can cause health problems, *occupational diseases*, or a decrease in workers' work capacity due to continuous exposure or for a certain period of time. In contrast to safety hazards that generally cause direct injury, health hazards often have a gradual impact that makes them difficult to recognize in the early stages. Potential health hazards in the industrial environment include physical, chemical, biological, ergonomic, and psychosocial hazards. Exposure to these factors can cause respiratory disorders, skin diseases, hearing loss, work stress, and chronic diseases that have an impact on worker productivity. Therefore, the

identification and control of health hazards is an important part of the implementation of occupational safety and health (K3) systems to create a safe, healthy, and productive work environment [6] [7].

The most dominant health hazard at *the press* station in palm oil mills comes from physical hazards due to exposure to high temperatures during the palm oil pressing process. Screw *presses*, *digesters*, and steam *pipelines* produce high temperatures that have the potential to cause burns if workers make direct contact with machine surfaces or pipes that do not have adequate protection. Meanwhile, the potential for chemical hazards at *the press* station is relatively low because the pressing process does not use harmful chemicals directly. However, workers still have the potential to be exposed to dust, *oil mist*, engine exhaust gases, if inhaled continuously can cause health problems. Therefore, the use of appropriate personal protective equipment, maintenance of ventilation systems, and periodic inspections of work environment conditions are important steps to minimize health risks due to exposure to physical and chemical factors [5].

Analysis of potential hazards at the palm oil mill press station using the *Hazard and Operability Study* (HAZOP) method showed that there was a variation in the level of risk of work accidents, ranging from medium, high, to extreme categories. In the area of routine operations and machinery maintenance, several forms of work accidents with moderate risk categories were found. These incidents include exposure to hot steam and hot fibers when the material comes out of the press machine (probability: 3, severity: 2) as well as exposure to hot oil during machine operation (probability: 1, severity: 3). In addition, press machine repair activities are also at risk of causing workers to be hit or scratched by work tools (probability: 1, severity: 3). Although these three types of accidents generally only result in minor to moderate injuries with a loss of less than three working days The impact still requires special attention so as not to interfere with daily productivity.

The high-risk category is dominated by the potential for accidents due to inadequate working environment conditions and exposure to hazardous energy. The potential for slipping or falling during the press station cleaning process has a high probability of occurring (4) due to slippery floor conditions, even though the severity is relatively small (2). Similar risks are also found in slippery areas of the digester press ladder (probability: 3, severity: 3) that have the potential to cause injury and require medical attention. In addition, the activity of turning on electrical panels at the press station risks causing workers to be electrocuted (probability: 3, severity: 3). These three potential high-risk hazards require careful handling considering their frequent occurrence and the potential occupational health disorders they cause.

The most critical finding in the study was the danger with the extreme risk category, namely the potential for a worker's hand to be pinched on a screw press during machine cleaning. This potential has a probability level of 3, but has a very fatal/catastrophic severity (5) because it can result in fatalities, permanent disability, or severe material loss. Based on the results of the risk evaluation, integrated Occupational Safety and Health (K3) control recommendations were prepared. Control recommendations include the implementation of strict Standard Operating Procedures (SOP) for cleaning and maintenance, Lockout/Tagout (LOTO) actions on screw press machines and electrical panels, housekeeping in the form of routine cleaning of slippery floors/stairs along with the installation of anti-slip step nosing, as well as the obligation to use appropriate Personal Protective Equipment (PPE) such as heat-resistant/mechanical gloves, safety shoes, and face shields.

V. Conclusion

The results of the identification of potential hazards at press stations at the Palm Oil Mill using the Hazard and Operability Study (HAZOP) method were obtained from two main categories of hazards, namely safety hazards (mechanical, electrical, and slippery floors/stairs) and health hazards (exposure to high temperatures, dust, and oil vapor). The main factors causing this hazard include inadequate working environment conditions, non-compliance with SOPs, lack of use of PPE, and weak technical and administrative control systems, with the impact of direct physical injury to chronic respiratory disorders. The level of risk at the press station varies from the Medium category (exposure to hot steam/oil and scratches on the work tool), High (slipping on the floor/slippery stairs

and electric shock), to the Extreme category which is very critical in the form of the potential for workers' hands to be pinched on the screw press machine during cleaning (probability: 3, severity: 5). As an effort to improve work safety, integrated control recommendations are formulated which include the implementation of strict cleaning SOPs, the implementation of the Lockout/Tagout (LOTO) system on electrical machines and panels, housekeeping improvements with the installation of anti-slip step nosing materials, and the obligation to use standard PPE in a disciplined manner.

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