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Analysis of occupational safety and health at chemical manufacturer with HIRARC method

Adinda Suchieyati Sahara^{*}, Dene Herwanto, Billy Nugraha

Department of Industrial Engineering, Singaperbangsa University, JL. HS Ronggo Waluyo Puseur, Karawang 41361, West Java, Indonesia

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ABSTRACT

PT Timuraya Tunggal is a leading supplier and manufacturer of chemical products. Within its operations, potential hazards exist, notably in the sulfuric acid production section, necessitating the role of occupational safety and health to prevent and mitigate accidents. This research adopts a qualitative descriptive approach, utilizing both primary and secondary data sources. The collected data undergoes processing using the HIRARC method, identifying hazards primarily through direct observation in the burner process. The results and discussions of this study conclude the identification of two potential hazards in the burner process at PT Timuraya Tunggal, comprising one low-risk, two moderate-risk, and one high-risk hazard. Control recommendations proposed for the burner process include administrative controls such as avoiding the burner area unnecessarily, installing guardrails, mandating the use of respirator masks and scrubbers, and implementing the use of caustic soda for SO₂ neutralization. Additionally, a suggested control for the burner process involves prominently displaying warning signs indicating 'hot surfaces, do not touch'.

1. Introduction

PT Timuraya Tunggal stands as one of the foremost suppliers and manufacturers of chemical products. Consequently, the production process harbors potential risks that could result in harm to individuals, company assets, and the surrounding environment. Recognizing these potential hazards underscores the critical role of occupational safety and health in preventing and mitigating accidents. Within the daily operations, numerous potential sources of danger manifest within the company environment, notably observed in the sulfuric acid production department where work accidents occur almost every month. This pattern signifies the prevalence of potential accidents within the burner process during work activities.

The Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method comprises a series of processes aimed at identifying hazards within routine and non-routine activities. HIRARC serves as an

essential effort to prevent and minimize potential work accidents, effectively managing and mitigating risks by appropriately avoiding, minimizing, and controlling these hazards, ensuring the safe execution of activities. Hazard identification, risk assessment, and control form integral components of the risk management system, which constitutes the foundation of the Occupational Health and Safety Management System. This system encompasses the systematic identification of hazards, thorough risk assessment, and effective risk control measures.

The research conducted by Dwi Desianna and Prayudhy Yushananta [1] aimed to identify hazards existing within a factory, conduct risk assessments, and implement risk control measures at each stage of work using the HIRARC method. Data collection involved observation and exposure measurements, standardized through two risk assessment parameters: the probability/likelihood of hazard and the severity of hazard. The study revealed four high-risk activities: mixing and stirring materials, checking rolling boxes, printing paving blocks, and cleaning remaining

*Corresponding author:

Email: adindasuchieyati@gmail.com

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materials. The highest risks of occupational diseases were respiratory disorders and skin, or eye irritation observed in material mixing, stirring activities, and cleaning material residue. Additionally, the highest risk of occupational accidents occurred during the checking of rolling boxes.

The utilization of the HIRARC method, along with the application of probability/likelihood of hazard and severity of hazard, proved effective in assessing the risks associated with both occupational accidents and occupational diseases. To mitigate these risks, efforts such as machinery repair and maintenance, establishment of danger zones, utilization of personal protective equipment, and administrative controls are imperative.

The research conducted by Giananta et al. [2] focused on the Industrial Machinery and Equipment (MPI) unit. The unit faced recurring work accidents, prompting the need for K3 (Occupational Health and Safety) improvement using the HIRARC method. HIRARC, encompassing hazard identification, risk assessment, and risk control, aims to identify hazards, assess associated risks, and subsequently mitigate them to minimize workplace risks. The research identified 21 risks in the preparation section, 36 risks in the machining section, and 27 risks in the assembling section. Subsequently, the causes of risks with the highest values were selected for risk control measures. The study's outcomes are intended to serve as proposals for enhancing the company's K3 system, thereby improving occupational health and safety measures.

The research conducted by Smaranda et al. [3] aimed to identify potential hazards within the fabrication process. The study utilized the HIRARC method to identify, assess, and control risks. This model facilitated the identification of primary and secondary hazards, focusing on activities impacting operational safety.

Within manufacturing activities at PT Tri Jaya Teknik, 30 potential risks were identified across stamping, trolley usage, milling, grinding, and welding processes. Assessment outcomes indicated 13.3% presented extreme risk, 30% high risk, 13.3% medium risk, and 43.34% low risk. To prevent work accidents, risk control measures were proposed, including the use of personal protective equipment in the factory environment, engineering solutions within production processes to minimize hazards, and administrative measures such as implementing standard operating procedures to comply with the company's established standards.

The research conducted by Khudhory et al. [4] aimed to identify, assess, and control potential hazards and associated risks within CV Jaya Makmur, utilizing the HIRARC method. Through observations, questionnaires, and interviews with a workshop owner and three workers, the study identified 18 potential hazards, comprising 12 low-level risks and 22 medium-level risks. Risk control measures implemented at CV. Jaya Makmur encompassed technical engineering solutions such as installing barriers between hazard sources and workers. Additionally, administrative controls involved alterations in work procedures,

regular supervision and reprimands, provision of training to emphasize the importance of Occupational Health and Safety in the workplace, scheduling, and conducting periodic maintenance of work equipment. Furthermore, workers were mandated to use personal protective equipment including work clothes, face shields, safety glasses, gloves, safety helmets, masks, safety shoes, and earmuffs while performing their duties.

The research conducted by Rahmanto and Hamdy [5] aim of identifying types of work accidents and mitigating occupational hazards in the production of electrical energy. Data analysis employed a descriptive data analysis technique for Hazard and Operability (HAZOP). HAZOP, a risk analysis technique utilized in establishing safety measures for new systems or modifications, identifies potential dangers or operational issues, enabling the analysis of occupational hazards and consequences in the field. The outcomes were integrated into a risk matrix scale, revealing that workers' behavior during work carried high levels of risk and potential dangers, classified as extreme, high, moderate, and low hazards. Recommendations to address these risks include providing self-protection tools and implementing fire-fighting systems in each sector, along with conducting safety and health training for workers. Such measures aim to cultivate a professional workforce that comprehends the significance of occupational health and safety.

The research conducted by Asmara and Purwaningsih [6] aimed to assist the company in mitigating potential risks within the production workshop. One of the methods employed was the HIRARC Method (Hazard Identification, Risk Assessment, and Risk Control). The HIRARC method involves a series of hazard identification processes within work activities, intended to effectively prevent and reduce potential work accidents, as well as control them during repair and maintenance activities to ensure a safe process. The research findings revealed 26 types of potential hazard risks, categorized as follows: 2 categories under 'Very High' (7.69%), 4 categories as 'Priority 1' (15.38%), 14 categories classified as 'Substantial' (53.85%), 6 categories denoted as 'Priority 3' (23.08%), and no potential risk categories identified as 'Acceptable' (0%).

The research conducted by Ulimaz and Ansa [7] aimed to analyze Occupational Safety and Health at the Loading Ramp Station in PT XYZ using the HIRARC Method. This study employed a case study approach. Data collection involved in-depth interviews conducted through purposive sampling. The HIRARC method was utilized for risk analysis at the Loading Ramp Station, focusing on activities like loading Fresh Fruit Bunches (FFB) onto lorries and withdrawing them using a capstan. This method identified processes with the highest risk scores. Implementing the HIRARC method facilitated solutions for high-risk scenarios at PT XYZ's Loading Ramp Station. Risk control measures recommended the obligatory use of Personal Protective Equipment (PPE) by employees during their factory duties. The company's responsiveness in enforcing

these measures, such as imposing sanctions on employees violating regulations, is crucial.

The research conducted by Trisaid [8] aimed to address the issues arising in RIG service activities, particularly in the preparation of materials and support facilities. Given the frequent occurrence of work accidents in these activities, a comprehensive identification of hazards, risk levels, and causes was crucial to formulate control recommendations, particularly in the RIG service area, to prevent work accidents. The HIRARC method, coupled with the FTA (Fault Tree Analysis) approach, was employed for this purpose. Analysis using the HIRARC method revealed that the highest-risk dangers encompassed falling, pinching, and slipping, rated at a risk level of 5, categorized as high-risk. Further analysis identified the causes of these risks, attributed to the improper positioning of materials or tools, not in compliance with regulations, and the inadequate implementation of Standard Operating Procedures (SOP) at work.

The study conducted by Aprilla and Yulhendra [9] aimed to identify, analyze the severity, and categorize hazard risks, applying the HIRARC method to control hazards within the crusher and belt conveyor areas of PT Semen Padang. This qualitative research employed a descriptive method utilizing hazard risk analysis, assessing likelihood and consequence, risk matrix analysis, and the HIRARC method for hazard control. The research findings unveiled 12 types of hazard risks within the crusher area and 8 hazards within the conveyor belt area at PT. Semen Padang between 2018 and 2021. These hazards were rated with a severity level of 60% falling into the medium category, 25% categorized as high, and 15% classified as low severity. The HIRARC method used for risk control encompassed strategies such as Elimination, Substitution, Engineering, Administration, and PPE.

The study conducted by Zein et al. [10] aimed to identify hazards using the HIRARC method, assess the likelihood and severity of potential accidents, and establish controls to mitigate risks during the water tank manufacturing process at CV XYZ. The research identified problems across 5 workstations, uncovering 7 potential hazards and risks faced by CV XYZ during tank production. The risk assessment revealed that among the 7 potential hazards, 2 had a low-risk potential, 3 were categorized as medium-risk, and 2 were deemed high-risk. The study offered risk management recommendations targeting all potential hazards at CV XYZ to minimize the occurrence of work accidents, aiming to enhance workplace safety.

The research conducted by Mauliyani et al. [11] aims to examine field conditions, specifically focusing on Hazard Identification, Risk Assessment, and Risk Control within the tank manufacturing process at PT Gemala Saranaupaya in Cilincing, North Jakarta. The study involved observing the work stage process from the work instruction section, conducting interviews related to work accidents that frequently occur during the process, and making direct observations. This descriptive qualitative research method generates

descriptive data through speech, writing, and observed behaviors of individuals. Through interviews and observations, several potential hazards were identified. The research assessed these risks at PT Gemala Saranaupaya, resulting in 8 identified hazards at an Extreme risk level (E), 7 at High risk levels (T), 3 at Low risk levels (R), and 2 at medium risk levels (S). Each work process presented its own set of hazards, requiring distinct risk assessments and control measures.

The research conducted by Wahid et al. [12] utilized the HIRARC method to analyze work safety risks and determine the level of work safety risks at PT SPI. The research findings highlight the significant influence of workers' attitudes on the implementation of occupational health and safety during work accidents. Occupational Health and Safety practices aim to protect and ensure the safety and health of workers, minimize the occurrence of work accidents, and enhance workers' welfare. The study identifies various factors influencing occupational safety and health risks, including human factors, standardization, work environment conditions, infrastructure elements (such as personal protective equipment), and weather conditions. Recommendations stemming from this study suggest immediate implementation of Policies or Standard Operating Procedures (SOPs), attention to factors contributing to work accidents, and the inclusion of productivity variables for further research.

Nur conducted a study aimed at identifying potential hazards at the Press station of PT XYZ, determining occupational safety and health risks, and proposing preventive measures or controls for occupational safety and health [13]. The study employed data collection techniques such as observation and interviews, while the analysis was based on HIRARC (Hazard Identification Risk Assessment and Risk Control). The identified potential hazards encompass hitting the head on an oil pipe, slipping/falling, inhaling dust, exposure to vapors/odors, exposure to noise, and being affected by hot steam. The risk assessment, utilizing a matrix of risk levels, likelihood, and consequence values, revealed one type of accident at a low-risk level, one at a medium-risk level, two at high-risk levels, and two at extreme-risk levels. To mitigate these risks, the study suggests employing Personal Protective Equipment (PPE) such as safety helmets, shoes, masks, earplugs, and wearpacks.

Santoso et al. conducted research aiming to identify workplace hazards, conduct risk assessments, and apply risk controls using the Hazard Identification Risk Assessment and Risk Control (HIRARC) method [14]. From the identified risks, the research aimed to minimize work accidents and create a safe and comfortable work environment for employees. The HIRARC method, a risk management approach involving hazard identification, risk assessment, and risk control, aims to reduce the level of risks within a workplace. This study identified 13 potential hazards from four primary activities and one maintenance

activity. The classification of these hazards includes one categorized as extreme risk level, one as high-risk level, seven as medium risk level, and four as low risk level.

Sari et al. conducted research [15] aimed at minimizing workplace hazards leading to accidents. The study aimed to implement risk management activities that reduce the risk level of work-related accidents, preventing losses in construction projects. An Occupational Health and Safety (OHS) management system was proposed to regulate and guide construction workers. Data for this study were collected by distributing questionnaires to 30 workers from the total population of 60 employees at PT Mam Energindo. The validity and reliability of the data were analyzed using the SPSS application. The validity, indicated by r count $>$ r table, was confirmed, and the reliability, measured by Cronbach Alpha with a value of 0.751, was established as reliable, as a Cronbach Alpha $>$ 0.7 indicates data reliability. The risk assessment revealed that the construction area of the West Pasaman Regional Hospital still maintains a low risk level, with three moderate accidents identified: being hit by equipment/materials, exposure to welding sparks, and potential infection due to the inhalation of dust from the cut ceiling.

Permatasari and Nurisusilawati conducted research aiming to identify potential hazards within the production process of Plant 1 at PT Perhutani [16]. The study involved hazard risk level calculations using the risk matrix and proposed hazard prevention strategies using the HAZOP method. Observations revealed 18 potential hazards and 27 potential hazard risks across 12 work processes within Plant 1 of PT Perhutani Pine Chemical Industry. Using the HAZOP method, the calculated risk levels were 11% for extreme hazards, 26% for high-level risks, 30% for medium-level risks, and 33% for low-level risks. The proposed improvements include developing a worksheet detailing the use of Personal Protective Equipment (PPE) in the work area to familiarize workers with potential hazards. Additionally, creating comprehensive Standard Operating Procedures (SOPs) for PPE usage and providing adequate awareness sessions to workers about potential hazards within each work process. It is recommended that the company enhances the work environment to effectively mitigate the risks associated with potential hazards.

The research conducted by Redana and Oktiarso [17] aims to investigate the causes of work accidents within the company. This endeavor emphasizes the need to prevent both work accidents and occupational diseases, and one effective approach for achieving this is through risk analysis. The HIRARC method (Hazard Identification, Risk Assessment, and Risk Control) is employed, encompassing three stages: hazard identification, risk assessment, and the determination of control measures based on the gathered data. Hazard identification involves conducting interviews and observations among employees and industrial house owners. Subsequently, risk assessment is executed by distributing questionnaires to evaluate the likelihood and severity of potential risk occurrences.

The research conducted by Indrayani et al. [18] aims to prevent potential hazards within a specific activity. This study relies on primary and secondary data sources gathered through interviews, observations, and documentation. Employing the HIRARC method, the research encompasses hazard identification, risk assessment, and risk control. The outcomes of the risk assessment identified 20 hazards across 10 processes in tofu production activities, classified as 40% low risk, 25% medium risk, 35% high risk, and 0% extreme risk. Given the absence of risks in the extreme category, the study prioritizes controlling the highest-risk area, identified as low risk. The suggested risk control measures for each activity involve the use of Personal Protective Equipment (PPE) and adjusting body positions to mitigate ergonomic risks.

Research conducted by Imran [19] aimed to identify potential hazards, assess their risk levels, and implement control measures using the HIRA method, which involves hazard identification, risk assessment, and risk control. This research was observational in nature. Primary data were gathered through observations and interviews, presented in tabular form, and then analyzed descriptively. The findings revealed 10 hazards within the billet production process in the smelting area, resulting in 23 risks associated with accidents and occupational diseases across three work activities. According to the assessment, among these 23 risks, 6 were categorized as low level, 12 as medium level, and 5 as high level. While the company had implemented several measures to mitigate these risks, there were some control efforts yet to be carried out, including replacing furnace types, employing material handling in specific activities, isolating noise sources within rooms, and enforcing work procedures and the use of Personal Protective Equipment (PPE).

Research conducted by Hidayat [20] aimed to address the causes of work accidents during fiber optic network installation using the FTA method. The study identified several factors contributing to work accidents, including workers' discomfort or heat-related issues leading to their reluctance in using Personal Protective Equipment (PPE). Additionally, the company's leniency in enforcing regulations regarding PPE usage and workers' lack of attentiveness during work were highlighted as contributing factors. To mitigate these risks, the study proposed several risk control measures, such as mandating the use of body safety harnesses for tasks at heights, conducting Occupational Health and Safety (OHS) training, supplying complete PPE kits to support project work at PT Mitra Karsa Utama, ensuring the use of helmets, safety shoes, and other necessary protective gear, providing safety briefings before work, and equipping workers with test pen tools to detect electricity early during tasks.

Long-term research plans in occupational health and safety will utilize the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method, specifically integrating Human Factor Analysis and Psychosocial Factors. This involves examining human elements like fatigue, stress, and motivation, which

significantly impact workplace safety. Identifying psychosocial factors contributing to risks will also be a focus.

Another significant aspect will be Safety Awareness and Culture Enhancement. The goal is to assess how this research can enhance safety consciousness and foster a safer workplace culture, employing effective educational and communication strategies.

The contributions of research employing the HIRARC method lie in its ability to meticulously identify potential workplace hazards, granting a comprehensive understanding of the risks worker's encounter. Risk analysis outcomes from the HIRARC method facilitate strategic planning for preventive measures, including hazard reduction, risk elimination, and effective risk management.

Specifically, this study aims to identify hazards within the sulfuric acid production department's work activities, assess the risk of work-related accidents, and utilize the HIRARC method for risk control. The goal is to provide comprehensive recommendations for improving company management.

2. Material and method

This research was conducted at PT Timuraya Tunggal. The type of research used uses a qualitative descriptive approach. There are two data sources used in this study, namely primary and secondary data. Primary data consists of likelihood and severity assessments and identified potential hazards and risks, obtained directly through observations and documentation conducted in the sulfuric acid production section at PT Timuraya Tunggal. While secondary data, consisting of company profiles, as well as from literature studies of journals and books related to research. The collected data is then processed using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method. See Fig. 1 for research flowchart.

2.1. Problem formulation

By looking at the potential hazards and the number of work accidents in the sulfuric acid production section, it is necessary to conduct hazard identification analysis, risk assessment, and risk control with the Hazard Identification Risk Assessment and Risk Control (HIRARC) method.

2.2. Metode Hazard Identification, Risk Assesment and Risk Control (HIRARC)

HIRARC is a process that explains the possibility of potential hazards, including the level of occurrence, level of danger to conduct a control evaluation of every potential loss and injury that occurs. Meanwhile, according to HIRARC, it has become fundamental to the practice of planning, management, and application of risk management. The application of the HIRARC method in the implementation of Occupational Safety and Health in the work environment can be done in 3

stages, namely hazard identification, risk assessment and risk control.

2.2.1. Hazard Identification

Hazard Identification is a process that can be done to recognize all situations or events that have the potential to cause accidents and occupational diseases that may arise in the workplace. Hazard identification is carried out with the aim of knowing the potential hazards of a material, tool, or system.

2.2.2. Risk Assessment

After all risks are identified, a risk assessment is carried out. Risk assessment is an analytical process to assess risk and identify control measures needed to eliminate or reduce existing risks to remain within tolerance limits. Every potential hazard found at the hazard identification stage will be carried out a risk assessment to determine the risk rating of these hazards. The equation for calculating risk assessment can be seen in Eq. (1).

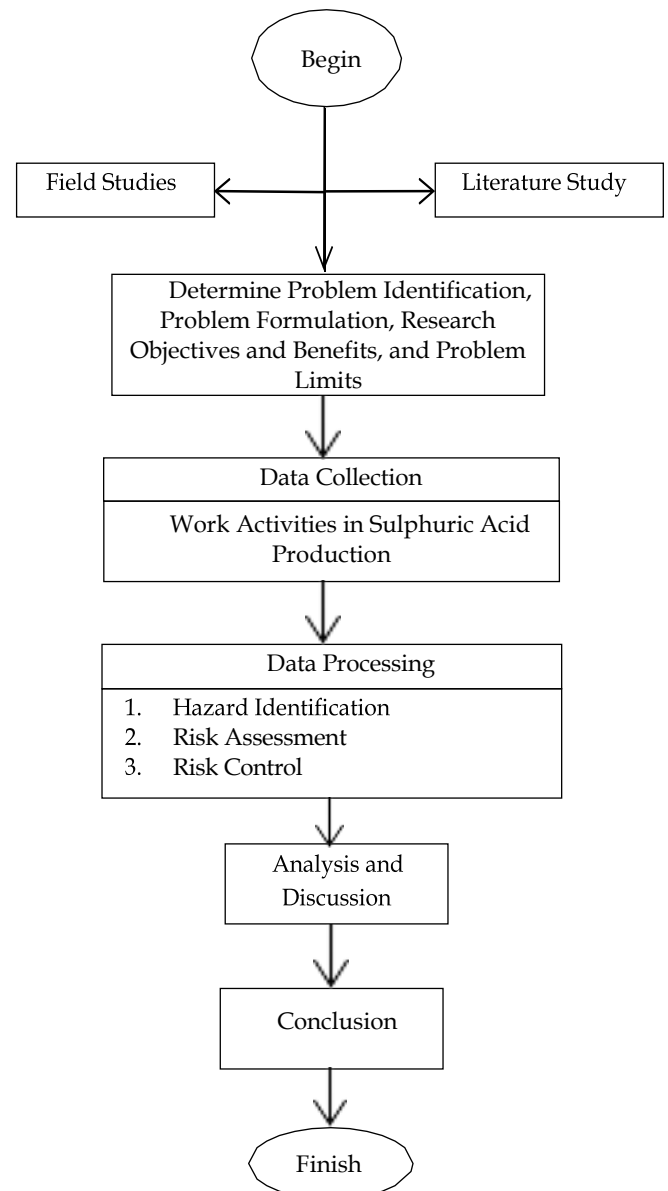


Figure 1. Flowchart research

Table 1.
Likelihood scale table [21]

Likelihood (L)	Explanation	Rating
Most likely	The probability of danger is very high	5
Possible	The probability of occurrence is high and common	4
Conceivable	May occur at any time in the future	3
Remote	Never happened for many years	2
Inconceivable	Impossible to happen and never	1

Table 2.
Severity scale table [21]

Severity (S)	Explanation	Rating
Catastrophic	Mortality rates are numerous, property damage is irreversible, and productivity is lost	5
Fatal	About one death occurred, and huge property damage	4
Serious	Wounds that are not fatal, but cause permanent disability	3
Minor	Wounds that are not permanent but causing the sufferer to be unable to do anything	2
Negligible	Abrasions, bruises, cuts, and cut-type wounds first aid	1

Table 3.
Matrix risk table [21]

Likelihood (S)	Severity (S)				
	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Table 4.
Action table [21]

Risk	Information	Action
15-25	Tall	High risk requires rapid action to control existing hazards
5-12	Keep	Moderate risk requires a pre-planned approach to dealing with hazards and taking interim measures if needed
1-4	Low	Low risk can be taken for granted and harm reduction is not considered essential.

Table 5.
Hazard Identification and Risk Assessment of burner process

Hazard Identification	Risk	Risk Assessment		
		K	P	TR
Hot temperature	Dehydration, too much sweating	2	2	4
	Burns due to contact with the body burner	2	3	6
The release of SO ₂ gas is exposed to the environment	Dizziness, nausea, respiratory distress, decreased concentration	3	3	9
	Air pollution to the environment	4	3	12

Risk is a combination of severity and likelihood of a dangerous event. The equation for calculating risk can be seen as follows

$$\text{Risk Rate} = \text{Likelihood} \times \text{Severity} \quad (1)$$

Likelihood means the probability of an event occurring in a certain period or under certain conditions. The degree of possibility of danger is found in Table 1. Severity means the result of an event such as the severity of human injury, damage from certain property or environmental damage that occurred. The severity scale is found in Table 2. Once likelihood and severity are determined, the risk level can be

determined by multiplying likelihood and severity. The results are used to determine the level. The risk is based on the risk matrix. The risk matrix is in Table 3. The results of the level of risk obtained are used as a basis for determining actions to be taken in dealing with hazards in the work environment, explaining the actions taken based on the level of risk contained in Table 4.

2.2.3. Risk Control

Risk control is the elimination or disabling of hazards so that they do not pose a risk to workers in the work area or while using work equipment. The danger

must be controlled on the source of the hazard found, and the closer to the source of the danger, the better. The choice of risk control method includes several things, namely:

- Evaluate and select short and long-term controls.
- Implement short-term controls to protect workers until permanent controls are established.
- Implement long-term controls when possible.

3. Results and discussions

The results and discussion explain in more detail about the data that has been obtained by observation and documentation which is then processed using the HIRARC method consisting of hazard identification, risk assessment, and risk control.

3.1. Hazard Identification

Hazard identification is carried out based on direct observation to the field by looking at work activities on sulfuric acid production carried out by operators in the *burner* process, then discuss with field supervisors who are one of the K3 experts at PT Timuraya Tunggal. Discussions with field supervisors or OHS experts are carried out to strengthen researchers in identifying potential hazards and risks that occur. The results of identifying potential hazards in the work activities of sulfuric acid production in the Burner process are shown in Table 5.

Table 5 shows two potential hazards identified from sulfur combustion in the burner process. Potential accidents in the combustion process can occur in the activities of entering raw materials into the furnace, checking the process, etc. that the potential for this accident does not yet exist, but it is possible that it will occur in the future if there is no current subscription. Furthermore, a risk assessment is carried out on the potential hazards found.

3.2. Risk Assessment

This risk assessment uses the ISO 31000 Risk Rating Matrix approach as used at PT Tunggal Timuraya. The assessment with the ISO 31000 Risk Rating Matrix approach discusses the severity, probability and level of risk as shown in Table 6. PT Timuraya Tunggal has made risk control efforts for potential hazards that exist in the burner process, including avoiding área burners if not necessary, installing guardrails, wearing respirator masks, scubbers, and using caustic soda for neutralization. Thus, in this study, an assessment of the remaining risks of the control efforts that have been implemented. Risk assessment in the burner process is shown in Table 5. From the calculation results, there were 2 cases of potential hazards in the burner process, 1 acceptable risk, then 2 moderate risk, and 1 high risk.

3.3. Risk Control

Risk control is a step to minimize potential hazards contained in the work environment. Control of potential hazards based on the results of priority scales in the risk control hierarchy. Hierarchy or methods carried out to control risk, including elimination, substitution, engineering engineering, administration, and personal protective equipment (PPE). again,ext stage after control is carried out, the risk assessment again to determine the level of risk after control can be seen in Table 7. From the results of the risk assessment again, after control. Hot temperatures have a severity value of 2 chance value 1 risk level value 2 so that the risk level is trivial (low), and has a severity value of 2 chance value 2 risk level 4 so that the risk level is acceptable (acceptable), SO₂ gas exposed to the surrounding environment has a severity value of 3 chance value 2 risk level 6 so that the risk level is moderate (medium) and has a severity value of 4, chance value 2, risk level value 8 so that the risk level is moderate (medium).

Table 6.
Risk level description

Risk		Necessary Actions
Category	Rating	
Tivial	1-2	No action required.
Acceptable	3-5	No additional action is required. Requires monitoring (patrol) to ensure existing controls are maintained.
Moderated	6-9	Must take measures to lower the level of risk. Risk reduction measures should be applied within 12 months.
Substantial	10-15	Must take measures to lower the level of risk. Risk reduction measures should be applied within 6 months Work should not be carried out until the risk level is lowered. The use of resources can be allocated in lowering risk.
Unacceptable	16-25	When risks involve ongoing work, immediate action needs to be taken. If the risk is impossible to reduce even with unlimited resources, the work is stopped and should not be carried out (within 7 days, minimum administrative control must be carried out)

4. Conclusions

Based on the results and discussion of this study, it can be concluded that there are two potential hazards identified from the burner process at PT Timuraya Tunggal with 1 low risk, 2 moderate risk, and 1 high risk. Control recommendations given to the burner process are administrative control in the form of avoiding área burner if unnecessary, installing

guardrails, wearing respirator masks, scubbers and the use of caustic soda for SO₂ neutralization. While the recommended control for the burner process gives a warning sign 'hot surfaces do not touch'.

Table 7.
Risk level description

Current Control	Risk After Control			Risk Level
	K	P	TR	
Avoid the burner area unnecessarily	2	1	2	Trivial
Installation of guardrails	2	2	4	Accepted
Wearing a respirator mask	3	2	6	Moderate
Scrubber, use of caustic soda for SO ₂ neutralization	4	2	8	Moderate

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