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Job Safety Analysis of Repair Multi-Media Filter (Confined Space) in Agribusiness and Industry Sector

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ABSTRACT

Working in confined spaces is inherently more dangerous than in other environments due to the various unexpected components and factors that must be assessed when identifying hazards. Job Safety Analysis (JSA) effectively identifies risks in non-routine operations and prevents accidents. This study aims to analyze and minimize the risks associated with repair work on the Multi-Media Filter (MMF) confined space tank in the Agribusiness and Industry Sector. The method employed is a descriptive observational Job Safety Analysis, with data collected on work stages, potential hazards, control methods, and hazard ratings for each job. The MMF tank repair work in confined spaces involves eight activities, with 27 identified hazards and risks. Of these, two jobs (15%) fall into the low-risk category, while six jobs (85%) are classified as medium risk; no high-risk jobs were found. The MMF tank repair work presents medium and low risks for each job. Workers can safely carry out the repair work, as no high-potential hazards were identified, ensuring their safety. It is recommended that the JSA be periodically updated, involving workers in the evaluation process to ensure continuity and relevance.

Keywords: Job safety analysis, Confined space, Repair, Work accident

INTRODUCTION

Industrial processes have two operating modes: non-routine operations and routine operations. For instance, everyday tasks like facility inspections, pressure regulation, and other things are part of normal operations at a gas transmission station. Li et al. (2018) state that non-routine activities include pigging, ventilation, and gas transmission start and stop times.

A room big enough and configured so employees may enter and operate inside is called a restricted area or confined space. Aside from that, it is not intended to operate constantly and has restricted access for entry and departure. Additionally, it may have hazards that endanger employees' lives or possibly cause them to pass away (Mardlotillah, 2020).

Due to the numerous unknown elements and factors that need to be considered when searching for dangers, working in confined spaces is more hazardous than working in other situations. Furthermore, circumstances are subject to sudden changes and unforeseen deterioration. Rescue teams' ability to respond to emergencies is further hampered by this, endangering their lives (Botti et al., 2018). According to Botti et al. (2015), there are seven primary causes of accidents in confined spaces: asphyxiation, poisoning, oxygen deprivation, drowning, explosion, and electric shock. Physical dangers account for 49% of deaths caused by entering restricted places, whereas atmospheric hazards account for 62% of deaths (Selman et al., 2018).

Despite international laws, attempts to develop safe work practices, and guidelines for working in confined spaces, the incidence of fatal accidents in these environments is rising (Burlet-Vienney et al., 2015). To establish suitable risk management, hazards can be defined as the probability and likelihood of damage or harm to health in hazardous settings.(Burlet-Vienney et al., 2015). Hazardous environments, fires, explosions ingesting freely-flowing solids or liquids, and other physical risks like falling from a height or becoming stuck in machinery are among the causes of events that cause mortality (Selman et al., 2019)

Doing a risk assessment of confined spaces and removing potential hazards before workers enter are essential to lowering the frequency of incidents (Cheng et al., 2023). In addition to regionally specific international guidelines and requirements for working in tight spaces

(Mohammad et al., 2018). Recently, several initiatives have been launched to assist practitioners in fulfilling safety regulations. These initiatives include identifying restricted spaces, risk assessment, and rescue (Botti et al., 2022; Burlet-Vienney et al., 2015; Selman et al., 2019).

Since understanding the elements that cause accidents is crucial for successful prevention, accident analysis is becoming increasingly popular as a technique for accident prevention. Vasconcelos & Junior (2015) also state that it aids in risk management. Risk assessment and identification are crucial components of safety management.

One of the most significant on-site risk management techniques for high-risk operations is job safety analysis (JSA), which uses a straightforward, organized team approach to identify the dangers connected to each stage in a project or activity and create suitable countermeasures. Practical risk-reduction techniques to get around this. Reduce or eliminate the risk (Zheng et al., 2017). To detect hazards in operational processes, especially non-routine activities, and avoid accidents, job safety analysis (JSA) is a valuable tool (Zheng et al., 2017).

JSA, also known as safe job analysis (SJA), task hazard analysis (THA), and job hazard analysis (JHA), is a process of methodically and consistently assessing qualitative risk (often restricted to hazard identification) for dangerous activities. Progressively take into account every risk connected to a certain work assignment. Using a more straightforward methodology, this adheres to the risk assessment concepts outlined in ISO 31000 Risk Management 2009.

To enable the implementation of steps to remove or manage risks, JSA can identify and evaluate all risk aspects related to work (Kjellen & Albrechtsen, 2017). According to studies by Yoon et al. (2011), the primary advantage of JSA is that it is a straightforward technique that aids in drawing attention to the risks associated with dangerous procedures. Working with JSA gives managers and staff insight into task-specific dangers. The advantage of JASA is that it is easy to use and directly related to operative work tasks. Involving employees in the development of the analysis can foster a better awareness of occupational safety and a higher sense of ownership over the decisions made (Rausand, 2011).

This research will be arranged into many analytical phases, encompassing data gathering, qualitative and quantitative analysis, and suggestions for subsequent measures. It is intended that the research's findings would offer helpful new information to improve workplace conditions, particularly for Multi-Media Filter Repair in (restricted space).

METHODS

Research Design

This study was conducted in the MMF tank repair area using a descriptive observational study design with Job Safety Analysis (JSA). The JSA method was employed to identify and control high-risk tasks at each step of the tank repair work or activities.

Population and Sample

The study population consisted of all workers involved in the repair process: 4 technicians, 2 operators, and 2 supervisors or safety team members, totaling 8 workers. The sample was randomly selected from the population using simple random sampling, ensuring equal selection opportunities for each element. The sample included 4 individuals from each role involved in the MMF tank repair.

Data Collection Techniques

The data collected consisted of both primary and secondary sources. Primary data were obtained through interviews with technicians, operators, supervisors, and the safety team in the agribusiness and industry sector to clarify and cross-check observational data. Secondary data required for the study included Standard Operating Procedures (SOPs) for confined space entry, emergency response SOPs for confined space entry, and modules related to working in confined spaces.

Data collection involved observing each task performed, with evaluations made using JSA documentation. Data collected included work stages, potential hazards, control measures, and hazard ratings for each task, all gathered through secondary data collection.

Data Analysis Techniques

Data analysis commenced by identifying the work steps involved in tank maintenance, drawing on observations, and interviews with maintenance workers. Once the work steps were identified, the next phase focused on recognizing the risks and potential consequences of each maintenance task. A risk assessment was conducted using a risk matrix that evaluated the likelihood and severity of each potential hazard. The resulting values were classified into three hazard levels: low, medium, and high, allowing for the prioritization of hazard control measures.

The collected hazard identification data were subsequently compared against relevant standards, regulations, and theories related to Occupational Health and Safety (OHS) practices in confined spaces. Recommendations for controlling hazards during the tank maintenance process were documented in the Job Safety Analysis (JSA) to enhance worker safety. The decision-making process adhered to applicable regulations, including the Occupational Health and Safety Guidelines for Confined Spaces issued by the Directorate of Occupational Health and Safety Norm Supervision, as well as the Decree of the Director General of Labor Supervision No. 113/Kep/DJPPK/IX/2006.

A risk analysis matrix was utilized to assess the degree of likelihood and consequences associated with the risk assessment process. The records from work safety analyses and interviews provided the foundation for data processing and analysis procedures, while AS/NZS 4360 (2004) served as the framework for the risk analysis table. Establishing criteria for likelihood and consequence constituted the initial steps in conducting risk assessments. A table to aid in determining risk assessment in table 1, 2 and 3.

Table 1.
Matrix of Risks

MATRIX OF RISKS	Minor (1)	Medium (2)	Serious (3)	Major (4)	Disaster (5)
Almost Absolute (5)	(M)5	(M)10	(H)15	(H)20	(H)25
Very Much Possible (4)	(M)4	(M)8	(M)12	(H)16	(H)20
Possible (3)	(L)3	(M)6	(M)9	(M)12	(H)15
Impossible (2)	(L)2	(M)4	(M)6	(M)8	(M)10
Rarely (1)	(L)1	(L)2	(L)3	(M)4	(M)5

Source: AS/NZS 4360:2004 (Ramli, 2010).

Table 2.
The Characteristics of Possibilities

Stage	Criteria	Explanation
5	Almost Absolute	Experience has shown that it occurs frequently and constantly.
4	Very Much Possible	Things happen in general
3	Possible	May happen or known is known to happen
2	Impossible	Impossible to occur in a typical situation
1	Rarely	Not expected to occur

Source: AS/NZS 4360:2004(Ramli, 2010).

Table 3.
Criteria of Consequences

Stage	Criteria	Explanation
1	Minor	There were no casualties and only a minor financial loss
2	Medium	Minor harm, minimal loss of money
3	Serious	Moderate harm, need for medical care, and significant financial loss
4	Major	Severe injuries to several people, significant financial loss, and disruption in production
5	Disaster	Death > One individual, significant losses, and a broad effect caused all activity to cease

Source: AS/NZS 4360:2004(Ramli, 2010).

RESULTS AND DISCUSSION

Eight positions in the Multi-Media Filter maintenance division are considered at risk for occupational risks based on the findings of in-depth interviews. The following are the outcomes of utilizing the Job Safety Analysis (JSA) approach to detect multi-media filter maintenance activities risks.

Table 4
Job Safety Analysis Of Repair Multi Media Filter (Confined Space) In Agribusiness And Industry Sector:

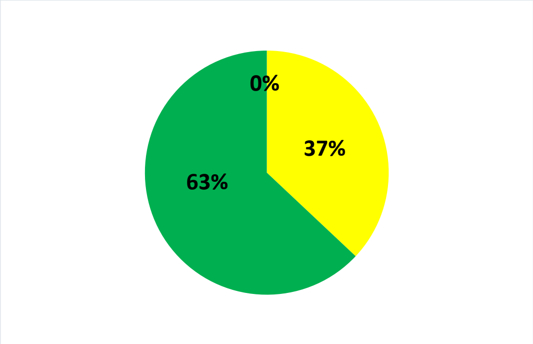
No	Work Procedures	An explanation of the risks and hazards associated with the work	Control	Residual Risks C	L	C.L
1.	Preparation of Equipment	- When getting ready supplies and equipment, hands become pinched or damaged. - Hit by the substance	- Use hand gloves - Team coordination and safety briefing - Avoid lifting objects that surpass human capabilities	3	1	3
2.	Assess the amounts of poisonous and flammable gasses	- Possible poisoning or fainting - Possibility of an explosion	- Let the air out through the manhole - Examine with a stick - Confirm again with the plant safety/EHS team - Ensure that there are no flammable or explosive items	2	2	4
3.	Move material manually	- Bruises - Muscle injury - Ripped/sliced injuries	- Use hand gloves, safety shoes, and safety work clothes - Team coordination - Use lifting gear if the weight of the material is too heavy	2	2	4
4.	Tank support removal (grinding)	- Difficult to breathe - Possibility of fire - Possibility of sparks	- Using a gas detector, determine the gas level - Ensure the tank support area is free of flammable or dangerous gasses. - Set up the fan to create circulation within the tank	4	3	12

		- The honed stone cracked - Ripped injuries - Gram-affected eyes	- Put on some lighting. - Ensure that nothing is preventing access to or from the entry or exit. - After finishing the work, close the manhole access and keep combustible and explosive objects out of the way. - Wear safety shoes, gloves, a welding hood, and a face shield - Ensure that the grinding stone's RPM exceeds the grinder's RPM. - Assure that the welding transformer and grinders have been examined.			
5.	Put in welding for tank support	- Difficult to breathe - Possibility of fire - Possibility of sparks - Radiation from light and heat - Non-standard cable setup	- Use a gas detector to check the amounts of gas. - Ensure that the tank support area is free of any flammable or dangerous gases - To create circulation in the tank, provide a blower. - Put on some lighting. - Ensure that no objects block exit access. - Block access to manholes when the work is finished. Keep explosive and flammable objects away. - Wear safety shoes, a welding hood, gloves, and a face shield. - Assure that the RPM of the grinding stone is greater than the RPM of the grinding. - Assure that the welding transformer and grinders have been examined.	4	3	12
6.	Grinding Plates (doubling plates)	- Possibility of fire - Possibility of sparks - The honed stone cracked	- Get rid of anything flammable and explosive materials. - Cover up sparks using blankets and fire extinguishers available at the work site. - Put on a face shield, gloves, and safety shoes, and make sure the engine speed is higher than the RPM of the grinding stone.	2	2	4
7.	Doubling tank	- Non-standard cable set-up - Radiation from heat - Gas cylinder leak - Welding radiation - Possibility of sparks - Suffered from electric shock	- As PUIL rules require, ensure the cable is free of rips and faults. - Check that the tube supply agent is certified to use pressure vessels. - Connect a chain to the tube with the stamp and place it on the self. - Ensure workers wear long sleeves, gloves, face shields, and aprons. - There is a flashback on the tube. - Wear an apron and welding hood or face shield. - Close the valve first if the flow can be controlled. - Make sure that grounding is implemented to prevent current leakage.	4	3	12
8.	Housekeeping area	Stumbling and slipping on materials	- Use hand gloves - Sort rubbish by kind and place it in the appropriate disposal location. - After the work is done, tidy up the area where you work.	3	1	3

Source: Primary Data, 2023

The job activities, risk factors for hazards, and suggested controls are listed in the table above. The procedures followed during the repair of the Multi-Media Filter provided critical findings for the research. The study examined job safety analysis (JSA), standard operating procedures (SOPs) for confined space entry, emergency response related to confined space work, and work modules in confined spaces within the agribusiness and industry sectors. Additionally, interviews were conducted with tank maintenance workers and the Environmental Health and Safety (EHS) personnel responsible.

In the maintenance operations of the Multi-Media Filter, this research identified eight task categories with a total of 28 potential risks. The risk evaluation revealed three levels: high, medium, and low. The findings indicated that low risk constituted 63%, medium risk 37%, and no high-risk activities were identified (0%).



Source: Primary Data, 2023

Figure 1. Diagram of Risks Category

Multi-media filter repairs are made to make sure the tank's state meets predetermined guidelines. According to the results of the EHS interviews, before the commencement of work, they had examined the risks associated with repairing the Multi-Media Filter; this was done to reduce the likelihood of work-related incidents. The study results indicate eight work phases, each with varying degrees of risk. Because all of the work is done by hand and part of it is accomplished in cramped areas, there is risk involved with every analysis. Job analysis in the given format:

Preparation of Equipment

The initial duty is equipment preparation, which is done to ensure the instruments that will be utilized for the Multi-Media Filter repair job are safe and can be used properly. One of the most important initial steps to success and efficiency in a project is to prepare the equipment before beginning work. According to Smith (2018) asserts that thorough equipment preparation can lower the possibility of mistakes and boost output. In line with Jones (2019) makes the case that there is a connection between job safety and equipment preparation, stressing that being well-prepared can lower the likelihood of mishaps. A system approach explains the idea of an efficient pre-work equipment preparation paradigm. According to Williams (2020), an equipment preparation system has to consider things like resource availability, regular maintenance, and the completeness of the equipment. This concept develops a comprehensive framework for comprehending and putting pre-work equipment preparation into practice.

Assess the Amounts of Poisonous and Flammable Gasses

Conducting inspections before workers enter the confined space area is necessary to ensure no poisonous or flammable gasses are present. The confined space area has a single exit and is a small work area. Monitoring the concentrations of combustible and poisonous gases to determine the proportion of each gas in the space or workplace is crucial for preventing hazardous situations that might endanger employee health or safety. The low oxygen levels in cramped areas can lead to respiratory issues and lightheadedness in workers, which is one of the risks (Sulardi & El-Ridho, 2019). Vallero (2019) states that acute poisoning resulting from the entry of a specific dose of a toxic substance into the body through ingestion, skin contact, or inhalation is a significant health issue associated with chemical exposure. Examples of acute poisoning include exposure to hydrogen sulfide (H_2S) and carbon monoxide (CO), which can occur at dangerous levels and may lead to severe outcomes, including death and incapacitation. Carbon monoxide poisoning can present initial symptoms such as headaches and shortness of breath, which may progress to severe dizziness, disorientation, and loss of vision and hearing. In cases of severe poisoning, fainting can occur, potentially leading to death (Holt & Berge, 2018).

Move Material Manually

Work activities, including lifting, pushing, tugging, carrying, transporting, or holding an object, are examples of manually moving materials. Manually carrying items to the work site makes it easier for staff to do their tasks in a restricted environment. This is done because work carried out in tight spaces has limited access. As a result, the necessary supplies must be carefully prepared so that personnel do not spend extended periods working in a small space. The American Material Handling Society defines material handling as an art and science comprising handling, moving, packaging, storing, and managing goods in all forms (Corlett et al., 1987). According to Monica & Chandra (2022), Any task applying MMHs may have a significant risk of work-related injuries. Workers may suffer losses or even be injured due to improper MMH operations. Musculoskeletal diseases are one of the outcomes of poor MMH activity.

Tank Support Removal (Grinding)

Tank support removal is a crucial component of tank operation and design that impacts the system's effectiveness, safety, and performance. Removing the physical supports, such as support structures and other supporting systems, affixed to the tank is called "tank support removal." The choice of support release design significantly impacts tank maintenance and upkeep. The removal of tank support influences personnel and operational safety factors in addition to productivity. Using the appropriate attachments for HDPE chemical tanks may significantly improve operating safety, maintenance effectiveness, and overall system performance (Mulyono et al., 2017).

Installation of Tank Support (Welding)

An essential component of tank construction and operation is the installation of tank support. Installing and modifying different supporting components to ensure the tank operates at its best is conceptually included in tank support installation. Tank support installation is a crucial component of tank construction and operation, claim (Prasutiyon et al., 2021). Proper tank support installation guarantees the tank's stability and safety and guards against damage to the tank, equipment, and accessories. It is critical to adhere to the manufacturer's handling, installation, and usage instructions to prevent any issues.

Grinding Plates (Doubling Plates)

"Double plate" refers to reinforcing a building's structure by adding additional plate layers. This approach is mainly utilized in structural engineering to enhance a plate or structure's strength, stability, and durability. In addition to improving structural strength, doubling plates positively impacts the stability and longevity of a construction. Doubling plates are also effective for controlling leaks in sulfur storage tanks, whether in operation or no longer functioning (Bahari et al., 2018). In emergencies, this technique serves as a highly useful repair strategy.

Doubling Tank

Doubling a tank refers to the concept of expanding its capacity through the addition of new structures or internal design modifications. Conceptually, doubling involves enhancing the tank's carrying capacity, safety, and operational efficiency. In addition to increasing capacity, tank doubling affects operational capabilities and mobility. Moreover, enclosing the primary storage tank within an adequately constructed outer tank provides enhanced protection against chemical leaks that can endanger workers and the environment (Ghorbani et al., 2020). Consequently, the outer shell contains any chemical leaks from the inner tank.

Housekeeping Area

Workplace cleaning, often called cleaning the work area, is maintaining an organized workspace. Conceptually, it involves tactics, approaches, and protocols to ensure a tidy and orderly environment. Beyond mere appearance, workplace cleanliness directly affects employee safety, health, and productivity. Factors influencing the cleaning process include the workspace arrangement, the tasks' nature, and corporate policies. To maintain order and cleanliness and prevent accidents, personnel must clean the work area after completing tasks and using any remaining materials when Huda (2021) examined variables linked to work accidents on building construction projects at PT. X in 2020, they found that tripping was one of the most common causes of accidents. The study also noted that dangerous behaviors, such as sleepiness, joking, disturbing other employees, and rushing to work, contributed to these incidents.

CONCLUSION

Based on the results table, the repair work on the Multi-Media Filter (MMF) tank has been assessed as having medium to low-risk levels for each task. Since there are no high-potential hazard risks, workers can safely carry out the work. The Job Safety Analysis (JSA) for repairing MMF tanks demonstrates that the primary objective of identifying and controlling potential hazards has been achieved through implementing adequate safety measures. This study significantly contributes to developing knowledge in occupational safety, highlighting the importance of a proactive approach to risk management in the industry. The benefits of this study for workers include creating a safer work environment, which can reduce workplace accidents and enhance worker welfare.

SUGGESTION

The work on the Multi-Media Filter (MMF) tank focuses on identifying specific hazards related to operations, inspections, and maintenance, particularly concerning chemical exposure (medium risk) and ergonomic injuries (low risk). First, schedule regular updates to the Job Safety Analysis (JSA) to capture any changes in the work environment or new procedures within the risk assessment. This practice ensures that safety measures remain relevant and practical. Second, employees should be involved in hazard assessments by developing strategies that actively engage them in risk assessments, such as training sessions or regular discussions about workplace risks. This approach raises safety awareness and empowers employees to play an active role in risk mitigation. Third, safety monitoring technology should be used by implementing software or apps for digital tracking and updating the JSA, making access and updates more efficient for all parties involved.

REFERENCES

Bahari, T., Uemura, H., Katsuura-Kamano, S., Yamaguchi, M., Nakamoto, M., Miki, K., & Arisawa, K. (2018). Nutrient-derived dietary patterns and their association with metabolic syndrome in a Japanese population. *Journal of Epidemiology*, *28*(4), 194–201. [Crossref], [Publisher]

Botti, L., Duraccio, V., Gnoni, M. G., & Mora, C. (2018). An integrated holistic approach to health and safety in confined spaces. *J. Loss Prev. Process Ind*, *55*, 25–35. [Crossref], [Publisher]

Botti, L., Duraccio, V., Gnoni, M. G., & Mora, C. (2015). A framework for preventing and managing risks in confined spaces through IOT technologies. *Safety and Reliability of Complex Engineered Systems- Proceedings of the 25th European Safety and Reliability Conference. ESREL*, 3209–3217. [Crossref], [Publisher]

Botti, L., Mora, C., & Ferrari, E. (2022). Design of a digital tool for the identification of confined spaces. *J. Loss Prev. Process Ind*, *76*, 104731. [Crossref],

[Publisher]

Burlet-Vienney, D., Chinniah, Y., Bahloul, A., & Roberge, B. (2015a). Design and application of a 5 step risk assessment tool for confined space entries. *Saf. Sci*, *80*, 144–155. [Crossref], [Publisher]

Burlet-Vienney, D., Chinniah, Y., Bahloul, A., & Roberge, B. (2015b). Occupational safety during interventions in confined spaces. *Saf Sci [Internet*, *79*, 19–28,. [Crossref], [Publisher]

Cheng, L., Xie, Z., Qin, X., Tang, D., Li, L., & He, Y. (2023). A mobile sensing system for future gas mapping in confined space using an olfactory quadruped robot. *Measurement: Journal of the International Measurement Confederation*, *213*(August 2022). [Crossref], [Publisher]

Corlett, E. N., Eklund, J. A. E., Reilly, T., & Troup, J. D. G. (1987). Assessment of workload from measurements of stature. *Applied Ergonomics*, *18*(1), 65–71. [Crossref], [Publisher]

Ghorbani, B., Miansari, M., Zendehboudi, S., & Hamedi, M. H. (2020). Exergetic and economic evaluation of carbon dioxide liquefaction process in a hybridized system of water desalination, power generation, and liquefied natural gas regasification. *Energy Conversion and Management*, *205*, 112374. [Crossref], [Publisher]

Holt, S. P., & Berge, N. D. (2018). Life-cycle assessment of using liquid hazardous waste as an alternative energy source during Portland cement manufacturing: A United States case study. *Journal of Cleaner Production*, *195*, 1057–1068. [Crossref], [Publisher]

Huda, N. (2021). Faktor-Faktor Yang Berhubungan Dengan Kecelakaan Kerja Pada Proyek Pembangunan Gedung Di PT.X Tahun 2020'. *Jurnal Kesehatan Masyarakat*, *9*(5), 652–659. [Crossref], [Publisher]

Jones, R. (2019). Keamanan Pertama: Peran Persiapan Peralatan dalam Keselamatan Kerja. *Tinjauan Kesehatan Kerja*, *22*(3), 78–94.

Kjellen, U., & Albrechtsen, E. (2017). *Prevention of Accidents and Unwanted Occurrences: Theory, Methods, and Tools in Safety Management*. CRC Press. [Crossref], [Publisher]

Li, W., Cao, Q., He, M., & Sun, Y. (2018). Industrial non-routine operation process risk assessment using job safety analysis (JSA) and a revised Petri net. *Process Safety and Environmental Protection*, *117*, 533–538. [Crossref], [Publisher]

Mardlotillah, N. I. (2020). Manajemen Risiko Keselamatan dan Kesehatan Kerja Area Confined Space. *Higeia Journal of Public Health Research and Development 315-327. Martono*, *03*(1), 58–66. [Publisher]

Mohammad, R., Amin, Z., Othman, N., Chelliapan, S., Amrin, A., & Aziz, S. (2018). *Recent Review on Legislations Related to Risk Assessment for Confined*.

Mulyono, T., Legono, D., & Suharyanto, S. (2017). *Model Tangki Untuk Prediksi Debit Sedimen Pada Daerah Aliran Sungai*. [Publisher]

Prasutiyon, H., Semin, & Pinto, F. (2021). *BAHAN BAKAR KAPAL*. Penerbit NEM. [Publisher]

Ramli. (2010). Identifikasi Bahaya dan Penilaian Risiko K3 Pada Tindakan Perawatan dan Perbaikan Menggunakan Metode HIRARC pada PT. X. *Seminar Nasional Riset Terapan*, *July*, 281–286. [Publisher]

Rausand, M. (2011). *Risk Assessment. Theory, Methods and Application*. Wiley. [Crossref], [Publisher]

Selman, J., Spickett, J., Jansz, J., & Mullins, B. (2018). An investigation into the rate and mechanism of incident of work-related confined space fatalities. *Saf. Sci*, *109*, 333–343. [Crossref], [Publisher]

Selman, J., Spickett, J., Jansz, J., & Mullins, B. (2019). Confined space rescue: A proposed procedure to reduce the risks. *Saf. Sci*, *113*, 78–90. [Crossref], [Publisher]

Smith, A. (2018). Pemahaman Mendalam terhadap Persiapan Peralatan: Panduan Praktis. *Jurnal Efisiensi Kerja*, *15*(2), 45–62.

Sulardi, S., & El-Ridho, N. K. (2019). Hazard identification and prevention methods on work in confined spaces. *IDENTIFIKASI*, *5*(2), 142–151. [Crossref], [Publisher]

Vallero, D. A. (2019). A Systems Approach to Waste Management. In *Waste* (pp. 15–32). Academic Press. [Crossref], [Publisher]

Vasconcelos, B., & Junior, B. B. (2015). The Causes of Work Place Accidents and their Relation to Construction Equipment Design. *Procedia Manufacturing*, *3*(Ahfe), 4392–4399. [Crossref], [Publisher]

Williams, C. (2020). Pendekatan Sistem terhadap Persiapan Peralatan: Kerangka dan Strategi Implementasi. *Jurnal Manajemen Operasional Internasional*, *35*(4), 112–130.

Yoon, I. K., Seo, J. M., Jang, N., Oh, S. K., Shin, D., & Yoon, E. S. (2011). A practical framework for mandatory job safety analysis embedded in the permit-to-work system and application to gas industry. *J. Chem. Eng. Jpn*, *44*(12), 976–998. [Crossref], [Publisher]

Zheng, W., Shuai, J., & Shan, K. (2017). The energy source based job safety analysis and application in the project. *Safety Science*, *93*, 9–15. [Crossref], [Publisher]