GRINDER RISK ASSESSMENT IN FABRICATION UNIT

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ABSTRACT

Production activities of variouswork are done in a fabrication unit and can lead to occupational accidents, for instance, accidents in the grinding process. The grinding process results in inevitable potential hazards and risks that must be controlled to minimize the occurrence of accidents. This study assessed the risk of grinding process in the fabrication unit of X Ltd., Surabaya. This study was an observational descriptive study with a cross-sectional design. The primary data were collected through interviews and observations, while the secondary data were obtained from the company's document. The risk identification showed 21 hazards in the grinding process. Based on the risk assessment, these hazards were classified into 13 low risks, 5 medium risks, and 3 high risks. The high risks were found during the wheel rotation, grinding sparks, and material falls.

Keywords: grinding, hazard identification, risk assessment.

ABSTRAK

Kegiatan produksi dari berbagai macam jenis pekerjaan kebanyakan dilakukan di unit fabrikasi dan dapat menimbulkan kecelakaan kerja, contohnya penggerindaan. Pekerjaan penggerindaan dalam prosesnya tidak lepas dari adanya potensi bahaya dan risiko yang harus dikendalikan untuk meminimalisir terjadinya kecelakaan kerja. Penelitian ini bertujuan untuk melakukan risk assessment pada pekerjaan penggerindaan di unit fabrikasi PT. X, Surabaya. Penelitian ini merupakan studi deskriptif observasional dengan desain studi potong lintang. Data primer diperoleh melalui hasil wawancara dan observasi, sedangkan data sekunder didapatkan dari dokumen perusahaan. Hasil penelitian menunjukkan bahwa dari identifikasi bahaya pada pekerjaan penggerindaan ditemukan 21 bahaya. Berdasarkan penilaian risiko, bahaya dapat digolongkan menjadi 13 risiko rendah, 5 risiko sedang, dan 3 risiko tinggi. Tiga tingkat risiko tertinggi pada pekerjaan penggerindaan terdiri dari putaran roda mesin gerinda, percikan gram, dan jatuhnya material.

***Kata kunci**: penggerindaan, identifikasi bahaya, penilaian risiko*

INTRODUCTION

Indonesia has diverse industrial sectors, one of which is the largest steel industry. As the Indonesian government is committed to infrastructure development, they support the foundation of strengthening the economic growth in the property, construction, and automotive sectors. As an implication, the demands for supporting products in the sectors, in this case of steel production, increased. The Indonesian Iron and Steel Industry Association (IISIA) showed an increase in the national demands of steel from 12.67 million tons in 2016 to 13.4 million tons in 2017. (Roy, 2018) also found Karakor Steel Ltd. supplied the national steel needs up to 14 million tons in 2018, marking an increase of six to seven percent from the previous-year achievement. Such demands are vital for the steel companies to spur production figures, including engagement in the construction and fabrication of steel. According to (Law Number 18 of 1999), concerning construction services, construction works constitute a whole or a series of planning or implementation along with supervision that includes the respective architectural, civilian, mechanical, electrical and environmental work to establish a building or other physical forms. To construct a building, the

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production process is required first. The production process is inseparable from labor and tools. Machine (tool) and human (worker) have a reciprocal relationship, that a machine cannot be enabled if no human operate it. In other words, if it is only human present but no machine available, the production process will not be able to run. Dangers and risks involved exist not only in the production process itself, but also each of other work processes.

In the era of industrial competition, it is required to maintain production stability. Company's stability might be interrupted due to unwanted events in the production process, such as work accident. Based on the data from the (ILO, 2013), every 15 seconds, one worker lost his life, and within a year there were 250 million work accidents, while 160 million workers suffered from occupational diseases. (Suma'mur, 2009) mentioned 2 factors, such as mechanical and environmental (unsafe condition) and human factors (unsafe action) posed work accidents. The X Ltd, located in Surabaya is an industrial company in the field of civil and steel construction. Types of work undertaken includes steel construction, plat work, general civil and mechanical works. As the company engaged in the construction and fabrication of steel, they own a fabrication unit that consists of measuring, cutting, grinding, fit-up, welding, blasting, painting, and packing. Given that many jobs are done in the fabrication unit, there are many hazards and risk sources that can cause occupational accidents. The grinding process often inflicts occupational accidents in the fabrication unit of X Ltd. Surabaya. Raids are the process of grinding or smoothing ferrous metals. Types of equipment used in the grinding process are a grinding machine, hand grinder, or hand grinders. This grinding process has imposed a considerable risk as seen in the company's accident report in 2017 where the most common occupational accident was eye injury experienced by a grinder operator in performing the grinding process. Occupational accidents ever caused disability to a grinding operator in 2014. As a result, he could not continue to work at the company. Another similar problem, that (Rochmawati,2013) based on the Safety Statistic Report at LDP Ltd. from January until March, was grinding workers in the fabrication unit commonly had an occupational accidents. During the period, eye injuries had occurred for 8 times, and finger injuries had occurred for 2 times. Therefore, it is necessary to put attention on this aspect so that the company can minimize the occurrence of accidents to grinder operators.

This study conducted a risk assessment in the grinding process in the fabrication unit of X Ltd. Surabaya. This study aimed to identify hazards and risks and conduct risk assessments.

METHODS

This study was observational research because it only performed observations by not giving an intervention to research objects. This study applied a descriptive method since it only described the objective and situation of the research objects. It used a cross-sectional design in which the data feeding and observation were carried out simultaneously at a given time. This study was conducted in the fabrication unit of X Ltd. Located in Surabaya in the grinding process from 15 August to 31 August 2018. With a total sampling technique, the samples were taken from the entire population, as many as 10 grinder operators and a occupational health and safety officer. The research object was the grinding process consisting of 3 stages; the initial stage, the grinding process, and the final stage.

The research variables included identification of hazards (physical hazards, mechanical hazards, electrical hazards, and a fire level from all three working stages), risk assessments by looking at the likelihood and severity, and finally risk evaluation. The primary data were obtained through interviews and observations on the grinder operators and occupational health and safety officer to identify the dangers and assess the risks to the grinding process. During the observation, this study employed a JSA (Job Safety Analysis) instrument sheet to facilitate the process of hazard identification and risk assessment. The hazard identification was carried out using proactive techniques through observation, interviews, and secondary data. Afterwards, the risk assessment was conducted by utilizing a useful risk analysis to determine the level of risk. The risk analysis used a semi-quantitative analysis technique multiplying the possible likelihood and severity. The multiplication between the levels of likelihood and severity was adjusted to the Risk Assessment Matrix (RAM) to obtain the risk value. The risk value was grouped into 3 risk levels, such as low risk, moderate risk, and high risk. The secondary data were retrieved from the company's documents, such as the overview and company profile, and related occupational safety and health document. This study was approved for the ethics permission from the Ethics Commission of Faculty of Public Health, Universitas Airlangga No.: 491-KEPK.

RESULT

Table 1. Possible Likelihood

Level	Criteria	Description
1	**Criteria**	**Description**
2	Rare	The danger is very small, never occurs, except for years.
3	Less Likely	Accidents may occur in certain conditions but are less likely.
4	Possible	Accidents may occur in certain conditions.
5	Likely	Accidents often occur or almost certainly occur in all conditions.

Source: US/NZS 4360:2004

Table 2. *Severity*

Level	Criteria	Description
1	Insignificant	No injuries incur, and there is small financial loss.
2	Minor	Minor injuries requiring first aid kit tools occur, and there is small financial loss.
3	Moderate	Injuries require medical treatment, and the financial loss is moderate.
4	Major	There are defects or elimination of the function of large materials, as well as body weight loss.
5	Catastrophic	Deaths and huge material loss are found.

Source: US/NZS 4360:2004

Table 3. *Risk Assessment Matrix*

		Severity				
		(1) *Insignificant*	(2) *Minor*	(3) *Moderate*	(4) *Major*	(5) *Crisis*
Likelihood	(1) *Rare*	*1*	*2*	*3*	*4*	*5*

(2) *Unlikely*	*2*	*4*	*6*	*8*	*10*
(3) *Possible*	*3*	*6*	*9*	*12*	*15*
(4) *Likely*	*4*	*8*	*12*	*16*	*20*
(5) *Almost certain*	*5*	*10*	*15*	*20*	*25*

Source: US/NZS 4360:2004

Table 4. Assess Risk value

Risk Value	Risk Level	Evaluation
1-6	Low risk	The risk is acceptable, but it is still done back again.
7-14	Moderate risk	Work can only be continued with the management authorization after the consultation with the experts and team of the assessment. If possible, hazards should be calculated to reduce the risks.
15-25	High risk	Work cannot be continued. A risk is not acceptable, and the recalculation of appropriate control should be done to reduce the risk.

Sumber: *AS/NZS 4360:200*

Hazard identification

The hazard identification and risk assessment at X Ltd, Surabaya were aimed to suppress the occupational accidents due to the grinding process. Therefore, the appropriate risk control could be conducted to prevent occupational accidents. The results of interviews and observations showed the grinding process consisted of the preparation, process, and final stages. There were 21 hazards and 21 risks identified, in which the grinding preparation had 7 kinds of hazards, the process stage had 8 kinds of hazards, and the final stage consisted of 6 kinds of hazards.

Table 5. Hazard Identification during the Grinding Process at X Ltd. in August 2018

Step Job	Potential hazards	Risk	Consequences
Grinding Preparation Phase			
	Grinding machine is not neatly arranged causing fingers pinned, bruises, and mild cuts.	Grinding machine is not neatly arranged and thus caused fingers pinned, bruises, and mild cuts.	Grinding machine is not neatly arranged causing fingers pinned, bruises, and mild cuts.
	Grinding machine can fall to legs and cause wounds and bruises.	Grinding machine can fall to legs and cause wounds and bruises.	Grinding machine can fall to legs and cause wounds and bruises.
	Sharp grinding stone causes scratches and wounds on hands.	Sharp grinding stone causes scratches and wounds on hands.	Sharp grinding stone causes scratches and wounds on hands.

Step Job	Potential hazards	Risk	Consequences
	Short circuit causes electric shocks, burns, and fire.	Short-circuiting causes electric shocks, burns, and fire.	Short circuit causes electric shocks, burns, and fire.
	Untidy cables trip workers and cause small wounds.	Untidy cables trip workers and cause small wounds.	Untidy cables trip workers and cause small wounds.
	Fraying cable causes electric shocks.	Fraying cable causes electric shocks.	Fraying cable causes electric shocks.
	Broken buttons cause electric shocks.	Broken buttons cause electric shocks.	Broken buttons cause electric shocks.
Grinding process			
	Grinder wheels cause wounds, defects, and loss of body parts.	Grinder wheels cause wounds, defects, and loss of body parts.	Grinder wheels cause wounds, defects, and loss of body parts.
	Flames cause skin irritation, burns, and fire.	Flames cause skin irritation, burns, and fire.	Flames cause skin irritation, burns, and fire.
	Sprinkling grams causes eye irritation, vision disorders, and blindness.	Sprinkling grams causes eye irritation, vision disorders, and blindness.	Sprinkling grams causes eye irritation, vision disorders, and blindness.
	dehydration, stress, fatigue, exhaustion.	There are dehydration, stress, fatigue, exhaustion.	dehydration, stress, fatigue, exhaustion.
	The noise of grinders can contribute to impared hearing, such as deafness.	The noise of grinders can contribute to impared hearing, such as deafness.	The noise of grinders can contribute to impared hearing, such as deafness.
	Vibration of grinding machine causes vibration and numbness in hands.	Vibration of grinding machine causes vibration and numbness in hands.	Vibration of grinding machine causes vibration and numbness in hands.
	Short circuit causes electric shocks, burns, and fire.	Short circuit causes electric shocks, burns, and fire.	Short circuit causes electric shocks, burns, and fire.

Step Job	Potential hazards	Risk	Consequences
	Final Grinding Process		**Final Grinding Process**
Final stage of grinding			
	Fraying cable results in electric shocks.	Fraying cable results in electric shocks.	Fraying cable results in electric shocks.
	Short circuit	Short circuit	Short circuit
	Grinding machine is not neatly arranged causing fingers pinned, bruises, and mild cuts.	Grinding machine is not neatly arranged and thus caused fingers pinned, bruises, and mild cuts.	Grinding machine is not neatly arranged causing fingers pinned, bruises, and mild cuts.
	Grinding machine can fall to legs and cause wounds and bruises.	Grinding machine can fall to legs and cause wounds and bruises.	Grinding machine can fall to legs and cause wounds and bruises.
	Sharp grinding stone causes scratches and wounds on hands.	Sharp grinding stone causes scratches and wounds on hands.	Sharp grinding stone causes scratches and wounds on hands.

Risk assessment

Risk assessment is part of the risk management stage done after conducting hazard identification. A risk assessment is an attempt to determine and calculate the magnitude of risk and whether the risk is acceptable or not (Ramli, 2010). Risk assessment includes two stages of risk analysis and risk evaluation and are calculated by multiplying the levels of likelihood and severity levels. Risk evaluation is the determination of the outcome of the risk analysis on whether it is acceptable or not (Ramli, 2010). Risk analysis results in the risk levels classified into 3 in evaluating the risk value. Such categories are acceptable risks that can be transmitted. The risk assessment in this study used semi-advanced analytical techniques based on the US/NZS 4360 Standards and JSA instrument sheet. The results of risk assessment were presented in Table 6. There were 21 risk types consisting of a low risk of 13, moderate risk of 5, and high risk of 3.

Table 6. Risk Assessment in the Grinding Process in the Fabrication Unit in August 2018

	Hazard identification	Risk Value		Risk Level
	Potential hazards	**Likelihood**	**Severity**	
Grinding Preparation				
	Grinding machine is not neatly arranged causing fingers pinned, bruises, and mild cuts.	3	2	6
	Injured legs due to grinding machine	3	2	6

	Sharp grinding stone causes scratches and glaze	3	2	6
	Short circuit	2	3	6
	Untidy cables trip workers	4	1	4
	Electrocuted cables	2	2	4
	Broken buttons and electric shocks	1	2	2
Grinding process				
	Smash of wheels of grinding machine	4	4	16
	Flames	5	2	10
	Sprinkling grams	5	3	15
	Dehydration and stress	2	1	2
	Noise of grinding machine	4	3	12
	Hand vibration syndrome due to machine vibration	5	2	10
	Short circuit	2	3	6
	Fallen materials	4	4	16
Final Grinding Process				
	Broken buttons and electric shocks.	1	2	2
	Electrocuted cable	2	2	4
	Short circuit	2	3	6
	Cable strike trips workers	5	2	10
	Untidy grinding machine, falls of grinding machine, fingers pinned, scratches.	2	1	2
	Flying gram flakes	4	2	8

DISCUSION

Hazard identification

Hazard identification in the grinding process in the fabrication unit of X Ltd., Surabaya was carried out proactively. Based on the interviews and observations to the grinder operators and occupational health and safety officers, in the three stages of grinding (grinding preparation, grinding process, and final grinding process) that used hand grinders, there were 21 kinds of hazards that could pose 21 different risks of occupational accidents. These hazards included 10 mechanical hazards, 7 electrical hazards, 3 physical hazards, and 1 fire hazard.

In the grinding preparation, several hazards found involved the danger of mechanical and electrical hazards. The first mechanical hazard was the untidy grinding machine that can cause the finger pinching for taking a pile of grinding machines in the storage box. The second potential danger was the downfall of materials or grinding machines that can cause loss of limb or other body parts. The third potential danger was the installation of grinding stones, which can cause scratches on the operators' hands since the surface of the stone was rough with sharp sides. The operators also used the grinding machine without checking the physical condition or replacing the grinding stones.

There were some potential electric hazards. The first hazard was a neat cable arrangement, which can trip the operators or workers . The study of (Dankis., 2015) stated that cables that were not neatly arranged and scattered in the work area can trip workers, thereby requiring a neat and permanent cable route to not interfere with the working process. Short circuit may occur when the operators turn the MCB (Miniature Circuit Breaker) in the electrical panel. This potential hazard with a small risk could shut down the MCB automatically. Second was a portion of the tug cable, connected with the electric panel routed to the cable of the grinding machine. In the wire of the tug, there was a fraying cable which was risky to cause electric shocks in wiring the grinding machine to the power outlet. The results of the interview showed a periodic inspection on the machine and equipment was always routine, but the results of observations still found fraying cables. Third was broken buttons of the grinder and perforated grinder. Before starting to operate the grinding machine, the operators turned on the machine's power button to fire. During this process, electric shocks might occur and pose dangers for the operators.

In the grinding process, several types of hazards identified were mechanical hazards, physical hazards, electrical hazards, and fire hazards. The mechanical hazards were first derived from the round of grinding machines during material smoothing. Rapid wheel rotation could rupture the grinding stones due to the discrepancy between the size of grinding stones and crushed materials. Besides, the rupture occurred because the operators did not replace the grinding stones appropriately. The second potential hazard was the spark of grams due to the rupture of grinding stones and materials in the iron smoothing process. This potential hazard contributed to many occupational accidents. The observation found some grinding operators did not wear PPE, such as glasses and faceshileds which were available during the grinding process. The occupational health and safety officer has to remind the operators to wear glasses properly. (Rochmawati, 2013) found the gram is possible to enter the eyes during and after the grinding process. After the process was done, some grams might be still attached to a helmet or face shield. While opening the helmet or face shield, the grams fell to the eyes. The third potential danger was the material falls during the displacement of the machine and turning off the machine. This study discovered that nearmiss accidents mostly occurred during these processes because sometimes the finished material from the grinding process were moved by rolling or lifting the wheels with the helpers' assistance.

The physical hazards identified involved high temperatures, noise, and vibration in the grinding machines. When the process of grinding was run, it generated the heat energy and sparks resulting in high temperature around the work area. Due to the high temperature, the grinding operators were dehydrated and fatigued. (Ahmad, 2012) found that heat temperature could cause fatigue often called as heat exhaustion. Symptoms of heat exhaustion usually begin with dizziness, excessive sweating, to faint due to excessive heat. The grinding process was run near the entrance of the fabrication unit so that the temperature outcome was not as bad as it felt because of the air circulation. In addition to high temperature, this process also produces noise from the wheels of grinding machine with the material. Based on the secondary data obtained, the noise intensity during the grinding process was at 90.5 to 94 dBA. Some operators still did not use earplugs. It exceeded 85 dBA as the standard of the Indonesian Ministry of Manpower and Transmigration of numbers Per. 13/MEN/X/2011. The sound energy from the grinding machine may result in hearing loss depending on individual's physical endurance (Ramli, 2010). Research conducted by (Pratama, 2013) found the intensity of noise in the fabrication unit of BSB Gresik Ltd. from the grinding process was around 93.5-96.5 dBA, exceeding the threshold. The high intensity of noise poses a risk of hearing impairment.

Moreover, potential vibration hazards were also generated in the grinding process. For instance, hand-arm tool puts the workers at risk of suffering from hand arm vibration syndrome. According to (Suma'mur., 2009), the effect of mechanical vibration of the arm caused abnormalities in the blood circulation and the radius, broken joints and bones due to numbness. Vibration can be minimized by using leather gloves. However, some grinding operators still did not ear gloves when performing grinding.

The electrical hazard identified during the grinding process was the short circuit for igniting the grinding machine. An incident to a grinders operator ever happened, but they only got an electric shock and no fatal injuries. A part of the grinding machine did not work well so that it resulted in a short circuit. (Ambarani, AY., 2016) explained the engine rotor parts become hot and cause short circuit when rotated continuously. Furthermore, if the machine is made from conductor, the electricity will break out to hands.

The fire sparks occured because of the friction between the wheels of grinding stones and iron materials. The grinding process can burn skin. The results of observation found that the operators did not install or use a cover in the grinding machine. This protector avoids the direct sparks to the body or objects. These sparks caused body injuries and fires when the objects were flammable. This potential hazard included safety hazards, such as due to flammable substances that caused fire (Tualeka, 2013).

The final grinding process, posed electrical and mechanical hazards. The electrical hazard included the broken power button, fraying tug cables, and short circuit during discharging the MCB. The power button should be turned on and off afterwards. The machine with power and perforated buttons will be risky to hands. Furthermore, the part of the tug cord may pose an electric current shock. At the time of unplugging the grinding machine from the power outlet on the cable, the electric current flew from the panel. After revoking the machine's cable with the tug cable, the MCB in the power panel was turned off. Electric shocks on the hands were caused by the short circuit. Additionally, wet hands that touch the operating MCB led to electric shocks.

The mechanical hazards in the final process were objects tripping the workers. This study showed the grinding operators did not immediately roll up the tug cable or set aside the cable after completing the work. The second danger was that the grinding machine was not neatly arranged in the storage box. Many grinding operators still had poor management of the machinewhich could lead them fall to the machine. It was also risky to pinch or slash the hands for using the grinders again. The last potential mechanical hazard was falling grams. The last thing to do after the grinding process was sweeping and throwing the rest of the chip in the working area into the trash. Falling grams gave long-term effects on the respiratory tract. Threfore, the grinding operators should wear a mask as a protector so that dust or remaining grams were not inhaled. However, most of them did not use masks. (Pratama, 2013) mentioned grinding, drilling, and sandblasting processes produced a particle size greater than 1 to 20 mm transferable to the air and being inhaled by the respiratory system.

Risk assessment

This study pointed out 21 potential hazards and risks based on the risk assessment. In the preparation process, 7 risks were found to be low risk, and 8 risks with 2 low-risk, 3 moderate-risk, and 3 high-risk categories were present in the grinding process. While, there were 6 risks with 4 low-risk and 2 medium-risk categories. In terms of likelihood, trap and bruises in fingers were rated three or moderate, while their severity was rated two or minor. It means that the grinders were poorly arranged in certain conditions because the company conducted weekly hygiene programs. Such small accidents did not incur financial losses since it just required first aid kit tools for the treatment. The multiplication of likelihood and severity levels equaled to six which can be categorized as low risk.

Meanwhile, feet injury risks had the moderate likelihood of and the minor severity. It indicates that the operators sometimes fell into the machine and got minor risks, such as feet bruises that only required first aid kit tools. the likelihood level of hand scratches was moderate, and its severity was minor. It means the scratches on hands or palms occurred in a certain time and did not cause a substantial loss. With regards to electric shocks, the likelihood level was unlikely to occur, and the severity was moderate. Such accidents can cause serious injuries or burns and even fire, causing a substantial loss. However, the multiplication of likelihood and severity value showed low risk categories for these accidents.

Due to the likely occurrence and insignificant severity, it was predicted that poor cable management was often found. For this reason, the operators or workers might be tripped but not get injuries. The risk did not cause both financial and material loss. In the fabrication unit, fraying cables resulting in electric shocks were rarely found since it was unlikely to happen, and the severity was minor.

Moreover, this study highlighted rare broken or perforated machine buttons with minor severity since the machine was only used in urgent circumstances. During the grinding process, the wheels of the grinding machine always rotated rapidly. When materials used are not compatible and the machine get overused, the grinding stone can be broken and hurt the operators, e.g., wounds, closs of body parts, defects and substantial material and financial loss with a high risk category.

Sparks possibly will occur in every process of grinding and cause skin irritation, burns, and even small fire. It posed minor severity and was categorized as moderate risk. Splashing grams certainly can occur during the grinding process, and it needs medical personnel to handle some injuries, such as eye irritation and blindness. This is a high risk that gave the company high loss. The operators will infrequently experience dehydration and heat stress which had the insignificant severity. It means that these risks did not result in injuries. Noise from the grinding machine often occurred in the grinding process. Many grinding operators did not wear earplugs so that they suffered from hearing impairment.

The machine’s vibrations were almost certain to occur during the grinding process and resulted in the disruption of nerve and numbness, which were moderate risks. Short circuit rarely occurred but caused serious injuries or burns and even fire that lead to a substantial loss to the company. Falling materials often occurred in the work area and caused severe injuries and a substantial loss.

The risk of being shocked by an electric current was unlikely to occur and had minor severity. It means that the potential danger of fraying cables was rare and only caused electrical shocks with slight injuries and no substantial harms to the company. Short circuit was unlikely to happen and had moderate severity. This low risk can cause serious injuries, burns, and even fire.

Most of the time, the operators and workers got tripped due to inappropriate cable routes. A mild injury was a result of short circuit which posed a moderate risk. Falling grinder was unlikely to occur with the insignificant severity. Rarely does the falling grinder happen, and it does not give any injuries. Besides, the inhalation risk with the minor severity was likely to occur and was considered moderate. It indicates the use of grams in the work area was very common especially when the grinding operator sweeps the rest of the grinder grams.

The risk evaluation was done to formulate a risk determination concept called ALARP (As Low As Reasonably Practicable). (Ramli, 2010)stated the green area signified low risk that was acceptable, while the yellow area symbolized a tolerable risk. A high risk was in the red area and was considered an unacceptable risk.

This study obtained 13 low risks with a score of 1-6 in the green area. It indicated that 13 risks were acceptable, but a further review should be taken as to whether or not the risk can be reduced. This study also found five moderate risks with a score of 7-14 in the yellow area. These risks were tolerable. The work can only be proceeded when there was a decision of the management consulted with experts and voting team. These risks should be further studies before starting the work.The fabrication unit had 3 high risks with a score of 15-25 in the red area. The work which exerts high risk should be re-examined to reduce the risk

CONCLUSION

Based on the hazard identification that has The hazard identification on the grinding preparation, grinding process, and final grinding process in the fabrication unit of X Ltd., Surabaya found 21 potential hazards leading to 21 occupational accident risks. Based on the assessment, 13 risks were at low-risk categories, i.e., acceptable risks, 5 risks were moderate, i.e., tolerable risks, and 3 risks were at high-risk categories, i.e., unacceptable risks.

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