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Environmental Health Risk Analysis Due to Particulate Matter (PM10) on Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

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Abstract: According to the ILO (*International Labour Organization*) factory workers in industrialized countries are affected by respiratory diseases (pneumoconiosis, silicosis and others) due to exposure to dust in the workplace. PM $_{10}$ in the air is the main parameter in air pollution originating from the use of transportation and increased industrial activity. The results of explosions from factories and vehicles entering and leaving the industry can pollute the air and produce pollutants and some workers at the PT Diamond Alfa Propetindo factory do not use personal protective equipment (PPE) masks so that there is possible pollution of *particulate matter* (PM $_{10}$) which is dangerous and causes health problems **.** This study aims to analyze environmental health risks due to *Particulate Matter* (PM $_{10}$), individual characteristics, risk level (RQ), and risk management. This study uses a descriptive observational method and Environmental Health Risk Analysis (ARKL). Respondent data collection techniques use total sampling and questionnaires. The results of PM $_{10\ measurements}$ that have been converted to a 10-hour measurement time at point 1 are 62.8 µg/m ^{3} , point 2 is 62.7 µg/m ^{3} , point 3 is 72.2 µg/m ^{3} and point 4 is 60.1 µg/m ^{3} and do not exceed the threshold value (NAB) of ambient air quality standards. The results of the RQ calculation obtained from 60 workers are RQ ≤ 1 which means they are not at risk of being exposed to PM $_{10}$ so they do not require risk management or risk control.
Keywords : Environmental Health Risk Analysis (ARKL), *Particulate Matter* (PM **10**) .

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1. Introduction

According to the World Body ILO (*International Labour Organization*) in 2015, around 30% to 50% of factory workers in industrialized countries experienced respiratory diseases, such as pneumoconiosis and silicosis due to exposure to dust in the workplace (Gaffar *et al* ., 2021) .

According to data from the *World Health Organization (WHO*), approximately 4.2 million people die annually from exposure to ambient air pollution. One factor contributing to the increase in air pollutants is the growth of industry . While the advancement of the industrial sector in Indonesia brings many benefits, it also creates various problems, one of which is air pollution (Mirza, 2022) .

Air quality in Indonesia is worsening due to increased use of transportation and increased industrial activity (Lintas *et al* ., 2024) . Industries that produce pollutants can pose health risks to humans, both in the short and long term, with the main impact being respiratory disorders due to air pollution (Septiana, 2021) .

The level of PM $_{10}$ in the air is the main indicator of air pollution because it can be related to the concentration of other pollutants (Anggraeni *et al* ., 2021) . *Particulate matter* (PM $_{10}$) is a type of air pollutant that has a shape, size, and composition that varies depending on the source. Particulate matter (PM $_{10}$) with a very small diameter is the most dangerous because it can enter the cardiovascular system and lungs, thereby increasing the

risk of long-term death (Study *et al* ., 2024) . Excessive exposure to PM $_{10}$ can cause disorders of the respiratory tract or symptoms of Acute Respiratory Infection (ARI) (Fahmi, 2020) .

According to WHO data, acute respiratory infections (ARI) are a leading cause of death in developing countries. The WHO states that ARI is a global health problem. Each year, nearly 4 million people die from ARI, with 98% of deaths caused by lower respiratory tract infections. This disease is more common in developing countries, with the percentage reaching 25% to 30%. In 2019, an estimated 4.2 million premature deaths worldwide were caused by ambient air pollution, both in urban and rural areas. These deaths generally occur due to exposure to fine particulate matter, which triggers cardiovascular disease, respiratory disorders, and cancer.

According to data from the Central Buton Health Service, the number of ISPA sufferers for all ages in 2023 was 592 people . Meanwhile , in 2024 , 620 people were recorded, collected from January to July . This data indicates an increase in the number of ISPA sufferers in 2024 (Central Buton Regency Health Office, 2024). Meanwhile, based on data from the Central Mawasangka Community Health Center In 2023, 190 people with ARI were recorded across all ages. In 2024, the number increased to 324, collected from January to June . This indicates an increase in the number of ARI sufferers (Mawasangka Tengah Community Health Center, 2024).

The results of initial observations on October 14, 2024 at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, mining activities can pose a risk of causing various diseases. The results of blasting from the factory and vehicles entering and leaving the industry can pollute the air and produce pollutants and some workers in the factory do not use personal protective equipment (PPE) masks, thus allowing for the possibility of dangerous *particulate matter* (PM $_{10}$) pollution which can cause health problems.

Based on the data and observation results that have been obtained, the researcher is interested in researching "Analysis of Environmental Health Risks Due to Exposure to Limestone *Particulate Matter* (PM $_{10}$) on Workers at PT. Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency",

2. Methods

This research was conducted in the limestone mining area of PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency . The time of this research was conducted from December 2024 to January 2025. This research used a descriptive observational method. This type of descriptive observational research is a research method carried out with the aim of creating a picture or describing a situation objectively. The research method uses the environmental health risk analysis (ARKL) method. ARKL aims to calculate the inhalation rate, dose response, exposure analysis, risk level , risk management received by a population due to exposure to pollutant agents in the environment. The population in this study were all workers who worked at PT. Diamond Alfa Propetundo, namely 60 workers . The air sample in this study was PM $_{10}$ measured using a *Portable* Insitu reading measuring instrument. Measurements were carried out 3 times at each point, namely morning , afternoon and evening with a distance of 500 m, 1 km, 2 km, to see the distribution pattern and the effect of distance on PM $_{10}$. The sampling point in this study was in the mining area of PT Diamond Alfa Propetindo based on the cardinal directions, namely West, East, North and South. The worker sample was the entire population of 60 workers who carried out work activities in the mining area of PT . Diamond Alfa Propetindo (based on an initial interview with Marwan on October 14, 2024). And age characteristics ranging from 20 – 50 years. This study uses secondary and primary data types. Secondary data can be obtained from the Central Buton Health Office and the Central Mawasangka Health Center. The primary data obtained were the results of measuring air quality of *particulate matter compounds* (PM $_{10}$), age, body weight (Wb), exposure time (t $_{E}$), exposure frequency (f $_{E}$), exposure duration (Dt), inhalation rate (R), intake (I $_{nk}$), risk level (RQ), and risk management. Presentation of research data in the form of tables and narratives.

3. Results

Particulate Matter (PM_{10}) measurements were conducted at four observation points. PM_{10} concentration measurements were conducted using an In-Situ Reading Portable instrument.

Table 1 *Particulate Matter* (PM_{10}) Concentration Values in the Field at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

Location	Measurement Time	PM_{10} concentration ($\mu g/m^3$)	NAB ($\mu g/m^3$)
Point 1 (Northern Section of PT Diamond Alfa Propetindo)	08.00-09.00 (Morning)	24	75 $\mu g/m^3$
	1:00-2:00 PM (Afternoon)	37	75 $\mu g/m^3$
	16.00-17.00 (Afternoon)	18	75 $\mu g/m^3$
Point 2 (East Section of PT Diamond Alfa Propetindo)	08.00-09.00 (Morning)	19	75 $\mu g/m^3$
	1:00-2:00 PM (Afternoon)	41	75 $\mu g/m^3$
	16.00-17.00 (Afternoon)	27	75 $\mu g/m^3$
Point 3 (Southern Section of PT Diamond Alfa Propetindo)	08.00-09.00 (Morning)	20	75 $\mu g/m^3$
	1:00-2:00 PM (Afternoon)	51	75 $\mu g/m^3$
	16.00-17.00 (Afternoon)	12	75 $\mu g/m^3$
Point 4 (Western Section of PT Diamond Alfa ssssPropetindo)	08.00-09.00 (Morning)	16	75 $\mu g/m^3$
	1:00-2:00 PM (Afternoon)	42	75 $\mu g/m^3$
	16.00-17.00 (Afternoon)	21	75 $\mu g/m^3$

Source: *Primary Data*

Based on Table 1 above, it shows that the measurement of *Particulate Matter* (PM_{10}) concentration was carried out at four points, namely Point 1 (Northern Part of PT Diamond Alfa Propetindo), Point 2 (Eastern Part of PT Diamond Alfa Propetindo), Point 3 (Southern Part of PT Diamond Alfa Propetindo), Point 4 (Western Part of PT Diamond Alfa Propetindo). The results of field measurements showed that the highest concentration of *Particulate Matter* (PM_{10}) was at point 3 at 51 $\mu g/m^3$ with daytime measurement time at 13.00-14.00. at each point is different because in the morning the activities in the mine are not yet operating such as heavy machinery or production processes that produce dust and low air temperatures that can limit the spread of particles, during the day mining activities are at their peak heavy machinery used in the mining process produces a lot of dust as well as increased transportation activities such as trucks carrying materials, motorbikes, and private vehicles as well as increasing air temperatures that cause dust and particles to be easily released, and in the afternoon many mining and transportation activities begin to decrease so that pollution tends to decrease and pollutant emissions decrease.

Table 2 Concentration of *Particulate Matter* (PM_{10}) at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Central Mawasangka District, Central Buton Regency

Location	Measurement Time	PM_{10} concentration ($\mu g/m^3$)	NAB ($\mu g/m^3$)

Point 1 (Northern Section of PT Diamond Alfa Propetindo)	10 hours	62.8	75 μg/m ^{3}
Point 2 (East Section of PT Diamond Alfa Propetindo)	10 hours	62.7	75 μg/m ^{3}
Point 3 (Southern Section of PT Diamond Alfa Propetindo)	10 hours	72.2	75 μg/m ^{3}
Point 4 (Western Section of PT Diamond Alfa Propetindo)	10 hours	60.1	75 μg/m ^{3}

Source: *Primary Data*

Based on Table 2 above, it shows that the concentration of Particulate Matter (PM $_{10}$) at point 1 (Northern Part of PT Diamond Alfa Propetindo) for 10 hours was 62.8 μg /m ^{3}, point 2 (Eastern Part of PT Diamond Alfa Propetindo) was 62.7 μg/m ^{3}, point 3 (Southern Part of PT Diamond Alfa Propetindo) was 72.2 μg/m ^{3} and point 4 (Western Part of PT Diamond Alfa Propetindo) was 60.1 μg/m ^{3}. So, the highest concentration of *Particulate Matter* (PM $_{10}$) was at point 3, namely 72.2 μg /m ^{3}.

Table 3 Distribution of Workers' Body Weight at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

Variables	Body Weight (kg)						
	N	**Mean**	**Median**	**Elementary School**	**Min**	**Max**	***P-Value***
Heavy Body	60	57.83	58.00	5,447	47	69	0.817

Source *: Primary Data*

Kolmogorov-Smirnov Test , the weight characteristic data from the entire worker sample obtained a *P-Value* = 0.817 which means the data is normally distributed, so the mean value of 57.83 kg was used . The mean value obtained will later be substituted into the *intake formula* to obtain the non-carcinogenic PM $_{10}$ *intake value* and the Risk Level (RQ) of the sample reviewed from the research location.

1. Gender

Gender was divided into two groups: male and female. The distribution of respondents by gender can be seen in the following table.

Table 4 Frequency Distribution of Gender of Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

Gender	**N**	**%**
Man	60	100
Total	**60**	**100**

Source: *Primary Data*

Based on Table 4, the number of workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, all of the workers are male, namely 60 people or 100%.

2. **Use of Masks**

The use of masks by workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, produced the following results.

Table 5 Distribution of Worker Mask Use at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Central Mawasangka District, Central Buton Regency

Use of Masks	Workers at PT Diamond Alfa Propetindo	
	N	**%**
Yes	19	31.7
No	41	68.3
Total	**60**	**100.0**

Source: *Primary Data*

Based on Table 5 above, there are 19 or 31.7% of respondents who wear masks while working and 41 or 68.3% of respondents who do not wear masks.

3. History of Respiratory Disease

The history of respiratory disease in workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency can be seen in the following table.

Table 6 Distribution of Respiratory Disease History in Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Kea Village, Mawasangka Tengah District, Central Buton Regency

History of Respiratory Disease	Workers at PT Diamond Alfa Propetindo	
	N	**%**
Yes	15	25.0
No	45	75.0
Total	**60**	**100.0**

Primary Data Sources

Based on Table 6, there are 15 or 25.0% of respondents who have a history of respiratory disease among workers at PT Diamond Alfa Propetindo and 45 or 75% of respondents who do not have a history of respiratory disease.

5.2.2.2 Worker Activity Patterns at PT Diamond Alfa Propetindo, Gundu -Gundu Village, Mawasangka Tengah District, Central Buton Regency

1. Exposure Time

Exposure time (t_E) or length of work at the research location in one day can be seen in the following table.

Table 7 Distribution of Worker Exposure Time at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

	Exposure Time (Hours/days)						
Variables	**N**	**Mean**	**Median**	**Elementary School**	**Min**	**Max**	**P-Value**
Time Exposure	60	10.00	10.00	0,000	10	10	0,000

Source: *Primary Data*

Kolmogorov-Smirnov Test , the respondent's exposure time in a day is 10 hours/day with a *p-value* = 0.000 which means it is not normally distributed, so the median value is used, namely 10.00 hours /day.

2. Frequency of Exposure

The frequency of exposure (f_E) or length of work at the research location in a year can be seen in the following table.

Table 8 Distribution of Worker Exposure Frequency at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

	Exposure Frequency (days/year)						
Variables	N	Mean	Median	Elementary School	Min	Max	P-value
Frequency Exposure	60	319.48	309.50	20,455	300	351	0,000

Source *: Primary Data*

Kolmogorov-Smirnov Test , the highest frequency of exposure of respondents in a year is 351 days/year and the lowest is 300 days/year with a *p-value* of 0.000 which means it is not normally distributed, so the median value is used, namely 309.50 days/year.

3. Duration of Exposure

Duration of exposure (D_t) or length of work at the research location in a year can be seen in the following table .

Table 9 Distribution of Duration of Exposure of Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, East Mawasangka District, Central Buton Regency

	Duration of Exposure (years)						
Variables	N	Mean	Median	Elementary School	Min	Max	P-value
Duration Exposure	60	2.33	2.00	0.729	1	3	0,000

Source: *Primary Data*

Kolmogorov-Smirnov Test , the highest duration of exposure of respondents in a year was 3 years and the lowest was 1 year with a *p-value* = 0.000 which means it is not normally distributed, so the median value is used, namely 2.00 years .

4. Inhalation Rate

The inhalation rate is the amount of PM_{10} that enters the human body every hour through the inhalation (breathing) pathway at the research location. The inhalation rate (R) is calculated using the formula y = 5.3 In (x) – 6.9. Where y = R (inhalation rate) in m^3 /hour and x = is the body weight of workers at PT Diamond Alfa Propetindo. The calculation results can be seen in Table 10 below.

Table 10 Distribution of Inhalation Rate of Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

	Inhalation Rate (m^3 /hour)						
Variables	N	Mean	Median	Elementary School	Min	Max	P-Value
Rate Inhalation	60	1451.85	1461.00	55,008	1343	1554	0.819

Source: *Primary Data*

Kolmogorov-Smirnov test , the highest inhalation rate of respondents in a year was 1554 m^3 / hour and the lowest was 1343 m^3 / hour with a p-value = 0.819 which means it is normally distributed, so the mean value used is 1451.85 m^3 / hour.

Environmental Health Risk Analysis (ARKL)

Exposure Analysis and Calculation of PM_{10} *Intake* in Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

Exposure concentration is the amount of *risk agent concentration* received and entering the human body, the average sample per average body weight of the sample per day. In the intake calculation below, it is carried out according to the location points of PM_{10} air quality calculations , namely at 4 points in the North, East, South, and West at PT

Diamond Alfa Propetindo. In this study, non-carcinogenic *intake is calculated for realistic* exposure or the length of time the respondents worked at the time of this study.

A summary of the variable values of the activity patterns of workers as exposed respondents can be seen in the following table .

Table 11 Individual Characteristics and Activity Patterns of Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

Individual Characteristics	Mark
Body Weight (w_b)	57.83 (kg)
Exposure Time (t_E)	10.00 hours/day
Exposure Frequency (f_E)	309.50 days/year
Duration of Exposure (D_t)	2 years
Inhalation Rate (R)	0.819 m^3/hour

Source: *Primary Data*

In a work environment exposed to air pollution, especially fine dust PM_{10} (*Particulate Matter* with particle size ≤ 10 micrometers), it is important to calculate the level of worker exposure to dust particles. Excessive exposure to PM_{10} can cause long-term health problems, for PM_{10} *Intake* received by workers at PT Diamond Alfa Propetindo is calculated using the following formula:

$$Intake\ (Ink) = \frac{C\ x\ R\ x\ t\text{E x fE x Dt}}{Wb\ x\ tavg}$$

Table 12 PM_{10} *Intake* Based on Sampling Points at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

Sample Point	$_{10}$ intake (mg/kg/day)
Point 1 (Northern Part of PT Diamond Alfa Propetindo)	0.50
Point 2 (East Section of PT Diamond Alfa Propetindo)	0.50
Point 3 (Southern Part of PT Diamond Alfa Propetindo)	0.57
Point 4 (Western Part of PT Diamond Alfa Propetindo)	0.48

Source: *Primary Data*

Based on Table 12, it shows that the *intake results* of the worker population at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, with the highest *intake value* at point 3 of 0.57 (mg/kg/day), while the lowest *intake value* was at point 4 of 0.48 (mg/kg/day).

Dose Response Analysis

Dose response analysis is used to determine the quantitative value or dose of a risk agent that is used as a reference to determine whether the agent can cause harmful effects to health at risk or not. The dose response analysis used is the reference concentration (RfC) in the respiratory tract (inhalation). Based on IRIS (*Integrated Risk Information System) data,* the RfC value of PM_{10} has not been detected in IRIS *(Integrated Risk Information System) data,* therefore, the reference concentration (RfC) value of PM10 is sought based on *the primary standard of the National Ambient Air Quality Standard* (NAAQS) for PM10 is 150 μg / m^3. This value then becomes the divisor value for the large Risk Characteristics (RQ) (Jusuf *et al.* , 2023) .

Risk Characteristics

Risk Characteristics (RQ) is a stage to calculate the level of risk of non-carcinogenic effects of risk agents (PM_{10}) on workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency. To find out the level of risk or danger from risk agents, it can be seen from the resulting (RQ) value. If the RQ value ≤ 1 then humans or populations are considered safe or not at risk, whereas

if the (RQ) value > 1 then humans or exposed populations are at risk or not safe so that control is then carried out with risk management.

$$RQ = \frac{1}{RfC}$$

Table 13 Risk Level (RQ) Population PM10 Workers at PT Diamond Alfa Propetindo Gundu-Gundu Village, Central Mawasangka District, Central Buton Regency

Sample Point	Risk Level (RQ) of PM $_{10}$	Risk
Point 1 (Northern Part of PT Diamond Alfa Propetindo)	0.033	No Risk
Point 2 (East Section of PT Diamond Alfa Propetindo)	0.033	No Risk
Point 3 (Southern Part of PT Diamond Alfa Propetindo)	0.038	No Risk
Point 4 (Western Part of PT Diamond Alfa Propetindo)	0.032	No Risk

Source: *Primary Data*

Based on Table 13, it shows that the calculation of the risk level (RQ) of the PM $_{10\ population}$ *is real-time* . The RQ value at point 1 is 0.033, the RQ value at point 2 is 0.033, the RQ value at point 3 is 0.038, and the RQ value at point 4 is 0.032. So, the highest RQ value is at point 3, which is 0.038, while the lowest RQ value is at point 4, which is 0.032. This shows that PM $_{10\ measurements}$ at all points are not risky, so no risk management or risk control efforts are carried out .

Discussion

Characteristics of Respondents at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

Based on the results obtained, there were 60 respondents, all of whom were male. The average age of respondents was 34.35 years with the oldest being 50 years old. And the average weight of respondents was 57.83 kg with the highest weight being 69 kg. As each respondent's age increases, it is also a risk factor for exposure to health problems because it is related to the accumulation of lifetime exposure. Body weight is included in the *intake calculation* because there is a relationship between the intake rate based on exposure time, exposure frequency and exposure duration so that it can determine the extent of exposure to PM $_{10\ risk\ agents}$. If the individual's body weight is smaller, the greater the intake received by the body, and vice versa, the greater the individual's body weight, the smaller the *intake value* received (Jusuf *et al* ., 2023) .

Distribution of Mask Use among Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Central Mawasangka District, Central Buton Regency

Based on the results of the study on the use of masks, it was found that out of a total of 60 respondents who used masks, 19 respondents and those who did not use masks were 41 respondents. From the results of this study, there are still many workers who do not use masks while working, making it easier for dust to enter the respiratory system. Based on research that has been conducted (Siregar, 2023), the use of masks that does not comply with the rules allows dust to enter the respiratory system. Masks are used to reduce the number of inhaled dust particles and prevent the entry of larger particles or protect against the entry of air pollutants.

The use of masks in K3 requirements, namely masks are used as personal protective equipment (PPE) and are included in the K3 components to protect workers from health risks and compliance with the use of masks for K3, namely the company's responsibility, workers' obligations, and part of a safe work culture.

Distribution of Disease History in Workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

Based on the results of the study, 15 respondents (25.0 %) had a history of respiratory disease and 45 respondents (75.0%) did not have a history of disease. According to research (Ferial *et al* ., 2021), workers in dusty environments are likely to have respiratory tract disorders, this is because the air they breathe has been contaminated by dust. Workers who have had lung disease tend to reduce ventilation perfusion so that the alveoli will experience too little air exchange. As a result, it will reduce oxygen levels in the blood. Therefore, it can be said that a history of respiratory disease is also considered a risk factor for the onset or cause that worsens respiratory tract disorders or acute respiratory infections (ARI) (Akbar *et al* ., 2024).

Particulate Matter **(PM $_{10}$) Concentration Risk Agents at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency**

$_{10}$ concentration in workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, the results showed that the average PM $_{1O\ concentration}$ at point 1 did not exceed the quality standard, namely 62.8 μg/m ^{3}, point 2 did not exceed the quality standard, namely 62.7 μg/m ^{3}, point 3 did not exceed the quality standard value, namely 72.2 μg/m ^{3}, point 4 did not exceed the quality standard, namely 60.1 μg/m ^{3} in accordance with the regulations stipulated by the government in Government Regulation Number 22 of 2021, namely 75 μg/m ^{3}.

Field concentrations, whether high or low, are influenced by various factors, including industrial limestone blasting, transportation activities or vehicle emissions, and the proximity of industrial sites to roads frequently used by motorized vehicles, including trucks transporting materials. Furthermore, the presence of vegetation also plays a role in influencing $_{PM10}$ concentrations in ambient air.

According to Mulyadi 2015 (Jusuf *et al* ., 2023) PM $_{10}$ comes from various sources, such as road dust, construction dust, material transportation, vehicle emissions, industrial chimneys, and crushing and grinding activities. Particulates are components suspended in the air as fine dust or particulates (PM) which are divided into three types. The first type is coarse PM with a diameter of 2.5 to 10 microns originating from soil abrasion, road dust (such as dust from tires, brake pads or linings). Based on their size, these particulates are divided into three categories, particles with a size of <2.5 microns or <0.1 microns, and >2.5 millimeters. The second type is fine PM with a size between 0.2 to 2.5 microns. While the third type is the most common comes from the combustion of fossil fuels and can easily enter the alveoli respiratory tract and has the potential to enter the bloodstream through the circulatory system.

PM $_{10\ concentration}$ was at point 3 with a measurement result of 72.2 μg/m ^{3} with an average temperature at point 29 ^{0} C, humidity 78% and wind speed 3 mph. This is directly proportional to the measurement results above because if the temperature increases, the dust content also increases. When the temperature rises, so does the amount of air humidity and wind speed. However, lower temperatures cause less air humidity and stronger winds. In addition, increased air humidity or wind speed makes PM $_{10\ Metter\ particles}$ become more maximum. And when it decreases, it makes PM 10 Metter particles minimum. When the temperature increases, air humidity increases and wind speed increases. At this point, the maximum PM $_{10\ Metter\ particles}$ occur. However, when the temperature increases, air humidity decreases and wind speed increases resulting in minimal PM $_{10\ Metter\ particles.}$

The number of heavy vehicles transporting sand passing through residential areas is one source of ambient air pollution influenced by weather factors, humidity, and wind speed. One of the air pollutants that cause health problems is *Particulate Matter* (PM $_{10}$) dust particles. Environmental conditions also worsen the situation because during hot weather, pollutant measurements also increase, while during rain, measurements become less effective because dust settles. If the weather is hot, the air becomes dry with high temperatures which causes air pollutants to increase because in the dry season there is no dilution of pollutants. In addition, low wind speeds increase pollutant concentrations and cause dust to settle on the surface of the ground and air (Jusuf *et al* ., 2023) . The presence of vegetation influences the low or high concentration of PM 10 in ambient air (Gusti *et* al., 2018) .

Analysis of Exposure (*Intake*) and Risk Characteristics (RQ) of Particulate Matter (PM $_{10}$) at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency

The intake value for PM $_{10\ exposure}$ was calculated using the variable *Realtime Intake* , which refers to the length of time the respondent has lived in the research area. Based on the calculation, the maximum and minimum intakes for each respondent differed because they can be influenced by PM $_{10}$ concentration, body weight, exposure time, frequency of exposure, and duration of exposure. Based on the results of the *intake* measurement, From the four points measured, the PM $_{10\ concentration}$ with the *intake value* The highest *real-time value* is at point 3, namely 0.57 mg/kg/day because this location is right on a road that will automatically be passed by many vehicles and the large number of material transport trucks is one of the causes of the high PM $_{10\ concentration}$ at point 3. The amount of *intake value* is interrelated with the value of the risk agent concentration, duration of exposure, frequency of exposure, and inhalation rate, namely the greater the value, the greater the intake of each respondent.

The final step in the ARKL study was to determine the risk level for respondents or individuals at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, at four sampling points. The risk level (RQ) was calculated by dividing the *intake value* by the reference dose (RfD). If the RQ value is ≥ 1, it indicates a risk that must be avoided to maintain worker health.

Based on the calculation results obtained, the PM $_{10\ concentration}$ with *real-time RQ* at four points recorded a risk level (RQ) of ≤ 1, this indicates that there is no health risk for each respondent or individual worker if exposed to the risk agent. The longer the daily exposure or the frequency of annual exposure of a person to a risk agent, the greater the intake value *received* by the respondent and the greater the risk of health problems due to exposure to the risk agent (Sentosa *et al* ., 2022) .

$_{10}$) Risk Management at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Central Mawasangka District, Central Buton Regency

The purpose of risk management is to reduce the concentration at a safe point from exposure to pollutants quantitatively. The calculations carried out are the calculation of determining the Safe Concentration (C), Determination of Safe Exposure Time (t_E), Determination of Safe Exposure Frequency (f_E) and Determination of Safe Exposure Duration (D_t). Based on the results of the RQ calculation at each PM $_{10\ measurement\ point}$, the results are ≤ 1, which means that the mining activities do not pose a risk to the environment and health because the values obtained are within acceptable thresholds so that they do not require risk management or risk control measures.

CONCLUSION AND SUGGESTIONS

Conclusion

Based on the results of research that has been conducted on Environmental Health Risk Analysis Due to Particulate Matter (PM $_{10}$) on Workers at PT Dioamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, the conclusions of the research are as follows: The results of PM $_{10\ concentration\ measurements}$ on workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency were obtained from the four sample measurement points, the concentration value did not exceed the Quality Standards set based on Government Regulation Number 22 of 2021. namely at point 1 the PM $_{10\ concentration\ value}$ was 62.8 μg / m ^{3} , point 2 was 62.7 μg / m ^{3} , point 3 was 72.2 μg / m ^{3} , and point 4 was 60.1 μg / m ^{3} . Of the 60 respondents, all respondents were male. The average age of respondents is 34.35 years with the oldest age being 50 years. Then the average weight of respondents is 57.83 kg with the highest weight being 69 kg, body weight is included in the *intake calculation* because of the relationship between the intake rate based on exposure time, exposure frequency and exposure duration so that it can determine the extent of exposure to PM $_{10\ risk\ agents}$. The highest PM $_{10}$ *intake analysis* results are at point 3 at 0.57 mg / kg / day. The overall RQ value at the four measurement points is ≤ 1, this indicates that there is no health risk. Risk management is carried out if the RQ value is ≥ 1, then in this study risk control is carried out. Based on the results of the PM $_{10\ calculation}$ at each point, the RQ value

is ≤ 1, which means that the mining activity does not pose a risk to the environment and health because the value obtained is within an acceptable threshold so that it does not require risk management or risk control measures.

Suggestion

The suggestions that can be given in this research are as follows:

It is hoped that the Central Buton Regency Government will monitor air quality or conduct regular checks on PM $_{10\ dust}$ levels , especially at PT Diamond Alfa Propetindo.It is expected that PT Diamond Alfa Propetindo will improve dust management, gas emission control, vehicle washing and truck bed closing, air quality monitoring and occupational health, so as to reduce PM $_{10\ emissions}$ and minimize negative impacts on health and the surrounding environment.It is expected that workers at PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, will wear masks when carrying out activities or working to minimize the entry of *Particulate Matter* (PM $_{10}$). which enters through inhalation.It is hoped that PT Diamond Alfa Propetindo, Gundu-Gundu Village, Mawasangka Tengah District, Central Buton Regency, will install an air pollution standard index (ISPU) information board to make it easier for workers and those using roads in the mining area to see the impact categories on health and the environment.

BIBLIOGRAPHY

Anggraeni, SHDA, Darundiati, YH, & Joko, T. (2021). Analysis of PM10 Concentrations from Measurements at the Kemayoran BMKG Station in Central Jakarta During the Covid-19 Pandemic. *Indonesian Public Health Media* , *20* (1), 63–69. https://Doi.Org/10.14710/Mkmi.20.1.63-69

Central Buton Health Service (2024)

F, M. *Et Al* . (2022). Distribution of Total Dust Particulate Levels and Worker Risk Factors for Acute Respiratory Infection (ARI) in the Limestone Burning Industry, Margasari District, Tegal Regency. *Sanitation: Journal of Environmental Health* , *9* (1), 26–30. Http://Journalsanitasi.Keslingjogja.Net/Index.Php/Sanitasi/Article/View/27/51

Fahmi Achmadi, U. *Et Al* . (2020). The Relationship between PM10 Dust Concentration and the Incidence of Acute Respiratory Tract Infection (ARI) Symptoms in Construction Project X Workers in Depok in 2018. *National Journal of Global Environmental Health* , *1* (3). Https://Doi.Org/10.7454/Jnklg.V1i3.1018

Ferial, L., Fitria, L., & Silalahi, MD (2021). Particulate Matter (Pm10) Concentration and Respiratory Symptoms Experienced by Workers at the "X" Cement Factory, Cilegon City, Banten. *Journal of Environment and Natural Resources (Journalists)* , *4* (1), 1–12. https://Doi.Org/10.47080/Jls.V4i1.1210

Gaffar, NF, Khidri, M., & Mahmud, NU (2021). *Description of Dust Levels in the Antang Lime Factory Environment, Makassar City* . *2* (1), 941–949.

Gusti, A., Arlesia, A., & Anshari, LH (2018). Declining Health Status of Traders Due to Exposure to PM10 Dust. *Indonesian Public Health Media* , *14* (3), 233--240. https://Media.Neliti.Com/Media/Publications/267621-None-C8fc89e9.Pdf

Jusuf, H., Prasetya, E., & Igirisa, N. (2023). Analysis of Environmental Health Risks of Exposure to Particulate Matter (PM10) and Carbon Monoxide (CO) in the Community in Buata Village, Botupingge District. *Sulolipu: Communication Media for Academics and the Community* , *23* (1), 187. https://Doi.Org/10.32382/Sulolipu.V23i1.3155

Lintas, L., Ungaran, D., Pertiwi, KD, Lestari, IP, & Afandi, A. (2024). *Pro Health Scientific Journal of Health Environmental Health Risk Analysis of Exposure to Pm10 and Pm2 Dust. 5. 6.* 85–91 .

Central Mawasangka Community Health Center (2024)

Sentosa, EA, Riviwanto, M., & Seno, BA (2022). Risk Analysis of Lung Function Disorders Due to Exposure to PM10 Dust in Wood Furniture Workers. *Journal of Environmental Sanitation* , *2* (1), 30–37. https://Doi.Org/10.36086/Jsl.V2i1.1239

Septiana, LP (2021). Analysis of the Relationship between Total Dust Level Exposure and the Incidence of Acute Respiratory Infections (ARI) in Silver Craftsmen in Tanjung Batu Village, Ogan Ilir. *Thesis. Sriwijaya University* . https://Repository.Unsri.Ac.Id/46456/58/Rama_13251_10031181722041_0030019103_Front_Ref.Pdf

Siregar, DR (2023). *Analysis of the Risk of Exposure to PM10 Dust in Palm Oil Mill Workers (Pks) at PT. Kresna Duta Agroindo in*

2022 .

Study, C., Village, J., District, EM, Regency, L., Agustan, J., & Hariani, PL (2024). *The Relationship of Pm 2 . 5 and Pm 10 in Ambient Air to Acute Respiratory Infection (Case Study of Tanjung Jambu Village, Merapi Timur District, Lahat Regency) The Relationship of Pm 2 . 5 and Pm 10 in Ambient Air to Acute Respiratory Infection* . *6* (2), 1–8.

Yudi Akbar, F., Onny Setiani, & Yusniar Hanani Darundiati. (2024). Analysis of Dust Exposure with Respiratory Disorder Symptoms in Brick Industry Workers: Literature Review. *Indonesian Health Promotion Publication Media (Mppki)* , *7* (1), 101–109. https://Doi.Org/10.56338/Mppki.V7i1.4633