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ANALYSIS OF ENVIRONMENTAL HEALTH RISKS FOR EXPOSURE TO HYDROGEN SULFIDE (H2S) GAS IN AMBIENT AIR TO SCAVENGERSAROUNDCIPAYUNG TPA

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ABSTRACT

It is predicted that waste in the world will continue to increase in 2050 which will reach 3.40 billion tons. Hydrogen Sulfide (H_2S) gas produced from decomposition of waste could be smelled, if its concentration in the air at around 0,0005 - 0,3 ppm. H_2S concentrations can cause health problems, such as eye irritation, throat irritation, breathing difficulty for people having asthma, headaches, and fatigue. Scavengers are a group of people who have health risks that need more attention, because they are exposed to hydrogen sulfide gas. Hence, the purpose of this research was to invastigated H_2S gas concentrations at Cipayunglandfilland also to estimate and analyze the amount of health risks of scavengers at Cipayunglandfillon hydrogen sulfide (H_2S) gas exposure in 2019.Methods of this research wasdescriptive analytic with cross sectional study design and interview method. The approach used in this research is Environmental Health Risk Analysis approach ARKL, with the number of sample 46 scavengers who have been working more than 1 year at CipayungTPA. The sampling technique uses the purposive sampling. The resultsisthe average of H_2S concentrations in CipayungTPA was 0.05 mg/m3 (exceeding quality standard). The current level of H_2S risk (realtime) and the next 30 years (lifetime) would be occurring the non-carcinogenic risks. Therefore, the safe concentration average is 0.021 mg / m3, safe exposure time 3 hours/day, and safe exposure frequency 117 days/year. The statistical test result of $\alpha < 0,05$, there is a significant weight relationship with a minimum risk level (p-value=0,000) with OR = 18,889 and there is significant exposure time relationship with a minimum risk level (p-value=0,006) with OR = 3,510.Suggetion is Depok City Government that is to follow-up regarding to health risk management especially for scavengers at Cipayung TPA.

Keywords: Hydrogen Sulfide, Scavenger, Final Disposal Site.

I. INTRODUCTION

Increasing the numbers of population rapidly can cause the problems in environmental degradation.It is increasing landfill. Garbage iswaste material of activities man and nature that can't be used again because of element or function had been used (Sejati, 2009).

Waste problem in the urban is the volume of waste exceeds the capacity of the Place Final Disposal (TPA). TPA is a place for saving and destroying waste in that way that can give the negative effect (Andhika and E.P Tofan, 2016). One of the problems for environment around TPA is the occurrence of pollution by leachate generated from waste and water pollution by leachate generated from waste and air pollution from biogas generated by landfill if it is not managed and handled well (Wahyono, 2001).

In the report of Bank Indonesia (2008), predicted that the waste in the world would increase in the 2050 reached 3.40 billion ton. Based on the data of Indonesian Environmental Statistics 2018, provinces in Indonesia which produce the highest waste in Java are Surabaya produces waste about 9.896,78 m3 per day and Jakarta produces waste about 7.164,53 m^3 (BPS, 2018). Depok is one of City in West Java Province with having population fast growth. Based on BPS in Depok (2018), population density in 2017, it was 11.256 people/km^2 that produce waste each person around 3.5 liter per day.

One of the problems at the TPA Cipayung, is excessive waste capacity. Therefore, it gives bad smell impact that comes from landfill. Waste disposal in landfill can cause consequent air pollution by the decomposition process in waste. The decomposition process can produces some gas component such as hydrogen sulfide (H_2S), methane(CH_4), carbon dioxide (CO_2), nitrogen (N), Oxygen (O_2), and ammonia (NH_3) (US EPA, 1991).

Hydrogen sulfide is a flammable gas, no colored, smelled like rotten eggs and gaseous, and the main line of exposure by inhalation. H_2S can be smelled if concentration in the air starting from 0.0005 to 0.3 ppm. In low concentration can cause health problems, such as eyes irritation, throat irritation, difficulty breathing on asthma sufferers, headaches, and easy tires (ATSDR, 2018).

Scavenger is one of people that collect the materials or goods that have thrown away as a trash. Therefore, they have health risk that should be taken after. Scavengers are very vulnerable exposed to polluting gas from garbage decomposition process. The reason is because they have daily activities in the TPA environment and where they live around the landfill (Singga, 2014).

Based on the data above, the researcher interest in researching to know H_2S gas concentration in the landfill Cipayung and estimate the amount health risks as well as to know the safety limit through hydrogen sulfide gas (H_2S) to scavengers at Cipayung TPA in 2019.

II. RESEARCH METHODOLOGY

This type of this research is analytic descriptive with study design cross sectional. The approach that used is the Analysis in Environmental Health Risk approach (ARKL) which is a measurement of concentration hydrogen sulfide gas concentration as well as do interviewing related characteristics anthropometry and activity patterns scavengers to count rates risk of scavengers working at the TPA Cipayung Depok City.

This research is located in TPA Cipayung. Time of this research is carried out in May-June 2019. Sample the object used is two points air sampling consist of unloading point and shorting point. Sample the subject used are 46 scavengers with age > 18 years old and have been working for more 1 year.

The variable will be researched are independent variable as follows: hydrogen sulfide gas concentration, time of exposure, frequency of exposure, duration of exposure, body weight, inhalation rate, and intake of H_2S gas exposure. As well as dependent variable is the risk quotients (RQ).

The analysis of the data conducts univariate analysis, Analysis in Environmental Health Risk (ARKL), and bivariate analysis. To count risk level, find the value of hydrogen sulfide gas intake out with the formula as follows:

$$I_{nk} = \frac{\text{C x R x } t_E \text{x } f_E \text{ x } D_t}{W_b \text{ x} t_{avg}}$$

Information:

I_{nk} = Total the concentration of risk agents (mg) entering the body with a certain body weight (kg) per day.

C = Concentration of the risk agent in ambient air.

R = Rate of the inhalation or the volume of air enters each hour. In this study is carried out on adult scavengers, and R = 0.83 m3/hour.

t_E = The period or number of hours the exposure occurred per day.

f_E = The period or number of days the exposure occurred per year.

D_t = The period or number of years the exposure occurred.

W_b = Body weight of human / population / group of population.

T_{avg} = The period of mean time for non-carcinogenic effect, it is Dt x 265 days/year.

The value of RQ (Risk Quotients) indicated the level of risk to human health due to exposure to hydrogen sulfide gas. If the RQ value is≤ 1, the exposure is still below the normal limit and the scavengers safe from non-carcinogenic risk, otherwise, if the RQ value is≥ 1 then the scavengers are at non -carcinogenic risk. To find out the RQ value, the researcher uses the formula as follows:

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

Information:

(*RQ*) = Risk Quotients for the effect of non-carcinogenic in inhalation exposure line.

I = Intake that had been counted

RfC = Risk agent reference value on inhalation exposure.

III. RESULT

Univariate Analysis

Based on the result of the average scavengers' age in TPA Cipayung is around 45.52 years with the oldest is 64 years old and the youngest is 25 years old. There are 32 male scavengers (69.6%) and 14 female scavengers (30.4%). The scavengers who work in TPA Cipayung have an average body weight around 53.39 kg with the lowest body weight is 40 kg and the highest is 84 kg.

Exposure time of scavengers < 8 hours per day as many as 14 scavengers (30.4%), for 8 hours per day as many as 16 scavengers (34.8%), and > 8 hour per day as many as 16 scavengers (34.8%) with an average exposure time of scavengers is 8 hours per day.

The minimum exposure frequency of scavengers is 183 days per year and the maximum are 285 days per year. The minimum exposure duration of scavengers is 2 years and the maximum is 27 years. The mean duration of scavenger exposure is 11.91 years. The inhalation line using the default value for adults is 0.83 m^3 /hr.

The Concentration of Hydrogen Sulfide Gas in TPA Cipayung

The source of exposure of hydrogen sulfide gas in TPA Cipayung comes from the garbage disposal of Depok City. Based on the result of measurements of hydrogen sulfide gas at 2 points in TPA Cipayung, it is obtained as follows:

Table 1. Results of Measurement of Hydrogen Sulfide Gas at TPA Cipayung

Point Samples	Concentration H_2S		TLV	Information
	ppm	mg/m^3		
Unloading Point	0.06	0.08	0.02	>TLV
Sorting Point	0.02	0.02	0.02	>TLV

Based on the table 1, the result of the analysis of the concentration of hydrogen sulfide gas at two points have exceeded the quality standard, namely at the unloading point of 0.06 ppm or 0.08 mg / m^3 and the sorting point of 0.02 ppm or 0.02 mg / m^3 with a quality standard value of hydrogen sulfide is 0.02 ppm based on KeMen LH Number 50 of 1996.

The RespondentsHealth Problem Complaints

Complaints of health problems felt by scavengers are 33 people (71.7%) get cough, 22 people (47.8%) are out of breath, 13 people (28.3%) feel sore throat, 13 people (28.3%) feel chest pain, and 11 people (23.9%) have eyes irritation.

Environmental Health Risk Analysis

1. Hazard Identification

Hydrogen sulfide gas enters to body through the inhalation line. Hydrogen sulfide gas doesn't have effect of cancer case then in this research use effect of non-carcinogenic. Scavengers in TPA Cipayung have health problems such as cough, out of breath, chest pain, sore throat, and eyes irritation.

2. Dose Response Analysis

The dose response analysis of hydrogen sulfide gas conducts RfC value which refresh to Intergrated Risk Information System (IRIS) by U.S. Environmental Protection Agency (2003). It is either $2\ x\ 10^{-3}$ or 0.002 mg / m^3.

3. Exposure Analysis

Based on the calculation results, real time intake and lifespan intake are obtained using the formula:

$$I_{nk} = \frac{\text{C x R x } t_E \text{x } f_E \text{ x } D_t}{W_b \text{ x} t_{avg}}$$

Table 2. The distribution of Real time and Lifespan Intake

Exposure	*Intake*(mg/kg/day)	
	Realtime	*Lifespan*
Minimum	0.0019	0.0093
Maksimum	0.0079	0.0375

Based on the table 2, minimum exposure of real time intake to scavengers is 0.0019 mg/kg/day and lifespan intake is 0.0093 mg/kg/day. Otherwise maximum exposure of real time intake is 0.0079 mg/kg/day and lifespan intake is 0.0375 mg/kg/day.

1. The Characteristics of Risk

Based on the calculation result, the risk quotients (RQ) value is obtained by using the formula:

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

The following results are:

Table 3. The Distribution of Risk Quotients (RQ) Realtime and Lifespan

Exposure	RQ	Total	
		f	%
Realtime	RQ ≤ 1	26	56.5
Minimum	RQ > 1	20	43.5
Lifespan	RQ ≤ 1	1	2.2
Minimum	RQ > 1	45	97.8
Realtime	RQ ≤ 1	0	0
Maksimum	RQ > 1	46	100
Lifespan	RQ ≤ 1	0	0
Maksimum	RQ > 1	46	100

Based on the table 3, the minimum risk quotients of *lifetime* unsafe scavengers or RQ > 1 are 20 people (43.5%) until the next 30 years *lifespan*with RQ value > 1 are 45 people (97.5%) or are at risk of non-carcinogenic effect. Meanwhile, the maximum risk quotients of real-time and lifespan scavengers exposure with RQ value > 1 are 46 people (100%) who had a risk of non-carcinogenic effect due to exposure to hydrogen sulfide gas.

2. Risk Management

Based on the result of estimation calculations due to hydrogen sulfide gas exposure to scavengers in TPA Cipayung, it is known in the next 30 years projections with a minimum RQ value >1, there are 45 people, otherwise with a maximum RQ value >1, there are 46 people, or it is concluded that all samples in this study are at risk in health problems that caused by hydrogen sulfide gas.

Therefore, risk management is needed in order to protect these scavengers. Several strategies in risk management are carried out by:

a) Determine the Safe Concentration

$$C_{nk\,(aman\,)} = \frac{RfC \text{ x } W_b \text{ x } t_{avg}}{R \text{ x} t_E \text{x } f_E \text{ x } D_t}$$
$$= \frac{0.002 \text{ x } 53.39 \text{ x } 4380}{0.83 \text{ x8x } 272 \text{ x } 12}$$

$$= 0.021 \text{ mg/m}^3$$

The calculation result of safe concentration is obtained the value 0.021 mg/m^3. The value is lower with the specified hydrogen sulfide gas quality standards it is 0.0278 mg/m^3. Therefore, the value is safe for the scavengers having body weight 53.39 kg with an exposure frequency of 272 days/year, and an exposure time of 8 hours/day.

b) Determine the Time of Safe Exposure

$$t_{Enk\,(aman\,)} = \frac{RfC \text{ x } W_b \text{ x } t_{avg}}{C \text{ xRx } f_E \text{ x } D_t}$$

$$t_{Enk\,(aman\,)} = \frac{0.002 \text{ x } 53.39 \text{ x } 4380}{0.05 \text{ x}0.83\text{x } 272 \text{ x } 12}$$

$$= 3.45 \text{ hours/day} = 3 \text{ hours/day}$$

The calculation result of safe exposure time is 3 hours/day. The safety value is not in accordance with the average length of time that the scavengers work, which is 8 hours/day and concentration of hydrogen sulfide gas is 0.05 mg/m^3. To minimize the non-carcinogenic effect of scavengers in TPA Cipayung, scavenger with a body weight of 53.39 kg and have been working for 12 years will safe with an exposure time for 3 hours/day.

c) Determine the Frequency of Safe Exposure

$$f_{Enk\,(aman\,)} = \frac{RfC \text{ x } W_b \text{ x } t_{avg}}{C \text{ xRx } t_E \text{ x } D_t}$$

$$f_{Enk\,(aman\,)} = \frac{0.002 \text{ x } 53.39 \text{ x } 4380}{0.05 \text{ x}0.83\text{x } 8 \text{ x } 12}$$

$$= 117.39\text{hari/tahun} = 117\text{hari/tahun}$$

The calculation result for safe exposure frequency is 117 days/year. The result is not accordance with the average of exposure frequency to scavengers namely 272 days/year. To keep scavengers safe in concentration of 0.05 mg/m^3, it is suggested to work 117 days/year for scavengers with a body weight of 53.39 kg working for 8 hours with an exposure length of 12 years.

Bivariate Analysis

Table 4. The Relationship between Body Weight, Exposure Time, Exposure Frequency, Exposure Duration with Minimum Risk Quotients for The Scavengers in TPA Cipayung

Variable	Risk Quotients (RQ)				OR (95% CI)	*P-value*
	> 1		≤ 1			
	n	%	n	%		
Body Weight (kg)						
≤ 51	17	73.9	6	26.1	18,889 (4,093-87,172)	0,000
> 51	3	13.0	20	87.0		
Exposure Time (hours/day)						
> 8 jam	12	75.0	4	25.0	3,510 (1,462-8,428)	0,006
8 jam	5	31.3	11	68.8		
< 8 jam	3	21.4	11	78.6		
Exposure Frequency (days/year)						
≥ 280	12	44.4	15	55.6	1,100 (0,336-3,600)	1,000
< 280	8	42.1	11	57.9		
Exposure Duration (year)						
≥ 8 tahun	13	56.5	10	43.5	2,971 (0,884-9,983)	0,136
< 8 tahun	7	30.4	16	69.6		

Based on table 4, the result of the *chi-square* statistical test with *fisher* exact is obtained *p-value* = 0.000 (α = 0.05); therefore, it can be concluded that there is significant between body weight with minimum risk quotients for scavengers in TPA Cipayung with the value of OR = 18,889 (4,093 – 87,172), it means the scavengers having body weight ≤ 51 kg chance 18.889 times to have risk quotients > 1 or risk of having health problems due to exposure to hydrogen sulfide gas.The result of the *chi-square* with *Person Chi-Square* is obtained *p-value* = 0,006 (α = 0.05); therefore, it can be concluded that there is significant between exposure time with minimum risk quotients for scavengers in TPA Cipayung with the value OR = 3,510 (1,462 – 8,428), it means the scavengers have been working for more than 8 hours/day chance 3,510 times to have risk > 1 or risk of having health problems due to exposure to hydrogen sulfide gas.The result of *chi-square* statistical test with *fisher exact* is obtained *p-value* = 1,000 (α = 0.05); therefore, it can be concluded that there is no significant between

exposure frequency with minimum risk quotients for scavengers in TPA Cipayung with the value OR=1,100 (0,336 – 3,600), it means the scavengers have been working for more than 280 days/year chance 1,100 times to have risk > 1 or risk of having health problems due to exposure to hydrogen sulfide gas.

The result of *chi-square* statistical test with *fisher exact* is obtained *p-value* = 0.136 (α = 0.05); therefore, it can be concluded that there is no significant between exposure duration with minimum risk quotients for scavengers in TPA Cipayung with the value OR = 2,971 (0,884 – 9,983), it means the scavengers have been working for more than 8 years chance 2,971 times to have risk > 1 or risk of having health problems due to exposure to hydrogen sulfide gas.

IV. DISCUSSION

Univariat Analysis

The average age of the Scavengers in TPA Cipayung is 45.52 years. According Azizah (2011) that the age can affect the toxicity in the body of the elderly (> 45 year), because it can be a decrease in the function of the body organs, thus affecting metabolism and decreased muscle work.The scavenger men are 32 people (69.6%) and women are 14 people (30.4%). According WHO (2003), that the men are more sensitive to the effect of exposure hydrogen sulfide gas, that is decreasing in oxygen absorption is greater than women by 5% - 18%.

The average body weight of the scavengers in TPA Cipayung is 53.39 kg. It is measured in the range of 40 to 84 kg. Based on the standard adult body weight set by the US EPA (2011), it is 70 – 80 kg. Therefore, body weight of the scavengers is smaller than had been set by US EPA. In study of the Environmental Health Risk Analysis (EHRA), if the body weight is getting smaller, the *intake*received is getting bigger. This thing is caused by the function of body weight as a denominator or divider in the *intake* formula (Ministry of Health, 2014).

The inhalation rate in this research uses a default value of 0,83 m3/hour. It is based on Djafri (2014) that the intake calculation requires default values of several exposure factors. The default value can use several correction and conversion factors according to the need for adjusting anthropometric characteristics (Djafri, 2014).

Based on the result of the research, is obtained the exposure time of the scavengers which have more than 8 hours are 16 people (34.8%). This is because the scavengers do not have limited time to work. The result of this research have the relationship with the research of Andhika, et al (2016) that the exposure time of the scavengers at TPA Mrican which is 8 hours/day are 22 people.

The average value of the exposure frequency of the scavengers in TPA Cipayung is 272.04 days/year with a minimum exposure frequency is 183 days/year and maximum is 285 days/year. Based on research of Rifa'i, et al (2016) that the minimum exposure frequency of the scavengers at TPA Jatibarang Semarang City is 300 days/year and the maximum exposure frequency is 360 days/year. The value of the exposure frequency is already more than the default value of exposure in the work environment, which is 250 days/year.

The average of the exposure duration of the Scavengers in TPA Cipayung is 11.91 years with the longest exposure duration 27 years. In the research of Rifa'i, et al (2016) that the average of the exposure duration of the scavengers at TPA Jatibarang Semarang City is 7.12 years. Based on research of people who have exposed to hydrogen sulfide gas for 4 years can cause the effects, one of the effects is respiratory insufficiency, to death involving nerveous system and central respiration (Arnold, et al, 1985 in WHO, 2003).

Hydrogen Sulfide Gas Concentration in TPA Cipayung

In this research, the result of the measurements is used as a minimum value at a concentration of 0.02 mg/^{m3}, and a maximum value at a concentration of 0.08 mg/m^3. It is because the scavengers activities is mostly carried out at the unloading point and the sorting point, so the scavengers can be exposed to hydrogen sulfide gas at concentrations that have been measured at the unloading point and the sorting point.

Human be able to inhale the smell of hydrogen sulfide gas at low concentration 0.5 ppm until 1 ppm. Based on the information of *Connecticut Departement of Public Health*, hydrogen sulfide gas concentration that contained in the air in TPA is ± 15 ppm. Hydrogen sulfide gas having concentration 500 ppm can cause *asphyxiant*, *edema pulmonary*, and death (Andhika& E P Tofan, 2016).

Complaint of Respondents Health Problems

At the larger concentration, olfactory paralysis can occur because hydrogen sulfide gas is very dangerous. In short-term exposure to high concentration, hydrogen sulfide causes many health effects, such as disruption of the respiratory system, neurological, cardiovascular, metabolic, reproductive, and ocular effects. Based on these effects, the effect of breathing is the most sensitive end point in humans after exposure to hydrogen sufide gas through inhalation (WHO, 2003).

Environmental Health Risk Analysis

Based on the calculation result of hydrogen sulfide gas in two points TPA Cipayung is obtained the concentration at the sorting point is 0.02 mg/m^3. Meanwhile, the concentration at the loading point is 0.08 mg/m^3 that has exceeded the odor quality standard. The concentration has exceeded the predetermined quality standard value. In low concentration it can cause health problem, such as eye irritation, throat irritation, difficulty breathing in people with asthma, headaches, and fatigue (ATSDR, 2016).

Dose response analysis is used to determine the relationship between the magnitude of chemical exposure dose and the occurrence of adverse effects on human health. This analysis is to determine the quality of the toxicity of risk agents that have the potential to cause adverse health effects in populations at risk (Siswati&Dinayah, 2017). The RfC value of hydrogen sulfide gas in this research uses the reference dose value from the Integrated Risk Information System (IRIS), which is 2 x 10^{-3}. This value is based on the research by Brenneman et al (2000) with an experimental dose if nasal lesions on the olfactory mucosa with NOAEL of 13.9 mg/m^3 (10 ppm) (US EPA, 2003).

The analysis of exposure aims to determine the line of exposure to risk agents in order to calculate the amount of intake or intake received in the population at risk. In determining the exposure analysis, the amount of risk agent intake that enters the body through inhalation is calculated. Intake is expressed as the number of exposures received by the individual per kilogram of body weight per day. Intake can be calculated in real time or duration of actual exposure and lifetime or lifetime calculated exposure.

The scavengers have different patterns of activity, exposure patterns, and anthropometry so that the intake values received vary. The scavengers who have overweight and have short duration of exposure will have minimal risk. Meanwhile, scavengers who inhale hydrogen sulfide gas with excessive quality standards will have a risk of respiratory tract disorders. The amount of risk to these scavengers is influenced by the amount of intake in each individual (Simbolon, 2018).

Bivariat Analysis

1. **The Relationship between Body Weight with Minimum Risk Quotients (RQ) to the Scavengers in TPA Cipayung 2019**

The results of the chi-square statistical test with Fisher exact is obtained the p-value = 0.000 (α = 0.05). This research have no relationship with the research of Sianipar (2009) which states that there is no relationship between the risk quotients and body weight of scavengers in TPA Ganet with a p-value = 0.645.

Environmental Health Risk Analysis (ARKL), if the body weight is getting smaller, the intake will be bigger. This is because body weight functions as a denominator or divider in the intake formula (Ministry of Health, 2014).

2. **The Relationship between Exposure Time with Minimum Risk Quotients (RQ) to the Scavengers in TPA Cipayung 2019**

The results of the chi-square statistical test with Person Chi-Square is obtained p-value = 0.006 (α = 0.05). This research have relationship with Sianipar (2009) that there is a relationship between exposure time and the risk quotients for scavengers in TPA Ganet with a p-value = 0.009.

The timing of this exposure greatly influences the exposure and intake values which can pose a health risk. If the time of exposure is greater, the gas intake that is inhaled into the body will increase. If exposed in the maximum time, there is a greater chance that scavengers will have an unsafe risk (Perdana, 2015).

3. **The Relationship between Exposure Frequency with Minimum Risk Quotients (RQ) to the Scavengers in TPA Cipayung 2019**

The results of the chi-square statistical test with Fisher Exact is obtained p-value = 1,000 (α = 0.05), so it can be concluded that there is no significant relationship between the frequency of exposure and the minimum risk quotients for scavengers at the Cipayung TPA with an OR = 1,100, it means that scavengers who working for more than 280 days/year had a 1,100 times chance of having a risk level of> 1 or the risk of experiencing health problems from exposure to hydrogen sulfide gas. The researcher assumed that the frequency of the exposure was not related because the researcher only asked about the length of the scavengers holidays during the holidays, so he did not know the length of the scavenger holidays in one year. This can affect the frequency of hydrogen sulfide gas exposure to the scavengers. According to Wardani (2012) in Perdana (2015) that the greater frequency of a person being exposed to hazardous substances in ambient air in one year, the greater the health risk received.

4. The Relationship between Exposure Duration with Minimum Risk Quotients (RQ) to the Scavengers in TPA Cipayung 2019

The results of the chi-square statistical test with Fisher Exact is obtained p-value = 0.136 (α = 0.05), so it can be concluded that there is no significant relationship between the duration of exposure and the minimum risk quotients for scavengers at the Cipayung TPA with an OR = 2,971, it means that scavengers who working for more than 8 years had a 2,971 times chance of having a risk level of > 1 or the risk of experiencing health problems from exposure to hydrogen sulfide gas. This research is not correlate with Sianipar (2009) which states that there is a relationship between the level of risk of health problems for scavengers at Ganet TPA who have worked for 15 year and scavengers who have worked for 15 years and scavengers who have worker for less than 15 years with an OR = 4,000.

According to Rahman, et al, (2008), the more often and longer a person is in a polluted or polluting environment, the greater the number of risk agents that enter the body so that health effects can occur.

To reduce the intake of scavengers, it is done by determining the safe limit / lowest risk by reducing contact with exposure in the form of minimizing the existing activity patterns in the Cipayung TPA. In addition, the risk of exposure to hydrogen sulfide gas can be controlled by using a technological approach that can be used to reduce the concentration of hydrogen sulfide gas in the Cipayung TPA.

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