

# 67. Polluters, Latex, 2021

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## CHARACTERISTICS OF POLLUTERS IN THE WORKING ENVIRONMENT OF PT X PALEMBANG CITY

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### 2 ABSTRACT

Rubber is one of the leading commodities in South Sumatra. In each of these forms of natural rubber production causes pollution in air, water, odor, and tatal/solid waste. This research will measure the concentration of ammonia (NH<sub>3</sub>) and hydrogen sulfide (H<sub>2</sub>S) in air, liquid and solid waste in the rubber factory environment. At the time of measurement in the air the average temperature was 31.9 C, the average pressure was 1011.75 bar, and the average humidity was 70.9%. The dominant wind is to the southeast. The highest concentrations of NH<sub>3</sub> and H<sub>2</sub>S are in the leum area. The concentration of each is 1.51 ppm with an average of 1.03 ± 0.42 ppm and 9.34 ppm with an average of 2.97 ± 4.29 ppm. The concentration of NH<sub>3</sub> and H<sub>2</sub>S in wastewater is the highest in wastewa 5 treatment. The concentrations of each were 65 mg/l with a mean of 33.67 ± 27.79 mg/l and 1.70 mg/l with a mean of 0.79 ± 0.82 mg/l. The highest NH<sub>3</sub> concentration was 3 total, while the highest H<sub>2</sub>S concentration was in the slab 3 the concentrations of each were 194.88 mg/Kg with an average of 148.88 ± 65.05 mg / Kg and 1.37 mg/Kg with an average of 1.27 ± 0.15 mg/Kg.

KEY WORDS: Rrubber, NH<sub>3</sub>, H<sub>2</sub>S, Rubber factory environment

### INTRODUCTION

2 Rubber is one of the leading commodities of South Sumatra (Directorate Gene 21 of Plantation, 2017; Permentan No. 38, 2008). Most of these natural rubber factories are in Palembang City (Gapkindo, 2020). In each of these forms of natural rubber production has an impact on the environment, workers and society. Common impacts are air pollution, water, odors (Pajarito *et al.*, 2018; Tekasakul and Tekasakul, 2006), and solid waste (Rahmaniar and Susilawati, 2018; Supraptiningsih and Sarengat, 2014). In rubber factories, air quality analyzes revealed the smell of ammonia (NH<sub>3</sub>) and hydrogen sulfide (H<sub>2</sub>S) (Promnuan and O-Thong, 2017; Rattanapan *et al.*, 2014; Yani *et al.*, 2012). The routes of entry of NH<sub>3</sub> and H<sub>2</sub>S into the body are through inhalation, oral and dermal (Agency for Toxic Substances and Disease Registry, 2004, 2016).

NH<sub>3</sub> and H<sub>2</sub>S have almost the same toxic effects on various organ systems (Chi *et al.*, 2018).

All rubber factories have a characteristic pungent smell like rotten eggs and fishy. There are several sources of pollutants, namely air, liquid waste and solids. Workers are exposed to and in contact with these pollutants. This research will measure the concentration of ammonia (NH<sub>3</sub>) and hydrogen sulfide (H<sub>2</sub>S) in air, liquid and solid waste in the rubber factory environment.

### MATERIALS AND METHODS

#### In the Air

##### Hydrogen Sulfide (H<sub>2</sub>S)

The sample was absorbed using 10 mL of absorbent. The absorbent material was 4.3 g of CdSO<sub>4</sub>.8H<sub>2</sub>O and 1.8 g of NaOH. This solution was dissolved in

10 250 ml of distilled water and 10 g of arabinogalactant was added. Then the solution is diluted with distilled water 11 to 1000 ml. The sampling time was 60 minutes with a flow rate of 0.4 L/m. The sampling tool used the Air Sampler Impinger MS 003GS S/N 0031523.

The test sample solution (10 ml of Absorbent) is transferred to a 25 ml test tube. 1.5 ml paminodimethylaniline dihydrochloride and 1 drop of FeCl<sub>3</sub> solution are added to the test solution. The test tube was shaken slowly until it was homogeneous. After that, let the solution sit for 30 minutes. The sample solution is f<sub>6</sub> to the cuvette in the spectrophotometer. The absorbance was measured at a wavelength of 670 nm. The absorbance of the sample then calculates the concentration using a calibration curve. The H<sub>2</sub>S concentration is calculated using the formula below (National Standardization Agency, 2007):

$$C_1 = \frac{a_1 - a_b}{V_s}$$

note:

C<sub>1</sub> = H<sub>2</sub>S concentration in ambient air (ppm);

a<sub>1</sub> = the amount of H<sub>2</sub>S from the test sample (μl);

a<sub>b</sub> = H<sub>2</sub>S quantity of the reference solution (μl);

V<sub>s</sub> = volume of sample gas under normal conditions at 25 °C, 760 mm Hg (l).

(Badan Standardisasi Nasional 2007).

#### Ammonia (NH<sub>3</sub>)

The sample was absorbed using 6 10 ml of absorbent. The absorbent material was 3 ml of H<sub>2</sub>SO<sub>4</sub> 97% and 200 ml of cold distilled water. Then the solution is diluted with distilled water 11 to 1000 ml. The sampling time was 60 minutes with a flow rate of 0.4 L/m. The sampling tool used the Air Sampler Impinger MS 003GS S/N 0031523.

The test sample solution (10 ml of Absorbent) is transferred to 1 25 ml test tube. Add successively to each test tube 2 ml of buffer solution, 5 ml of phenol reagent solution and 2.5 ml of sodium hypochlorite reagent solution and then homogenized. Add distilled water to the test tube until it reaches a mark, then homogenize and let stand for 30 minutes. Enter the test sample solution into the cuvette on the spectrophotometer, then measure the absorption at a wavelength of 630 nm. The absorbance of the sample then calculates the concentration using a calibration curve. The H<sub>2</sub>S concentration is calculated using the formula below (National Standardization Agency, 2005a):

$$C = \frac{a}{V} \times 1000$$

note:

C = concentration of NH<sub>3</sub> in ambient air (ppm);  
a = the amount of NH<sub>3</sub> from the test sample based on the calibration curve (μg)

V = volume of inhaled air corrected under normal conditions at 25 °C, 760 mmHg

1000 = conversion from l to m<sup>3</sup>

In the Water

#### Hydrogen Sulfide (H<sub>2</sub>S)

1 A sample of 25 ml was put into a 50.0 ml volumetric flask. The sample is diluted with sulfide-free water to the mark. The solution was added with 0.5 mL of sulfuric acid-amine reagent and 0.15 ml of FeCl<sub>3</sub> solution (3 drops). The solution is immediately inverted (reversed once) slowly, let stand for 5 minutes. The solution is added with 1.6 ml of (NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub> solution, let stand 10. H<sub>2</sub>S concentration is calculated using the below (National Standardization Agency, 2009):

$$S^{2-} (mg/L) = \frac{A}{(\text{slope} \times V)} \times \frac{V_2}{V_1} \times f$$

note:

A = absorbance of the measured test sample

V = volume of test sample (ml)

V<sub>1</sub> = final volume of test sample (ml)

V<sub>2</sub> = initial volume of test sample (ml)

f = dilution factor

#### Ammonia (NH<sub>3</sub>)

A sample of 25 ml was put into a 50 ml Erlenmeyer. Add 1 mL of phenol solution. 1 ml sodium nitroprusside. 2.5 ml oxidizing solution. erlenmeyer covered with plastic. Color formation is left on for 1 hour. The solution 8 inserted into a cuvette on a spectrophotometer at a wavelength of 640 nm. The NH<sub>3</sub> concentration is calculated using the formula below (National Standardization Agency, 2005b):

Amonium level (mgN/l) = c x fp

note:

C = levels obtained from measurement results (mg/l)

fp = dilution factor

In the Solid

#### Hydrogen Sulfide (H<sub>2</sub>S)

A sample of 50 grams of rubber was added with 100 ml of concentrated HCL. The sulfide vapor is

collected directly with a sulfide absorber of 4.3 g of  $\text{CdSO}_4 \cdot 8\text{H}_2\text{O}$  and 10 g of NaOH. This solution was dissolved in 250 ml of distilled water and 10 g of arabinogalactant was added. The sample was absorbed using 10 ml of absorbent.

A sample of 7.5 ml was inserted into test tubes A and B, using a special wide tip pipette. For tube A, add 0.5 ml of amino-sulfate acid reagent and 0.15 ml of  $\text{FeCl}_3$  solution (3 drops). For Tube B add 0.5 ml of 1 + 1  $\text{H}_2\text{SO}_4$  and 0.15 ml (3 drops) of  $\text{FeCl}_3$  solution and stir, then wait for 5 minutes and add 1.6 ml  $(\text{NH}_4)_2\text{HPO}_4$  to each tube, wait for 10 minutes and do a color comparison. Sulfide concentrations from 0.1 to 2.0 mg/l were measured with a 1 cm light path. The calibration curves prepared by the colorimetric tests were made on  $\text{Na}_2\text{S}$  solution simultaneously analyzed by iodometric method. The sulfide concentration is read on a calibration curve. The  $\text{H}_2\text{S}$  concentration is calculated using the formula below (American Public Health Association, 2017):

note:

$C_1$  =  $\text{H}_2\text{S}$  concentration in ambient air (ppm);

$a_1$  = the amount of  $\text{H}_2\text{S}$  from the test sample (°L);

$a_2$  =  $\text{H}_2\text{S}$  quantity of the reference solution (°L);

$V_s$  = volume of sample gas under normal conditions at 25 °C, 760 mmHg (L).

(Badan Standardisasi Nasional 2007).

#### Ammonia ( $\text{NH}_3$ )

50 gm of rubber samples were extracted with 0.1 N sulfuric acid as much as 50 ml. Let stand for 24 hours. A sample of 25 mL was put into a 50 ml Erlenmeyer flask. The liquid is added with 1 ml of phenol solution, 1 ml of sodium nitroprussida solution, and 2.5 ml of oxidizing solution. The sample is covered with plastic wrap. The color is allowed to develop at room temperature of 27 °C and dim light for 1 hour. Measure absorbance at 640 nm. Then, make a standard liquid by diluting the stock solution of ammonia into the sample concentration range. The standard fluid is treated with the sample. The sample concentration is calculated by comparing the absorbance of the sample with a standard curve. The absorbance of the sample then calculates the concentration using a calibration curve. The  $\text{NH}_3$  concentration is calculated using the formula below (American Public Health Association, 2017):

note:

$C$  = concentration of  $\text{NH}_3$  in ambient air (ppm);

$a$  = the amount of  $\text{NH}_3$  from the test sample based

on the calibration curve ( $\mu\text{g}$ )

$V$  = volume of inhaled air corrected under normal conditions at 25 °C, 760 mmHg

1000 = conversion from L to  $\text{m}^3$

## RESULTS AND DISCUSSION

This research was conducted at PT X on 27 November -3 December 2019. PT. X is a company engaged in rubber processing. PT. X with a production capacity of  $\pm 4,000$  tons per month. Products produced by PT. X is SIR 10, SIR 20, SIR 10 VK, SIR 20 VK. Type VK is added to the drug in the process. Type SIR 10 VK, SIR 20 VK and SIR 20 VK KAWANOJI are only produced by PT. X. The products are exported to world tire factories. PT. X processes the raw material for rubber which is called Bokar (rubber processing material). Bokar is processed into semi-finished rubber, then exported abroad. Production is divided into two parts, namely part I (wet production) which processes raw materials to become blankets and production II (dry production) processes blankets into crumb rubber.

The basic material for rubber is latex. Latex is a colloidal dispersion system of poly (cis-1,4-isoprene) and  $(\text{C}_5\text{H}_8)_n$ . Latex will clot when added with a coagulant (Nasution, 2016; Purbaya, Sari, Putri, & Fajriaty, 2011). If the coagulants used are acidic but do not have antibacterial and antioxidant properties, natural antioxidant-destroying bacteria will develop. These bacteria will cause ammonia and sulfide concentrations (Research Center of Industrial plant and freshener, 2014; Solichin and Anwar, 2006; Tekasakul and Tekasakul, 2006; Towaha, Aunillah, and Purwanto, 2013). The results of measurements in air are in Table 1. The concentrations of  $\text{NH}_3$  and  $\text{H}_2\text{S}$  in the air were measured at 4 points. When measuring the average temperature of 31.9 C, the average pressure was 1011.75 bar, and the average humidity was 70.9%. The dominant wind is to the southeast. The highest concentrations of  $\text{NH}_3$  and  $\text{H}_2\text{S}$  are in the leum area. The concentration of each is 1.51 ppm with an average of  $1.03 \pm 0.42$  ppm and 9.34 ppm with an average of  $2.97 \pm 4.29$  ppm.

The  $\text{NH}_3$  concentration is still below the odor level standard while the  $\text{H}_2\text{S}$  concentration is above the odor level standard (Ministry of Manpower and Transmigration, 2011; State Minister for the Environment, 1996).  $\text{NH}_3$  and  $\text{H}_2\text{S}$  in biogas pose serious challenges to human health and the environment (Elizabeth *et al.*, 2017).  $\text{H}_2\text{S}$  above 1 ppm can have negative health effects (Malone *et al.*,

2017). H<sub>2</sub>S with chronic low exposure can have implications for cardiovascular health, nervous system and respiratory disorders (Bates *et al.*, 2002), but 15 years later, studies have found no negative effects (Bates *et al.*, 2017).

NH<sub>3</sub> and H<sub>2</sub>S have almost the same toxic effects on various organ systems. The toxic effects of H<sub>2</sub>S can affect the nervous system, respiratory system, cardiovascular system, digestive system, and immune system (Chi *et al.*, 2018). The toxic effects of NH<sub>3</sub> can affect the respiratory system, eye system, integumentary system, cardiovascular system, digestive system, and nervous system (EPA, 2016; Makarovsky *et al.*, 2008).

The results of measurements in water are in table 2. NH<sub>3</sub> and H<sub>2</sub>S concentrations were measured at 3 points. The highest concentrations of NH<sub>3</sub> and H<sub>2</sub>S in wastewater treatment. The concentrations of each were 55 mg/l with a mean of 33.67 ± 27.79 mg/l and 1.70 mg/l with a mean of 0.79 ± 0.82 mg/l.

The NH<sub>3</sub> concentration is still above the liquid waste quality standard, while the H<sub>2</sub>S concentration is below the liquid waste quality standard (Governor of South Sumatra, 2012; State Minister for the Environment, 2014). The combination of H<sub>2</sub>S and water can produce sulfuric acid which has a corrosive effect. H<sub>2</sub>S is the main compound which reacts with most metals and its chemical activity increases with increasing pressure and concentration, in the presence of water and at higher

temperatures. The combination of NH<sub>3</sub> and water can also cause stress corrosion cracking in carbon steel (Latosov *et al.*, 2017).

The measurement results in total/solid are in Table 3. The H<sub>2</sub>S concentration in the solids was measured in 2 parts. The highest NH<sub>3</sub> concentration was in total, while the highest H<sub>2</sub>S concentration was in the slab. The concentrations of each were 194.88 mg/Kg with an average of 148.88 ± 65.05 mg/kg and 1.37 mg/kg with an average of 1.27 ± 0.15 mg/Kg.

NH<sub>3</sub> and H<sub>2</sub>S concentrations are above the liquid waste quality standard (Governor of South Sumatra, 2012; State Minister for the Environment, 2014). Solid waste has no quality standards. So that we identify based on liquid waste. Slabs are processed rubber directly from farmers. Concentrations that exceed the quality standard can adversely affect farmers and workers in rubber factories, because they come into direct contact with the slab. Tatal is solid waste which is produced by rubber production. Processing 100 kg of latex yields about 3-5% yield (Rahmaniar and Susilawati, 2018). Until now, the tatal has not been used effectively. Tatal is still piled in the environment around the factory. Concentrations that exceed the quality standard can adversely affect the environmental ecosystem.

## CONCLUSION

At the time of measurement in the air the average

**Table 1.** The concentrations of NH<sub>3</sub> and H<sub>2</sub>S in the air at the PT X

No	Area	Concentrations (ppm)	
		NH <sub>3</sub>	H <sub>2</sub> S
1	Dock	1.25	1.68
2	Leum storehouse	1.51	9.34
3	Driyer 3	0.63	0.43
4	Employee housing	0.73	0.43
	Average±SD	1.03±0.42	2.97±4.29
	Odor level quality standards (State Minister for the Environment, 1996)	2.0	0.02
	Threshold value (Ministry of Manpower and Transmigration, 2011)	25	1

**Table 2.** Concentrations of NH<sub>3</sub> and H<sub>2</sub>S in the liquid waste of the PT X rubber factory working environment

No	Area	Concentrations (mg/l)	
		NH <sub>3</sub>	H <sub>2</sub> S
1	Leum storehouse	24	0.56
2	Breaker	12	0.12
3	Wastewater treatment	65	1.70
	Average ± SD	33.67 ± 27.79	0.79±0.82
	Liquid waste quality standards (Governor of South Sumatra, 2012; State Minister for the Environment, 2014)	15	0.8

**Table 3.** Concentrations of NH<sub>3</sub> and H<sub>2</sub>S in the environment of the PT X rubber factory

No	Units	Concentrations (mg/Kg)	
		NH <sub>3</sub>	H <sub>2</sub> S
1	Slab	102.88	1.37
2	Total	194.88	1.16
	Average±SD	148.88±65.05	1.27±0.15
	Liquid waste quality standards (Governor of South Sumatra, 2012; State Minister for the Environment, 2014)	15	0.8

temperature was 31.9 C, the average pressure was 1011.75 bar, and the average humidity was 70.9%. The dominant wind is to the southeast. The highest concentrations of NH<sub>3</sub> and H<sub>2</sub>S are in the leum area. The concentration of each is 1.51 ppm with an average of 1.03 ± 0.42 ppm and 9.34 ppm with an average of 2.97 ± 4.29 ppm. The concentration of NH<sub>3</sub> and H<sub>2</sub>S in wastewater is the highest in wastewater treatment. The concentrations of each were 5 mg/l with a mean of 33.67 ± 27.79 mg/l and 1.70 mg/l with a mean of 0.79 ± 0.82 mg/l. The highest NH<sub>3</sub> concentration was in total, while the highest H<sub>2</sub>S concentration was in the slab. The concentrations of each were 194.88 mg/Kg with an average of 148.88 ± 65.05 mg/Kg and 1.37 mg/Kg with an average of 1.27 ± 0.15 mg/Kg. The relationship between pollutants and the health impacts of workers in rubber factories is not yet known.

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