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ANALYSIS OF LEAD CONTENT (Pb) IN WASTE STREAMS AND WELL WATER AND PUBLIC HEALTH COMPLAINTS AROUND THE PAPER INDUSTRY IN BONDOWOSO

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Abstract

Wastewater in an industry which is often called liquid waste is a by-product produced by several human activities. Liquid waste pollution from industrial effluents containing lead (Pb) in dug well water used by the community for daily needs can cause poisoning and health complaints. This study aims to determine the content of lead (Pb) in the liquid waste stream and well water as well as public health complaints around the pulp and paper industry. This type of research was descriptive with the observational method. Liquid waste from the paper and pulp industry is known to contain heavy metal type lead (Pb), if it pollutes the environment around the industry it can cause various negative impacts for the community. There were 2 samples of dug well water 90 meters that have lead content above the quality standard, namely in well 8 and well 10 with lead content of 2,998 mg/L and 4,247 mg/L while for other dug well water it did not exceed the threshold value with results below 0.0085 mg/L. Based on the results of interviews with 40 respondents, most of the respondents who used dug well 8 and well 10 water experienced health complaints such as skin redness and itching on the hands and arms, and the most experienced redness, itching, and hot eyes after using dug well water contaminated with lead (Pb).

***Keywords**: Lead (Pb); Liquid Waste; Dug Well Water; Health Complaints*

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INTRODUCTION

Waste is the result of waste from the production process that is considered to have no economic value (Sunarsih, 2018). One of the negative impacts of industry is in the form of waste disposal that can cause health problems in humans, and pollution problems in the environment and can cause pollution to surrounding water sources, such as residents' wells. The burden of environmental pollution is getting heavier with the presence of chemical pollutants and heavy metals (Arief, 2016; Afrianti & Irni, 2019).Water used for daily needs has quality standards that have been set in accordance with the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017.

Based on study conducted by (Haryati *et al.,* 2012), liquid waste from paper production contains heavy metals such as iron (Fe), copper (Cu), cobalt (Co), zinc (Zn), lead (Pb). The highest concentration contained was heavy metal lead (Pb) which was 2.3458 ppm. Another study conducted by (Novita *et al.,* 2012) analyzed the results of the pulp and paper industry wastewater taken at the WWTP outlet in the Driyorejo Gresik area, which was disposed of in a class II river, was known to contain heavy metal Pb of 1,040 mg/l, which means it has exceeded the predetermined NAV.

According to WHO, 80% of industrial liquid waste in the world is disposed of carelessly, while in developing countries as much as 70% of industrial liquid waste is disposed of without being treated early. Based on the Ministry of Environment and Forestry, 75% of rivers in Indonesia are heavily polluted by liquid waste. Based on the green post community to Kompas media, in 2016 the liquid waste of the B3 waste industry in East Java reached 19.4 million tons per year or around 1.6 million tons per month. Based on Bondowoso Regency DLH data in 2017 and 2020, there was one industrial area that produced Pb waste. The resulting Pb levels were 0.002 mg/L, and <0.005 mg/L.

Paper industry X is one of the pulp and paper manufacturing industries located in Bondowoso Regency, which produces a type of cultural paper, namely joss paper. Based on East Java Governor Regulation Number 72 of 2013 to determine the pollution load in pulp and paper industrial wastewater is to measure the content of BOD, COD, TSS, pH, and Lead (Pb). Based on the explanation from the Ministry of Industry, joss paper is type of smooth paper, where

the Pb parameter is specific for industries that produce fine paper and bleached fine paper, and for the paper industry that carries out the deinking process.

Lead (Pb) is a carcinogenic heavy metal and able to pollute the environment such as water, soil, air, animals, plants, and humans. In 2013, WHO estimates that lead poisoning has resulted in around 143,000 deaths and 600,000 cases of intellectual disability in children each year (Sembel, 2015; Chandra, 2015).

Symptoms of lead poisoning include stomach pain, headache, nausea, fatigue, difficulty sleeping, nausea, weight loss, loss of appetite, difficulty concentrating, muscle weakness, anemia, kidney damage, coma, and death. Acute poisoning shows neurological signs of pain, abdominal pain, vomiting, diarrhea, and constipation (Sembel, 2015).

The liquid waste generated from the X paper industry is disposed of through the surrounding residential areas. The dump is like a river with a width of 1-3 meters. The volume of waste will increase when the industry carries out the disposal process. The condition of the liquid waste is brownish green, emits a pungent odor, and is slightly foamy. Based on data from DLH Bondowoso has conducted laboratory tests on industrial liquid waste X, the parameters tested include temperature, turbidity, dissolved residue, suspended residue, Electrical Conductivity, COD, pH, and Sulfide, while for lead (Pb) there was no analysis has been done. There were community wells that were close to the liquid waste flow body with a distance of 14-95 meters and use well water for daily needs. Based on this description, the researchers aims to determine the lead (Pb) content in the flow of liquid waste and well water as well as public health complaints around the X paper industry in Bondowoso Regency.

MATERIALS AND METHODS

This study was conducted around the X paper industry environment in Bondowoso Regency, and dug wells belonging to residents in the settlements around the X paper industry liquid waste stream, as well as Banyuwangi Regency Environmental Service Laboratory. This study was carried out in October – November 2020.

Sampling of liquid waste used a grab sampling technique. According to SNI 6989.57 (2008) the grab sampling method is a method of collecting wastewater taken momentarily at a certain location. Sampling of well water and respondents in the study used a total

sampling technique. According to Sugiyono (2018) a saturated sample or what is often referred to as total sampling is a sampling technique by taking all members of the population or respondents as a sample. Sampling of liquid waste and well water samples was carried out based on SNI 6989.57-2008 (National Standardization Agency, 2008). The tools used for sampling liquid waste and dug well water include 500ml glass bottles, HNO3 solution, coolbox, gloves, plastic pipettes, meters, pH paper, labels, ice cubes, ballpoint pens and buckets. Liquid waste sampling was carried out at one stage of the production process. Based on SNI 6989.58 (2008), it was known that the method of taking groundwater samples consists of several procedures. The first is to prepare a water sampling device that is in accordance with the type of water to be tested. Rinse the water sampler with the water sample to be taken as much as 3 times. Put it in a container suitable for analysis. After rinsing, water samples were taken. Preservation with 2ml HNO3 solution for 500ml bottles or until the sample pH <2.

Data collection techniques in this study were interviews, observation, documentation, and laboratory tests. Data collection techniques can be carried out in various ways, for example interviews, questionnaires, observation, or a combination of the three (Sugiyono, 2018).

RESULTS AND DISCUSSION

1. Overview of the Physical Condition of Liquid Waste and Well Water

Table 2. Physical Condition of Liquid Waste

No.	Parameter	Yes		Not	
		N	%	N	%
1.	Smell	2	20	8	80
2.	Color	2	20	8	80
3.	Flavor	2	20	8	80

Based on the observation results regarding the physical condition of paper liquid waste and dug well water, it was found that industrial X liquid waste that was disposed of directly into residential areas had a dark brown color and emitted a strong stench, there was sediment such as blankets and foam on the surface of the liquid waste, for the physical condition of while the dug wells of the surrounding community, it was found that 2 samples of dug well water had poor water quality, which was characterized by smell, taste, and color. Water can be categorized as clean if: it looks clear (colorless), does not smell, and has no taste so that when consumed it does not cause side effects.

2. Description of the Use of Dug Well Water and Health Complaints to the Community.

The dug well water was used by the community to meet daily needs such as toilets (bathing, washing, latrine) and also for consumption needs. Based on the results of interviews with as many as 40 respondents have used dug well water for > 1 year. Wells that were used for a relatively long time have a greater possibility of contamination because in addition to increase pollutant sources, it is also easier for pollutant sources to seep into the well following the ground water flow in the form of converging to the well (Handriyani *et al.,* 2020).

Utilization of dug wells indicates that as many as 14 respondents (35%) used dug well water only for toilet purposes, and as many as 26 respondents (65%) used dug well water for consumption and toilet. Dug wells are one of the most common well constructions and are currently widely used by the community to extract water from the ground for daily purposes, for example consumption purposes, individual hygiene maintenance, such as bathing, brushing teeth, and cleaning objects. washing food, eating utensils, washing clothes and other necessities (Pati, 2019).

Table 2. Health Complaints Based on the Physical Condition of Well Water

Health complaints	Category	Physical Condition of Well Water				Total	
		Bad		Good			
		n	%	n	%	n	%
Reddish Skin on the Fingers	Yes	4	10	0	0	4	10
	Not	10	25	26	65	36	90
	Total	14	35	26	65	40	100
Reddish Skin on Hands	Yes	8	10	0	0	8	20
	Not	6	15	26	65	32	80
	Total	14	35	26	65	40	100
Reddish Skin on Wrist and Arm	Yes	6	15	0	0	6	15
	Not	8	20	26	65	34	85
	Total	14	35	26	65	40	100
Itchy Fingers	Yes	10	25	0	0	10	25
	Not	4	10	26	65	30	75
	Total	14	35	26	65	40	100
Itchy Hands	Yes	10	25	1	2.5	11	27.5
	Not	4	10	25	62.5	29	72.5
	Total	14	35	26	65	40	100
Itching on Wrist and Arm	Yes	10	25	1	2.5	11	27.5
	Not	4	10	25	62.5	29	72.5
	Total	14	35	26	65	40	100
Nausea	Yes	5	12.5	0	0	5	12.5
	Not	9	22.5	26	65	35	77.5
	Total	14	35	26	65	40	100
Throws up	Yes	0	0	0	0	0	0

Health complaints	Category	Physical Condition of Well Water				Total	
		Bad		Good			
		n	%	n	%	n	%
	Not	14	35	26	65	40	100
	Total	14	35	26	65	40	100
Diarrhea	Yes	0	0	0	0	0	0
	Not	14	35	26	65	40	100
	Total	14	35	26	65	40	100
Dizziness or Headache	Yes	3	7.5	0	0	3	7.5
	Not	11	27.5	26	65	37	92.5
	Total	14	35	26	65	40	100
Red, Itchy and Hot Eyes	Yes	13	32.5	0	0	13	32.5
	Not	1	2.5	26	65	27	67.5
	Total	14	35	26	65	40	100

Based on the results of interviews conducted on 40 respondents regarding health complaints from 40 respondents there were an average of 14 respondents who experienced public health complaints, on average of the respondents experienced health complaints of itching on the skin and arms.According to the National Health and Medical Research Council (2015) when water containing lead (Pb) comes into contact with human skin, it can cause skin rashes, burning sensations, tingling or prickling on the skin surface.

The most common health complaints experienced by respondents were redness, itching and hot eyes. Based on the study conducted by (Gilhotra *et al.,* 2007) on the impact of chronic lead exposure on humans, a 35-year-old female patient who suffered from acute lead poisoning later presented with visual loss in the right eye and normal vision in the left eye. She had pale discs, narrowed arterioles and heavy pigmentation in the peripheral center, the right eye was more affected than the left eye. Electrodiagnostic tests identified asymmetry of visual function characterized by lead retinal toxicity. It indicates that lead poisoning with a long period of time can affect the function of the eye organs. Of the respondents who experienced public health complaints, of the 15 respondents who experienced health complaints, 14 of them used dug well water for toilet needs and the rest used dug well water for consumption and toilet needs. Based on the National Health and Medical Research Council (2015) exposure to lead (Pb) can be absorbed through the skin and can cause several symptoms such as skin rashes, burning sensations, tingling and prickling of the skin. In the long term, lead enters the bloodstream and spreads to the liver, kidneys, lungs, brain, spleen, muscles, and

heart, and can be stored in bones and teeth.

3. The content of lead (Pb) in the Industrial Liquid Waste Flow Agency

Based on the results of the liquid waste sample testing carried out at the Environmental Service Laboratory of Banyuwangi Regency, it is known that the liquid waste sample from the pulp and paper industry has a lead (Pb) content of 16.126 mg/L. It indicates that the sample of liquid waste from the Pulp and Paper Industry X in Bondowoso Regency exceeded the quality standard set by the East Java Governor Regulation Number 72 of 2013 concerning the quality standard of wastewater for industry and/or other business activities, which is 0.1 mg/L.

4. The Content of Lead (Pb) in Resident's Well Water Around the Industrial Liquid Waste Stream

Water pollution is an event where substances enter the water which causes the water quality to decrease so that it can interfere or endanger public health (Regulation of the Minister of Health of the Republic of Indonesia no. 173/Menkes/VII/77).

Table 3. Frequency Distribution of Lead Content in Well Water

Location	Distance (m)	Lead Content (Pb) in mg/L
Well 1	94,5	≤ 0,0085
Well 2	85,0	≤ 0,0085
Well 3	88,0	≤ 0,0085
Well 4	77,0	≤ 0,0085
Well 5	74,0	≤ 0,0085
Well 6	68,0	≤ 0,0085
Well 7	33,0	≤ 0,0085
Well 8	17,0	2,998
Well 9	48,4	≤ 0,0085
Well 10	14,1	4,247

Based on observations, it was known that the distance between the 10 respondents' dug wells and the liquid waste stream was 95 meters, it can cause contamination of the dug well water. Based on (Sarudji, 2012) the main source of groundwater pollution was polluted industrial waste. Pollution caused by chemical substances can reach a distance of up to 95 meters, thus the water source used by the community to meet their daily needs should be more than 95 meters from the chemical disposal site/pollutant source. The results of testing 10 samples of respondents' wells located around the liquid waste stream of the pulp and paper

industry X in Bondowoso Regency, which exceeds the predetermined threshold value, and 8 dug well water did not contain lead (Pb).

CONCLUSION

Based on the results of the study then can be concluded that most of the respondents' dug well water had good physical water quality and 2 of them had poor physical water quality, namely color, smell, and taste. Interviews with 40 respondents showed that 90% of respondents used dug well water for > 5 years. Respondents who used polluted dug well water experienced several health complaints on average, some of the most common health complaints experienced were itching on the hands and arms, and redness, itching, and hot eyes. The lead (Pb) content in the liquid waste is 16.126 mg/L, exceeding the predetermined threshold value of 0.1 mg/L. There were lead (Pb) content in 2 dug well water samples, namely well 8 of 2,998 mg/L and well 10 of 4.247 mg/L.

REFERENCES

Afrianti, S., & Irni, J. (2019). ANALISA TINGKAT PENCEMARAN LOGAM BERAT TIMBAL (Pb) DI DAERAH ALIRAN SUNGAI DELI SUMATERA UTARA. BIOLINK : Jurnal Biologi Lingkungan Industri Kesehatan, 6(2), 153-161.

Arief, L. M. 2016. Pengolahan Limbah Industri: Dasar-Dasar Pengetahuan dan Aplikasi di Tempat Kerja. Yogyakarta: ANDI.

Badan Standar Nasional Indonesia. 2008. SNI 6989.57.2008 Air dan limbah Bagian 57: Metode Pengambilan Sampel Air Permukaan.

Chandra, R.H., (2015), Akumulasi Timbal (Pb) dan Keanekaragaman Jenis Lichenens di Taman Kota Medan, BioLink, Vol. 2 (1), Hal: 23-37

Gilhotra, J., Lany, H. V., & Sharp, D. M. (2007). Retinal Lead Toxicity. Indian Journal of Ophtalmology , 152-154.

Handriyani, A. T., Habibah, N., & Dhyanaputri, G. A. (2020). ANALISIS KADAR TIMBAL (Pb) PADA AIR SUMUR GALI DI KAWASAN TEMPAT PEMBUANGAN AKHIR SAMPAH BANJAR SUWUNG BATAN KENDAL DENPASAR SELATAN. Jurnal Sains dan Teknologi , Vol. 9 No. 1: 68-75.

Haryati, M., Purnomo, T., & Kuntjoro, S. (2012). Kemampuan Tanaman Genjer (Limnocharis Flava (L.)Buch.) Menyerap Logam Berat Timbal (Pb) Limbah Cair Kertas pada Biomassa dan Waktu Pemaparan Yang Berbeda. LenteraBio , Vol. 1 No. 3 :131-138.

National Health and Medical Research Council. (2015). Evidence on the Effects of Lead on Human Health. Australia: National Health and Medical Research Council.

Novita, Yuliani, & Purnomo. (2012). Penyerapan Logam Timbal (Pb) dan Kadar Klorofil Elodea canadensis pada Limbah Cair Pabrik Pulp dan Kertas. LenteraBio , Vol. 1 No. 1:1-8.

Pati, T. M. (2019). ILMU KESEHATAN MASYARAKAT UNTUK FARMASI. Yogyakarta: Deepublish.

Peraturan Gubernur Jawa Timur Nomor 72 Tahun 2013. Baku Mutu Air Limbah Bagi Industri dan/atau Kegiatan Usaha Lainnya. 16 Oktober 2013. Surabaya

Peraturan Menteri Kesehatan Republik Indonesia Nomor 32 Tahun 2017. Standar Baku Mutu Kesehatan Lingkungan dan Persyaratan Kesehatan Air untuk Keperluan Higiene Sanitasi, Kolam Renang, Solus Per Aqua, dan
Pemandian Umum. 31 Mei 2017. Jakarta

Peraturan Menteri Kesehatan RI No. 173/Menkes/VII/77. Tentang Penyediaan Air Minum yang Harus Memenuhi Standar Kuantitas dan Kualitas. Jakarta.

Sarudji, D. (2012). Kesehatan Lingkungan. Sidoarjo: Media Ilmu.

Sembel, D. (2015). Toksikologi Lingkungan. Yogyakarta: ANDI.

Sugiyono. (2018). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

Sunarsih, L. E. (2018). PENANGGULANGAN LIMBAH. Deepublish: Yogyakarta.