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Spatial Analysis of Pollution of Lead Heavy Metal (Pb) In the Flow of River (Banger and Pekalongan) Pekalongan City

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Abstract:*UNESCO has declared Indonesian batik asa world heritage since 2 October 2009, this provision made a demand for batik in the global market continue to increase. The enhancement was also directly proportional to the growth of the industry, especially in the City of Pekalongan. The small-scale batik industrieswhich did not have an environmental permit anddisposed of their wastewater directly into the surrounding environment did not have wastewater treatment may have a high negative impact on pollution from the river flow. The use of inorganic lead-contained in the batik production process poseshazardsto the river ecosystem.This study used a descriptive method with a spatial analysis approach.As many as 13 water samples were taken from 13 sampling points with the distance of each sample as far as 1.2 kilometers in the Pekalongan river flow. We used AAS to measure water lead content in each sample which was taken using a grab sampling method. The research (Banger and Pekalongan) found that Pb concentration was average height tested three times at point 1 (1.11 mg/L), point 2 (1.09 mg/L), point 9 (1.46 mg/L), point 10 (1.39 mg/L), Point 11 (1.28 mg/L), point 13 (1 mg/L) exceeded the quality standard for thethird class of river-based on* government regulations number 82 of 2001.*The concentration of lead-heavywas visualized in the form of maps forthe lead-heavy metal distribution with spatial analysis. There are three criteria of river pollution, namely low river pollution, river pollution under the supervision and river pollution needs to be handled (points 9,10 and 11) in the downstream and (points 1,2) caused by batik industry in the surrounding area***.** *Among13 samples of Pekalongan river water flow, Pekalongan Regency, it can be concluded that all above the quality standard based on the quality standards of government regulations number 82 of 2001 with the category class 3.*
Key Word*:spatial analysis, lead, batik industry*

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I. Introduction

UNESCO has declared batik as a Humanitarian Heritage for Oral and Non-material Culture (Masterpieces of the Oral and Intangible Heritage of Humanity) since 2 October 2009, with the inauguration of batik as a world heritage expected to improve the welfare of the Indonesian people.[1] Pekalongan City is one of the cities with the biggest main commodity is batik so that the City of Pekalongan is referred to as "the city of batik." Pekalongan.[2,3]Besides, the increased production of liquid waste due to the presence of the batik industry certainly harmsunder the environment or society.

The batik industry unit certainly produces a waste, both from domestic activity waste or from production activities. The resulting waste can also be in the form of solid waste from pieces of cloth, dye bottles to damaged batik cloth. Whereas liquid waste comes from the washing process, coloring from batik-making activities.[4] Batik coloring using inorganic chemical dyes such as the use of lead-heavy metals has a high level of risk and toxicity both for aquatic biota or for public health.[5] Batik industry that does not have a letter of environmental permits also have a high level of pollution risk to river bodies because the waste that is disposed of does not undergo prior processing.

Lead heavy metal pollution in Indonesia can be sourced from industrial activities, such as the batik industry.[6] River pollution in Pekalongan City is high due to the presence of existing batik industrial units, and the use of inorganic chemical dyes such as lead heavy metals as batik dye. Heavy metal waste is one of the sources of pollutants that are harmful to the survival of living things.[6,7] That is because heavy metals have, properties and levels of toxicity that can interfere with the human health system.[7]

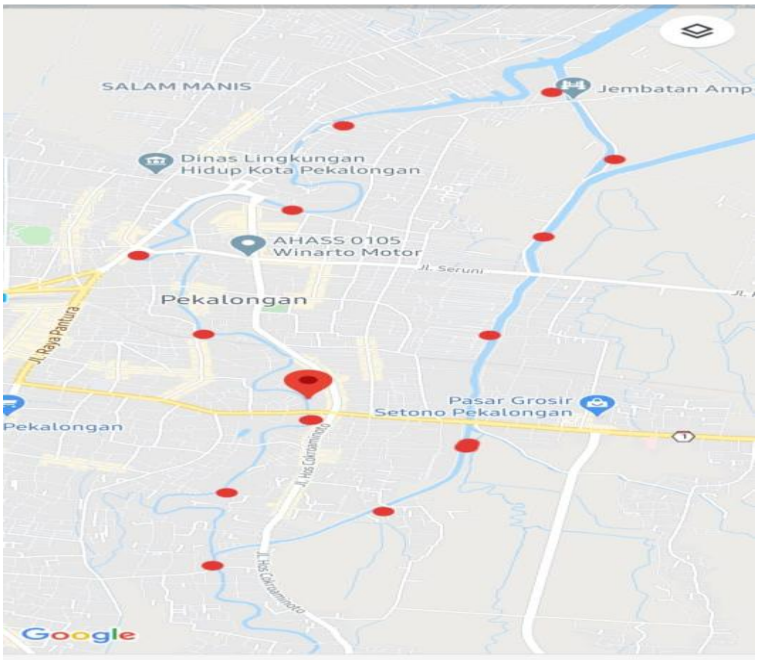
The effects of heavy metals such as lead can undergo bioaccumulation in aquatic biota and biomagnification at the top of the food chain, namely humans.[8] Because of the nondegradable nature of lead, it is difficult to find, biomarkers in humans that can be used to identify lead are in urine and blood.[9, 10] Even though the threshold value allowed on white shrimp is 0.3 mg / kg.[11]

Wastewater has a large impact on human health, causing waterborne diseases such as inflammation of the intestine, cholera, schistosomiasis, and hepatitis infection and apart from being a disease transmitter in wastewater, there is also disease-causing agents.[12] Wastewater containing heavy metal lead can enter through inhalation, ingestion or dermal. But the largest pathway through inhalation and ingestion, absorption of Pb in the air in the inhalation pathway + 40% in the ingestion pathway + 5-10%, then Pb is distributed in the blood + 95% bound to red blood cells, and the rest is bound to plasma.[13,14,15]

The results of a preliminary study conducted from 86 batik industry units in Pekalongan City, only 12 units had obtained an environmental permit so that 74 batik industry units had not received an environmental permit so there was the potential for pollution risk to the river body due to the process.[16] The general objective of this study was to determine the distribution of lead-heavy metals (Pb) in the Pekalongan City river flow, while the specific objectives in this study measured the levels of lead-heavy metals (Pb) and to map areas contaminated with heavy metal lead (Pb) in the Pekalongan City river flow

II. Material And Methods

This research uses a descriptive method to describe or analyze the distribution of lead-heavy metals in the river flow (Banger and Pekalongan), Pekalongan City, which then uses spatial analysis through a geography information system (GIS). A total of 13 water samples were taken by grab sampling with 13 sampling locations at each sampling location and one sample was taken and rarely 1.2 Km, samples were taken at one time with consideration of the non-rainy season within the last four days, the condition of the river water volume is not large, as well as on the laminar flow, in the Pekalongan City river flow (Banger river and Pekalongan river) with the following sample location planning,



Picture 1 Location Sampling

Picture 1 as many as 13 sampling locations of water in the Pekalongan City river flow (Banger and Pekalongan rivers) at each distance of the sample location as far as 1.2 Km to have a balanced and appropriate distance interval. The lead-heavy metal test was conducted by the Pekalongan City Environmental Departement using AAS

Study Design: Descriptive method with approach spatial analysis

Study Location: River flow (Banger and Pekalongan), Pekalongan City

Study Duration: November 2019 to February 2020

Sample amount: 13 waters of the river (Banger and Pekalongan)

Subjects & selection method:samples were taken by grab sampling with 13 sampling locations at each sampling location and one sample was taken and rarely 1.2 Km, samples were taken at one time with consideration of the non-rainy season within the last four days, the condition of the river water volume is not large, as well as on the laminar flow

III. Result

There are as many as 15 units of the batik industry along with the river flow (Banger and Pekalongan) which do not have Pekalongan City WWTP,Pekalongan City is located between 60 50 '42 "- 60 55' 44" South Latitude and 1090 37 '55 "- 1090 42' 19" East Longitude. The National Spatial Planning (TNSP) establishes

Pekalongan City as a Regional Activity Center (RAC) As a RAC, it is hoped that Pekalongan City can function as a development center for the surrounding area, which includes Pekalongan Regency and Batang Regency. A total of 13 samples were then analyzed for lead heavy metal content by the Department of Environment of Pekalongan City, using grab sampling technique which was then analyzed using AAS.

The process of making batik is done through the process of washing first. washing cloth to remove starch, followed by inserting the cloth into castor oil/peanut oil in ash so that the fabric becomes limp, then do the "mori" cloth hammered to smooth the layer of fabric so it is easy to make batik.

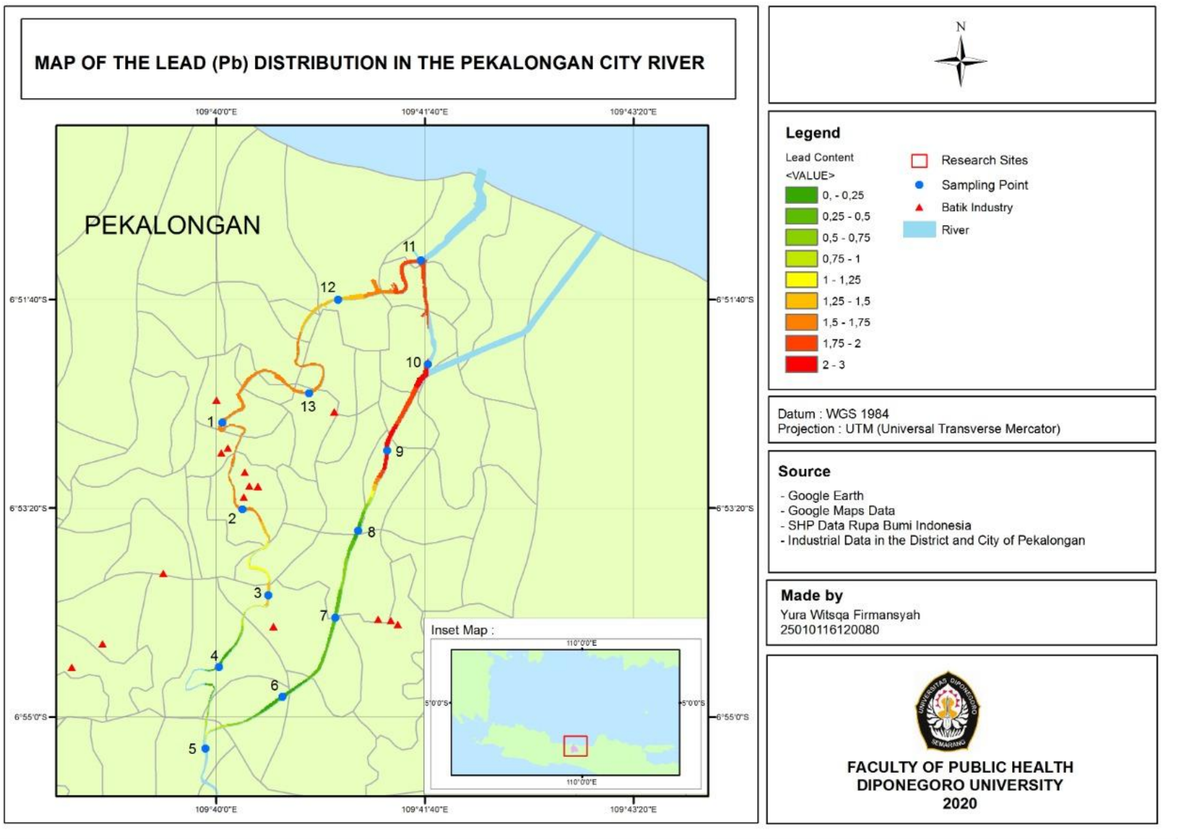
The second process is making patterns on the fabric by imitating existing patterns. The third process is batik paraffin carve into a cloth that starts with drawing outline patterns and filled. The fourth process is grating and burning, the wax is scraped off with a metal plate and rinsed with clean water, then aired to dry. The fifth process is closing the blue color with a pattern in the form of a check or dot with paraffin. Then proceed with hope, which is dying cloth to give a brown color to parts that are not closed at paraffin. the last process is nagging, namely releasing the paraffin by putting cloth in boiling water that has been mixed with materials to facilitate the release of wax. Then rinse with clean water and aerate. [19,20,]

Table no 1 Showsthe result of laboratory tests conducted by the Pekalongan City Environmental Agency on the lead content of heavy metals (Pb) in the Pekalongan City river water sample

Table1:the result lead test of laboratory

No	Location	Repeat Analysis Results (mg/L)			Water Quality Standards Based on Class (mg/L)				Average Test Results (mg/L)
		1	2	3	I	II	III	IV	
1	Point 1	1.19	1.03	1.11	0.03	0.03	0.03	1	1.11
2	Point 2	1.14	1.05	1.08	0.03	0.03	0.03	1	1.09
3	Point 3	0.90	0.88	0.84	0.03	0.03	0.03	1	0.87
4	Point 4	0.06	0.03	0.07	0.03	0.03	0.03	1	0.05
5	Point 5	0.70	0.70	0.82	0.03	0.03	0.03	1	0.74
6	Point 6	0.02	0.02	0.09	0.03	0.03	0.03	1	0.04
7	Point 7	0.21	0.09	0.34	0.03	0.03	0.03	1	0.21
8	Point 8	0.11	0.15	0.23	0.03	0.03	0.03	1	0.16
9	Point 9	1.42	1.44	1.53	0.03	0.03	0.03	1	1.46
10	Point 10	1.60	1.28	1.30	0.03	0.03	0.03	1	1.39
11	Point 11	1.34	1.32	1.17	0.03	0.03	0.03	1	1.28
12	Point 12	1.06	0.87	0.84	0.03	0.03	0.03	1	0.92
13	Point 13	0.94	1.02	1.02	0.03	0.03	0.03	1	1

Table 1 is the result of laboratory tests by the Department of Environmentof Pekalongan City using the AAS method,an analytical method for determining metal and metalloid elements based on absorption (absorption) of radiation by the free atoms of these elements. The analysis test was carried out in three repetitions in each sample. In all three times, the results of the experiment and the average yield in mg / L overall the lead content of heavy metals in the Pekalongan City river flow exceeds the quality standard in government regulation number 82 of 2001 by classifying class III rivers with standard values quality of 0.03 mg / L. And the results of the highest sampling location of the heavy metal content of lead are at the sampling location at point 9 downstream with an average yield of 1.46 mg/L and the lowest the sampling location at point 4 with an average yield of 0.05 mg/L. Samples were taken at one time with consideration of the non-rainy season within the last four days, the condition of the river water volume is not large, as well as on the laminar flow.



Picture 2 The result of spatial analysis of the levels of pollution on the sampling point

Picture 2 the distribution of heavy metals with 13 samples and as many as 15 total batik industries around the Pekalongan City river flow results obtained from the spatial analysis of the upstream heavy metal concentration above the quality standard but still in the safe category (green color) with a vulnerable value of 0-0, 75. Then in the middle, the distribution results need to be monitored (yellow) with a vulnerable value of 1-1.25. While the downstream obtained red distribution results with vulnerable values equal to or above 1.25 the results of an accumulation from upstream. The distribution of the batik industry is also found around the Pekalongan City river flow which has an important role in the contamination of lead-heavy metals in river bodies. The absence of industrial wastewater disposal plants (IPAL) is a driving factor for the occurrence of river water pollution problems.

Spatial analysis is done by mapping the Pekalongan City river. Categorized into three colors green, yellow, orange, and red with different color degradation. Each color has an interval of 0.25 intending to mark a low level of pollution, in supervision to the need to handle based on the quality standards of government regulations number 82 of 2001 for class 3 rivers. The first sampling point was obtained with the results of the first to third experiments of 1.19, 1.03, 1.11, and the average value was 1.11 and then categorized in red color degradation with the status of need for handling, the first sampling location is close to the industry so that high levels of lead allow it to be sourced from nearby industries. The second sampling point was obtained with the results of the first to third experiments of 1.14, 1.05, 1. 08 and the average value is 1.09 and then categorized in red color degradation with the status of need for handling, the first sampling location is close to the industry so that the high lead content allows sourced from the closest industry. The third sampling point was obtained with the results of the first to third experiments of 0.90, 0.88, 0.84 and the average value was 0.87 and then categorized as green color degradation with pollution in monitoring status. The fourth sampling point was obtained with the results of the first to third experiments of, 0.06, 0.03, 0.07, and the average value was 0.05 and then categorized in green color degradation with pollution in monitoring status. The fifth sampling point was obtained with the results of the first to third experiments of 0.70, 0.70, 0.82 and the average value was 0. 74 then categorized as green degradation with pollution in monitoring status. The sixth sampling point was obtained with the results of the first to third experiments of, 0.02, 0.0.2, 0.09, and the average value was 0.04 then categorized in green color degradation with pollution in monitoring status. The seventh sampling point wasobtained with the results of the first to third experiments of 0.21, 0.09, 0.34 and the average value was 0.21 and then categorized as green color degradation with pollution in monitoring status. The eighth sampling point was obtained with the results of the first to third experiments of 0.11, 0.15, 0.23 and the average value was 0.16

and then categorized as green color degradation with pollution in monitoring status. The ninth sampling point was obtained with the results of the first to third experiments of, 1.42, 1.44, 1.53, and the average value is 1.46 and then categorized in red color degradation with the status of need for handling because point nine is at the downstream of the lead accumulation process. The tenth sampling point was obtained with the results of the first to third experiments of 1.60, 1.28, 1.30 and the average value was 1.39 and then categorized as red degradation with the status of the need of handling because point nine was at the downstream of the lead accumulation process. Eleven sampling points were obtained with the results of the first to third experiments of 1.34, 1.32, 1.17 and the average value was 1.28 and then categorized into red degradation with the status of the need for handling, because point nine is at the downstream of the lead accumulation process. 46 then categorized as red degradation with the status of needing treatment because point nine is at the downstream of the lead accumulation process. The tenth sampling point was obtained with the results of the first to third experiments of 1.60, 1.28, 1.30 and the average value was 1.39 and then categorized as red degradation with the status of need of handling because point nine was at the downstream of the lead accumulation process. Eleven sampling points were obtained with the results of the first to third experiments of 1.34, 1.32, 1.17 and the average value was 1.28 and then categorized into red degradation with the status of need for handling, because point nine is at the downstream of the lead accumulation process. 46 then categorized as red degradation with the status of needing treatment because point nine is at the downstream of the lead accumulation process. The tenth sampling point was obtained with the results of the first to third experiments of 1.60, 1.28, 1.30 and the average value was 1.39 and then categorized in red color with the status of need for handling because point nine was at the downstream of the lead accumulation process. Eleven sampling points were obtained with the results of the first to third experiments of 1.34, 1.32, 1.17 and the average value was 1.28 and then categorized into red degradation with the status of need forhandling, because point nine is at the downstream of the lead accumulation process. The tenth sampling point was obtained with the results of the first to third experiments of 1.60, 1.28, 1.30 and the average value was 1.39 and then categorized as red degradation with the status of a need of handling because point nine was at the downstream of the lead accumulation process. Eleven sampling points were obtained with the results of the first to third experiments of 1.34, 1.32, 1.17 and the average value was 1.28 then categorized into red degradation with the status of need for handling because point nine is at the downstream of the lead accumulation process. The tenth sampling point was obtained with the results of the first to third experiments of 1.60, 1.28, 1.30 and the average value was 1.39 and then categorized as red degradation with the status of the need of handling because point nine was at the downstream of the lead accumulation process. Eleven sampling points were obtained with the results of the first to third experiments of 1.34, 1.32, 1.17 and the average value was 1.28 and then categorized into red degradation with the status of need for handling, because point nine is at the downstream of the lead accumulation process. 39 then categorized as red degradation with the status of needing treatment because point nine is at the downstream of the lead accumulation process. Eleven sampling points were obtained with the results of the first to third experiments of 1.34, 1.32, 1.17 and the average value was 1.28 and then categorized into red degradation with the status of need for handling, because point nine is at the downstream of the lead accumulation process. 39 then categorized as red degradation with the status of needing treatment because point nine is at the downstream of the lead accumulation process. Eleven sampling points were obtained with the results of the first to third experiments of 1.34, 1.32, 1.17 and the average value was 1.28 and then categorized into red degradation with the status of need for handling, because point nine is at the downstream of the lead accumulation process.

The twelfth sampling point was obtained with the results of the first to third experiments of, 1.06, 0.87, 0.84, and the average value was 0.92 then categorized as yellow with degradation status under supervision. And for the thirteenth final sampling point obtained with the results of the first to third experiments of, 0.94, 1.02, 1.02 and the average value is 1 then categorized in red color with the status of need for handling, because the twelfth sapling point is downstream so that the accumulation process lead can occur.

LEADS IN THE BATIK INDUSTRY

Lead is a material used as a dye or pigment in making batik. In the process of washing cloth “mori” only produces organic and inorganic chemical waste there is no lead in it because the process of washing “mori” only aims to remove starch ($C_6H_{10}O_5$) n on the cloth “mori”. The process of making patterns is drawing patterns on cloth using ink, black or brown ink can be in the form of TEL (tetraethyl lead) or TML (tetramethyl lead) and produce inorganic chemical waste in the form of TEL and TML. In this batik process the use of wax (grease) with several colors and sourced from heavy metals, white wax can be in the form of [$Pb(OH)_2.2PbCO_3$] and red color (Pb_3O_4) and the resulting waste is also inorganic chemistry from the wax containing the heavy metal. The scraping process is the removal of wax on a cloth, wax made from heavy metals will become inorganic chemical waste. The process of closing the pattern by using a blue dye, blue color can also be taken from heavy metals in the form of cerrusite lead. The coating process is the process of dying “mori” cloth into the brown dye to produce a brown color on the fabric, the use of the brown color can be in the form of organic or inorganic dyes and produce waste from these dyes. And in the last stage is the withdrawal, releasing the entire paraffin on the fabric, in this process produces inorganic chemical waste from heavy metal dyes and organic waste from organic dyes. The process of closing the pattern by using a blue dye, blue color can also be taken from heavy metals in the form of cerrusite lead. The coating process is the process of dying “mori” cloth into the brown dye to produce a brown color on the fabric, the use of the brown color can be in the form of organic or inorganic dyes and produce waste from these dyes. And in the last stage is the withdrawal, releasing the entire paraffin on the fabric, in this process produces inorganic chemical waste from heavy metal dyes and organic waste from organic dyes. The process of closing the pattern by using a blue dye, blue color can also be taken from heavy metals in the form of cerrusite lead. The coating process is the process of dying “mori” cloth into the brown dye to produce a brown color on the fabric, the use of the brown color can be in the form of organic or inorganic dyes and produce waste from these dyes. And in the last stage is the withdrawal, releasing the entire paraffin on the fabric, in this process produces inorganic chemical waste from heavy metal dyes and organic waste from organic dyes. the use of brown can be in the form of organic or inorganic dyes and produces waste from these dyes. And in the last stage is the withdrawal, releasing the entire paraffin on the fabric, in this process produces inorganic chemical waste from heavy metal dyes and organic waste from organic dyes. the use of brown can be in the form of organic or inorganic dyes and produces waste from these dyes. And in the last stage is the withdrawal, releasing the entire paraffin on the fabric, in this process produces inorganic chemical waste from heavy metal dyes and organic waste from organic dyes. Currently, the most commonly used lead pigments include lead chromate ($PbCrO_4$), lead molybdate chromate ($Cr_2Mo_2O_{11}Pb_2$), and lead sulfate ($PbSO_4$). Lead chromates are made in a variety of crystal structures to produce different colors, including "chrome yellow" (dark yellow), "middle chrome" (reddish yellow), and "orange chrome" (orange). Lead molybdate chromate produces bright red pigments. The mixture of lead chromate with lead sulfate and other compounds produces many colors such as "primrose chrome" (pale yellowish greenish), "lemon chrome" (slightly reddish greenish-yellow), and "chrome green" (a mixture of lead chromate and iron blue). Substitutes for this pigment include organic and inorganic pigments that do not contain lead compounds. Lead carbonate ($2PbCO_3 \cdot Pb(OH)_2$), also called "white lead"

IMPACT OF HEAVY METALS IN HEALTH AND WATER

The river body is the final disposal site for all industrial or domestic waste. An industrial unit that has a wastewater treatment plant (IPAL) will produce less risk of pollution because it has undergone a management process first. Whereas industrial units that do not have WWTPs will immediately dispose of their wastewater without management and this will have a direct impact on the biota in the waters.[17]

Lead may exist as dissolved species and suspended in water. In many cases, lead is important to explore the possibility of biomethylation from lead and the distribution of organolead compounds from man-made sources in the environment. Lead in an aqueous environment is most likely to be found in the +2 oxidation state. Only a small amount tends to reach water through deposition of air, drainage water, or runoff from agricultural land, the most important source is industrial waste, in this study, especially the batik industry.

Lead is one of the heavy metals that is very dangerous for living things because it iscarcinogenic, can cause mutations, biodegrade for a long time and the toxicity is unchanged. Pb can pollute the air, water, soil, plants, animals, and even humans. Water biota that is contaminated with heavy metals will undergo a process of bioaccumulation to biomagnification which will reach the peak of the highest manganese chain, namely in humans. So that the presence of lead-heavy metals in water bodies will have a risk to threaten health to the surrounding community.[18]

IV. Conclusion

The results of research conducted on 13 samples of Pekalongan river water flow, Pekalongan Regency, it can be concluded that the results of the laboratory for heavy metal content carried out by the Pekalongan City Environmental Agency are all above the quality standard based on the quality standards of government regulations number 82 of 2001 with the category class 3. Then also found areas that are polluted with three statuses, namely pollution in monitoring, pollution in surpervision, and pollution need treatment.

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