**JOURNAL OF PUBLIC HEALTH FOR TROPICAL AND COASTAL REGION (JPHTCR)**

Journal homepage: http:/ejournal2.undip.ac.id/index.php/jphtr/index

ISSN : 2597-4378

***Research Article***

# The Impact of Batik Sewage Disposal Towards The Quality of Dug-Well Water in The Batik Industry Center of Jenggot Pekalongan City

*Slamet* Budiyanto [1)], *Anies*[2)], *Hartuti* Purnaweni [3)], *Henna* Rya Sunoko [2)]

[1)] Doctoral Program of Environmental Science School of Postgraduate Diponegoro University
Coresponding Author : ibudks@google.com
[2)] Faculty of Medical Diponegoro University
[3)] Faculty of Social Science and Political Science Diponegoro University

## Abstract

***Backgorund*:** The development of batik industry in Indonesa today is quite rapid after batik has been acknowledged by UNESCO as the intangible world heritage from Indonesia. Pekalongan City is well-known as "Batik City" and it is one of the biggest batik industry centers in Indonesia with its 917 batik industries. Jenggot (administrative) village is one of the biggest batik industry centers in Pekalongan with 203 artisans of batik indstries. The process of batik making needs some dye of synthetic one containing heavy metals one of which is Pb. The present condition, most of the batik industry sewage in Jenggot goes straight to the environment without prior treatment. The purpose of this research is to find out the impact of the disposal of batik sewage containing heavy metal Pb towards the quality of dug-well water around the areas of batik sewage disposal.
***Methods* :** This is descriptive analytical research with cross-sectional approach method. The research was conducted by taking direct samples of sewage in the community of batik industries, i.e the sample that floods the residential drain and the sample of dug well around the sewage flood. The sample was tested in the laboratory with the AAS instrument.
***Results* :** The result of this study, out of 67 samples of batik sewage, showed 17 samples (25.4%) contained heavy metal Pb above the quality standar set, i.e 0.03 mg/L. Twenty (20) samples (29.9%) out of 67 samples of water puddle in the residential areas was above the standard quality set, i.e 0.03 mg/L. As to the quality of dug well, it was found 129 samples (61.4%) out of 210 kinds of well water contained heavy metal Pb above standard quality set, i.e. 0.01 mg/L.
***Conclusion* :** This result showed that the quality of environment has declined marked by the polluted dug-well water of the inhabitants around the batik industry center in Jenggot Pekalongan.

**Keywords**: Jenggot batik indsustry; batik sewage; quality of dug-well water

***Article History :*** *Received :28-10-2019 ; Revised : 7-11-2019; Accepted: 30-12-2019*

## Background

The acknowledgement of UNESCO in 2009 that batik was the cultural heritage of Indonesia had the effect on the increase of demand and consumption on batik. This increase in demand pushes the growth and development of batik centers in Indonesia.[1] According to Indonesian National Standard (SNI) No 08-0239 1989 batik is defined as

textile material as a result of coloring in accordance with specific pattern of Indonesian batik, by using wax as the wax resist. Batik motif is made by an instrument called *canting*, i.e. a kind of a pen made of brass with a wax fluid container and a bamboo handle to hold. Batik is a motif of drawing on a piece of shroud colored with natural dye or synthetic one.[2]

In the beginning, when batik production was still a home-made scale, batik process was done traditionally with an instrument called "canting". Its product was called "hand-made batik" as it was made manually by the batik artisan. *Canting* is immersed in the fluid of natural dye, then put onto a piece of prepared shroud to draw an expected motif. In modern era, the batik process comes to the process of mass production by using technological machine that its product is called "*Batik Cap"* (Stamp Batik) or "Printing Batik". The Batik proceedings, from the beginning to the end, use the dye as its raw materal. Traditional batik or hand-made batik uses natual dye, while modern printing batik uses synthetic dye as it has some exceptional aspect.

The synthetic dye for batik process contains a number of heavy metal elements that are presumed to still exist in its sewage. The result of Sasongko and Tresna's study (2010) about the heavy metal content in the water sample and sediment in Jenggot adminstrative village, Pekalongan, showed that the content of Cr (0,1363 ± 0,0000) ppm in the water sample and Cr (12176 ± 0,2698) ppm in the sediment. (The content of Cr in the water sample is in accordance with standard quality of water sewage based on the Regional Regulation of Central Java Number 10 Year 2004 as big as 1 ppm dan Government Regulation Number 82 Year 2001 for the category of "poor".[3] Water sample was taken out of rainwater canal in Jenggot village flowing to the River Setu.

Generally speaking, batik fluid sewage is disposed through river without any prior treatment. Only a small number of batik industry utilizes Sewage Treatment Plant (IPAL) that is supplied by the government. The increase in batik production results in the pollution of river environment because of its sewage disposal. The data of batik industry sewage per sub-district in Pekalongan City can be seen in the following table:

**Table 1.** The Amount of Batik Industry Sewage Per Sub-District in Pekalongan City, 2014

| No. | Sub-district | Number of Industry | Large of Areas ($m^2$) | Capacity of Production per Month (in scores) | The Amount of Sewage Per Month |
|---|---|---|---|---|---|
| 1 | South Pekalongan | 442 | 90,207 | 77,783 | 32,503 |
| 2 | West Pekalongan | 247 | 56,585 | 26,676 | 23,314 |
| 3 | East Pekalongan | 124 | 27,590 | 10,115 | 7,156 |
| 4 | North Pekalongan | 104 | 19,120 | 7,165 | 10,904 |
| **Total** | | **917** | **193,503** | **121,739** | **73,878** |

The data of table 2 shows that batik industry produces fluid sewage as much as 73,878 $m^3$ per month. South Pekalongan with its highest production will automatically be the highest sewage producer too, i.e. 32,503 $m^3$ per month.

Sasongko and Tresna's research result (2010) that identifies heavy metal element Cr (0,1363 ± 0,0000) ppm is different from the writer's observation result in the samples of dug-well and artesian-well water between 10 – 12 m away from batik industry location in the Jenggot adminstrative village. [3]

Accroding to *Kepmenkes* (the Health Minister's Decision) RI No. 492/2010, the quality standard of lead content (Pb) in water medium for water consumption is 0.01 mg/L. The content is still higher than the value of standard quality of water for drinking consumption but it is under the value of standard quality threshold of water for hygiene and sanitation concerned with the *Permenkes* No. 32/2017, that is to say, 0.05 mg/L. The population around the area of batik indutry uses dug-well or artesian-well water for a bath, wash, cooking, and consumption. Around the well, there is puddle of water from industry sewage in which the distance between the puddle and the people's well is around 10 – 12 m.

The above ground water of the dug well as well as artesian well is able to be polluted by the heavy metal (Pb) from the sewage, and becomes a threat to the human health. Heavy metals such as Cd, Cr, Ni, and Pb are able to contaminate above ground water and ground water by absorption through the ground.

Based on the empirical facts reported by researches in the past and the difference between the researcher's finding with the results of previous researchers, the writer has therefore the intention to research the impacts of batik industry sewage on the water quality in administratave village of Jenggot, Pekalongan City. This research is important to be done since heavy metal infiltration into above ground water or ground water consumed by the people around the batik industry area is not safe or dangerous for health. Heavy metal intake for human body throuhg drinks, meals, or bronchial tube can cause serius health problems. Exposure to Pb in human blood can cause, among other things, low hemoglobin (Hb) or anemia, hypertension, reproduction disorder, and so forth. The safe PB limit in the blood in accordance with US EPA (2010) is 30 μL/ 100 mL blood or 25 UL/ 100 mL blood to WHO. [4] Inswiasri & Sintawati (2016) reported that there was possitive correlation between Pb content di the blood with anemia. 36% of children in the recycling area of used storage batteries in Bekasi – Bogor exposed to the source of Pb pollution suffered from anemia. [5]

Pb contamination in above ground water and ground water as reported in the previous research can change water quality above the threshold of safe standard quality for public need as well as consumption. This study intends to investigate the change of water quality in the puddle, dug-well or artesian water, and the impacts of water quality change contaminated by Pb toward hemoglobin in the human blood.

The aims of this study is to describe the impacts of batik industry sewage on the quality of dug well and artesian well in the batik industry location of Adminstrative Village of Jenggot Pekalongan City and to describe the correlation between the quality of well water and Pb content in the blood.

## Methods

This research is an observational study with quantitative-descriptive approach to measure the change of water sewage, water puddle, dug-well water, artesian-well water by evaluating Pb content in them. The measurement then continued by measuring the Hb content in the people's blood who consume the dug-well or artesian-well water. Correlation between the change of water quality because of Pb contamination with health problem measured by percetage of the people suffering from anemia. The observataion data collection is done in one certain period. Based on the analytical analysis used in this study, this research is then of the descriptive catagory and its sample number is 67.

The variables tested covers the Pb content in the puddle water and the blood. Chi-square test is executed with Crosstab technic to find out the correlation among the variables. The result of this observation is desribed in the form of percentage of events.

## Results and Discussion

### *Heavy Metal Content (Pb, Cd, and Cr) in the Puddle Water and Dug-well Water*

Data in the table 2 is the average value of heavy metal content (Pb, Cd, dan Cr) in the puddle water and dug-well water. The mean of Pb content in the puddle and dug-well water is 0,020 mg/L and 0,013 mg/L. compared to the Pb content in the water sewate >= 0,03 mg/L, Pb content in the puddle water and dug-well water then gradually decrease 2 significantly, i.e. 20% dan 45.83%. The minimum value in the puddle water and dug-well water is 0,006 mg/L and 0,001 mg/L each, while its maximum is 0,0992 mg/L and 0,0474 mg/L.

**Table 2.** Heavy Metal Content (Pb, Cd, dan Cr) in the Puddle Water and Dug-well Water

| KINDS OF WATER | Pb | Cd | Cr |
|---|---|---|---|
| Puddle Water | 0.024322 | 0.001000 | 0.005400 |
| Dug-well Water | 0.013162 | 0.001000 | 0.003157 |

### The Correlation between Pb Content of Dug-well Water with the Distance of Dug-well Water toward Puddle Water

The range of minimum Pb content and its maximum indicates that there is a correlation between Pb content in the dug-well water with the well distance and with puddle water. This is visible form the result of chi-square test as follows table 3. Probability value (Asymp. Sig,) = 0,003 < $\alpha$ = 0,05. The result indicates that there is a positive correlation between Pb content in the dug-well water with the distance of dug well toward the puddle water. Farther away the distance of dug well to the puddle water, lower Pb content in the dug-well water and vice versa.

**Table 3.** The Result of chi sguare test for Pb content Dugwell Water * the Distance of Dug Well

| | Value | Asymp. Sig. (2-sided) |
|---|---|---|
| Pearson Chi-Square | 1381.251[a] | 0.003 |

***The Correlation between Pb Content in the Dug-well Water with Pb Content in the Blood***

Probability value (Asymp. Sig,) = 0,023 < α = 0,05. The result shows that there is positive correlation between Pb content in the dug-well water with Pb content in the blood. Higher Pb content in the well water, hight Pb content in the blood and vice versa.

## Discussion

The average of Pb content in the dug-well water is 0,024 mg/L. This content is far above the threshold of safe standard quality of water for consumption in accordance with *Kepmenkes* RI No. 492/2010, i.e. 0,01 mg/L. This condition causes the risk of health problem as mentiioned above. Heavy metal, including Pb, dissolved in the water will go throung two processes, sedimentation and absorption by organism. If the logam concentration is bigger than the lower power of solution, so the metal will fall to the bottom.

The amount of metal content that goes to the bottom is influenced by the environment condition if the environment condition lacks oxyten due to organic material contamination, so the heavy metal will go down to the bottom. Heavy metal concentration that is dissolved in the water influenced by season. In the rainy season, metal concentration gets smaller because of dilution effect. Conversely, metal concentration in the dry season will get higher due to concentrated. In addition to the natural factor, Pb content in the dug-well water around the batik industry location in the adminstrative village of Jenggot, South Pekalongan sub-district, influenced more by industrial activities that are frequently done in the dry season.[3] In the dry season, there are two factors triggering Pb content dissolved in the dug-well water to be higher. ***First***, thickening factor or the increase of metal Pb concentration dissolved naturally for the lack of water supply coming from rainwater; ***second***, the increase of batic production that is more commonly held in the dry season.

## Conclusion

Batik industry sewage in the administrative village of Jenggot, South Pekalongan sub-district, Pekalongan City causes the quality of dug-well water around the industrial location goes trough the significant change. The quality of dug-well water consumed for drinking and cooking need contaminated Pb with average content 0.013 mg/L, above the threshold of the standard quality of water for consumption = 0.01 mg/L regulated in the *Kepmenkes* RI No. 492/2010. There is a positive correlation between the Pb content in the dug-well water with the dug-well distance to the puddle, with probability value = 0.03 smaller than critical value α = 0.05. There is a positive correlation between Pb content in the well water with Pb in the blood of people livingn around the industrial

location, with probability value = 0.023 smaller than critial value $\alpha = 0.05$.

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