



**Liquid Waste Pollution Load Analysis Home Industry Batik
And The Impact On The Quality Of River Water In The Sub-District Of Pekalongan Selatan,
Pekalongan City**

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Abstract

The batik industry sector grows the level of employment and contributes to encouraging economic growth, especially in Pekalongan City. However, along with the increase in the number of batik industries, it is possible to cause health problems, both public health and environmental health. Batik consists of several processes including preparation, batik, coloring, releasing batik wax, and finishing. In these processes, several materials are used, namely paraffin, gondorukem (coophony, rosin), resin, microwax and animal fat. The batik production process generally uses chemical compounds at every stage which in addition to producing B3 waste, exposure to these chemical compounds will of course have

an impact on environmental health. The amount of pollution load from the type of batik industry varies greatly and depends on the type and amount of chemicals used. The result of the research is that the actual liquid waste discharge (DA) is smaller than the maximum liquid waste discharge (DM). The actual pollution load for heavy metal parameters namely Lead (Pb, Zinc (Zn), Chromium (Cr) and TSS parameters is smaller than the maximum pollution load (DM) of each parameter, while for the COD parameter the results are almost close to the maximum limit and for BOD5 the actual pollution load is greater than the maximum pollution load for both daily and monthly pollution loads. From these results it can be said that the discharge and pollution load of the batik home industry wastewater have not contributed greatly to the pollution parameters COD, TSS, Lead (Pb), Zinc (Zn),

Keywords: pollution load, liquid waste, home industry, impact of river water quality

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INTRODUCTION

The batik industry is currently a small and medium industry, sometimes combined with a home industry. The batik industry has been developing in Indonesia for a long time and is one of the jobs for a number of workers in the city and even in the countryside, this industry has grown, including in Pekalongan City (Oethomo, 2010). Pekalongan has the highest number of batik business units compared to Surakarta and Yogyakarta. Data from the Department of Industry and Trade of the City of Pekalongan shows the number of batik MSME centers in 2016 was 257 business units spread over 9 industrial centers with a total of 3,023 workers. In 2017 there was a decrease in the number with only 242 units with a total of 2,920 workers (Department of Cooperatives and SMEs of Pekalongan City, 2017).

The batik industry sector grows the rate of employment and contributes to encouraging economic growth. However, along with the increase in the number of batik industries, it is possible to cause health problems, both public health and environmental health. The Department of Environment (DLH) of Pekalongan City, noted that at least 5 million liters of waste are produced by the batik industry in Pekalongan City every day. Of the total batik waste produced, the Waste Water Management Installation (IPAL) in Pekalongan City can only accommodate 45% and the rest is simply thrown into the river (Department of City Planning and Environment of Pekalongan City, 2017). This is the main trigger in the occurrence of environmental pollution, especially in several rivers in Pekalongan City.

Liquid waste from the batik industry has a bad impact on the environment because some of it cannot be decomposed naturally and is carcinogenic so it must be managed properly. Moreover, dye discharge is a pollutant whose impact is most quickly detected by the naked eye even though the level is below 1 ppm (Parreira, LM, 2012). Based on Chakraborty there are thousands of color variations that can be produced from one group of Naphtol dyes and its Diazonium salt alone, while in the batik dyeing process there are 12 groups of dyes. Apart from residual dyes, the liquid waste released by the batik industry also contains chemicals supporting



the production process such as NaOH, NaNO₂, HCl, Na₂CO₃, and Na₂O₃Si with varying concentrations depending on the color of the batik you want to produce (Chakraborty, JN, et. Al 2014).

The first step in the water pollution prevention strategy is to conduct an audit and characterization of liquid waste originating from industrial activities (Rathore, J, 2012). Information related to the pollutant load factor per unit product can be used to quickly estimate the total pollution load in an area so that it is useful for solving pollution control problems in certain sectors. The amount of pollution load from the type of batik industry varies greatly and depends on the type and amount of chemicals used. In addition, each type of fabric fiber also has different absorption characteristics of the dye used in the batik process.

METHOD

The maximum liquid waste discharge (DM) and the actual liquid waste discharge (DA) are calculated using the volumetric method based on the Industrial Liquid Waste Quality Standards (Especially the textile industry as attached in the Minister of Environment Regulation No. 5 of 2014 concerning waste water quality standards) (LH Regulation No. 5 of 2014).

$$DM = Dm \times Pb$$

DM = maximum liquid waste discharge permitted by the industry concerned (m³/month)

Dm = maximum liquid waste discharge as stated in the attachment of Permen LH no. 5 of 2014, according to the industry concerned (m³/unit of product)

Pb = actual production in a month (expressed in units of production as stated in the attachment of the Minister of Environment Regulation No. 5 of 2014, according to the industry in question)

$$DA = Dp \times H$$



Information :

DA = actual liquid waste discharge (m^3/month).

Dp = result of measurement of liquid waste discharge (m^3/day).

H = number of working days in the month concerned.

Maximum Pollution Load (BPM) and Actual Pollution Load (BPA) based on Industrial Liquid Waste Quality Standards (especially the textile industry) (LH regulation no. 5 of 2014) are calculated using the formula below.

$$\text{BPM} = (\text{CM})_{ix} \text{Dm} \times f$$

Information :

BPM = maximum pollution load

$(\text{CM})_i$ = maximum level of pollutant-i (mg/l)

Dm = maximum liquid waste discharge as stated in the attachment of Ministerial Regulation no. 5 of 2014, according to the type of industry in question stated in $\text{m}^3/\text{unit of product}$

F = conversion factor = $(1,000/\text{m}^3) \times (1 \text{ kg}/1,000,000 \text{ mg}) = 0.001$

$$\text{BPA} = (\text{CA})_{ix} (\text{DA}/\text{Pb}) \times f$$

Information :

CPA = actual pollution load ($\text{kg parameter per unit product}$)

$(\text{CA})_i$ = actual level of pollutant-i (mg/l)

Pb = actual production in a month (expressed in production units as stated in the attachment of the Minister of Environment Regulation no. 5 of 2014)

F = conversion factor (0.001)



RESEARCH RESULT

Liquid Waste Discharge (effluent)

Maximum liquid waste discharge (DM) for stamped batik industry in quality standard = 100 m³/ton of textile products, batik production in a month (Pb) = 38,000 yards = 28,880 m³, liquid waste discharge from measurement results (Dp) = 5.56 m³/day, and the number of working days per month is 26 working days with 1 day off a week and operating hours start from 7 am to 4 pm. The number of employees owned is as many as 50 employees.

The results of calculating the maximum liquid waste discharge (DM) and the actual monthly liquid waste discharge (DA) are as follows:

Maximum liquid waste discharge (DM)

$$\begin{aligned} \text{DM} &= 100 \text{ m}^3/\text{ton} \times 4.5 \text{ ton} \\ &= 450 \text{ m}^3/\text{month} \end{aligned}$$

Actual liquid waste discharge (DA)

$$\begin{aligned} \text{DA} &= 5.56 \text{ m}^3/\text{day} \times 26 \text{ days} \\ &= 144.56 \text{ m}^3/\text{month} \end{aligned}$$

So DA < DM

Liquid Waste Pollution Load

The allowable burden of industrial wastewater pollution is in accordance with the Minister of Environment Regulation no. 5 of 2014 concerning Liquid Waste Quality Standards for industrial activities. The industrial wastewater parameters used in calculating the pollution load in this study are BOD, COD, TSS and Pb (Lead) parameters. Calculations are carried out as follows:

Maximum Pollution Load (monthly):

$$\begin{aligned} \text{BPM.BOD}_5 &= \text{CM. BOD}_5 \times \text{Dm} \times f \\ &= 60 \text{ mg/l} \times 100 \text{ m}^3 \times 0.001 \\ &= 60 \text{ mg/l} \times 0.1 \\ &= 6 \text{ m}^3 \text{ kg/ton} \end{aligned}$$

Actual Pollution Load (monthly):



$$\begin{aligned}
 \text{CPA. BOD}_5 &= (\text{CA})\text{BOD}_5 \times (\text{DA/Pb}) \times f \\
 &= 523.15 \text{ mg/l} \times \left(\frac{147.42 \text{ m}^3/\text{bulan}}{4,5 \text{ ton}} \right) \times 0.001 \\
 &= 523.15 \text{ mg/l} \times 32.124 \times 0.001 \\
 &= 523.15 \text{ mg/l} \times 0.0321 \\
 &= 16.793115 \text{ kg/ton}
 \end{aligned}$$

$$\text{So (CPA)} > (\text{BPM})$$

Maximum pollution load (daily):

$$\begin{aligned}
 (\text{BPMi}).\text{BOD}_5 &= \text{BPM} \times (\text{Pb/H}) \\
 &= 6 \text{ m}^3 \times \left(\frac{4,5 \text{ ton}}{26 \text{ hari}} \right) \\
 &= 6 \text{ m}^3 \times 0.1730 \text{ ton/day} \\
 &= 1,038 \text{ kg/ton}
 \end{aligned}$$

Actual pollution load (daily):

$$\begin{aligned}
 (\text{BPAi}). \text{BOD}_5 &= (\text{CA})\text{BOD}_5 \times \text{Dp} \times f \\
 &= 523.15 \text{ mg/l} \times 5.56 \text{ m}^3/\text{day} \times 0.001 \\
 &= 523.15 \text{ mg/l} \times 0.00556 \\
 &= 2.908714 \text{ kg/ton}
 \end{aligned}$$

$$\text{So (BPAi)} > (\text{BPM})$$



Number of working days per month = 26 days Number of working hours per day = 8 hours Average production of batik per month = 40,000 yards = 36,576 meters If 1 kg of product weight is equivalent to 8 yards then the product weight per month is 4,572 kg (4.5 tons)						
LIQUID WASTE DEBT						
Dp, (measured waste discharge) = 5.56 m ³ /day DA, (actual liquid waste discharge) = 144.56 m ³ /month DM, (maximum liquid waste discharge) = 450 m ³ /month						
LIQUID WASTE POLLUTION LOAD						
Indicator	BOD5	COD	TSS	Lead (Pb)	Chrome (Cr)	Zinc (Zn)
BPM (kg/ton)	6 mg	15 mg	5 mg	0.1 mg	0.1 mg	1 mg
BPA (kg/ton)	16.793115 mg	13.245102 mg	0.182 mg	0.028558 mg	0.01638 mg	0.028622 mg
BPMi (kg/ton)	1,038 kg/day	2,595 kg/day	0.865 kg/day	0.0173 kg/day	0.0173 mg	0.173 mg
BPAi (kg/ton)	2.908714 kg/day	2.2941672 kg/day	0.0315 kg/day	0.004942 kg/day	0.0028356 mg	0.00495396 mg
Information : DA < DM CPA.COD5 > BPM.COD5 BPAi.COD5 > BPMi.COD5 BPA = Actual Pollution Burden per month BPM = Maximum Pollution Expense per month BPAi = Actual Pollution Load per day BPMi = Maximum Pollution Load per day						

Table 1. Discharge & Pollution Load of Batik Industry Liquid Waste



DISCUSSION

Based on the calculation of the discharge and the maximum pollution load and the actual pollution load from the Rama batik home industry which was sampled in this study, as shown in the table above, it can be seen that the actual liquid waste discharge (DA) is smaller than the maximum liquid waste discharge (DM). . The actual pollution load for heavy metal parameters namely Lead (Pb), Zinc (Zn), Chromium (Cr) and TSS parameters is smaller than the maximum pollution load (DM) for each parameter, while for the COD parameter the results are almost close to the maximum limit and for The actual BOD5 pollution load is greater than the maximum pollution load for both daily and monthly pollution loads.

The home batik industry in Pekalongan City still uses synthetic dyes, namely naphtol, indigosol, indanthrene and rapid as the main dyes. The batik managers revealed the reasons for using synthetic dyes because they have been used to using these dyes since the beginning of production, are easy to obtain with a fixed composition, have many colors, produce bright colors and have not maximized socialization activities from the department regarding the use of batik process materials other than the dye. Another factor is because these dyes are more affordable than natural dyes by looking at consumers who are more interested in buying batik fabrics at low prices and in large quantities.

Compared to other parameters, the actual pollution load (BPA) for the BOD5 parameter is much higher than the maximum pollution load (BPM). . This can happen because the liquid waste of the batik home industry is not processed before being discharged into the environment (rivers).

A few things to keep in mind that out of a total of 33 middle-class batik industries in Pekalongan Selatan District, Pekalongan City, there are only 3 industries that have environmental permits. This result resulted in monitoring the management of liquid waste cannot be carried out optimally and industrial owners can more easily dispose of their waste products directly into rivers or drainage channels around industrial locations without prior management due to lack of supervision from the authorities.

Regarding the toxicological aspect, several studies have stated that the liquid waste from batik has a negative impact on health. Synthetic dyes are toxic and can cause skin cancer. In addition, the Indonesian Embassy for the Netherlands for Trade has given a warning letter to the Director General



of International Trade of the Indonesian Ministry of Trade in 1996 regarding the prohibition of the use of some Naphtol dyes and Diazonium salts which have been imposed in Germany because of their impact on health. According to Timothy in Sulaksono, Naphtol dyes which are included in the azo group are xenobiotic compounds that are difficult to degrade and when degraded often produce other compounds that are more toxic than the parent compound (Sulaksono, A, 2015).

Regulations governing environmental sustainability have also been made and contained in regional regulation number 5 of 2014 Pekalongan Regency regarding regulations for waste water management. In chapter IV article 4 paragraph 1 it is explained that "Every person or entity that carries out activities that produce waste water is obliged to carry out waste water management." Then it is also contained in paragraph 2 which reads "Wastewater discharged into water or water sources must meet the quality standards stipulated by laws and regulations." In chapter IX article 28 b it reads "make a suitable waste disposal channel determined by the competent authority". This means that every industry must have involvement in waste water management activities, which are then implemented by having a waste water disposal installation (IPAL). given can be in the form of administrative sanctions such as: written warnings, government coercion, suspension of environmental permit, or revocation of environmental permit. Then, in Article 37, sanctions are in the form of compensation or compensation due to the impact of pollution and or environmental damage to criminal penalties as regulated in Article 38. However, it seems that this regulation has not been applied properly to industry players, this is evidenced by the fact that out of a total of 33 medium-sized batik industries which is located in the South Pekalongan sub-district, Pekalongan City, there are only 3 units of the batik industry that have an environmental permit, which means only 3 industries.

The increase in the number of home industry batik productions also causes an increase in the amount of liquid waste produced. The less assertive attitude of the government and also the lack of attention from home industry owners regarding the dangers of disposing of liquid waste from batik production without any prior processing resulted in unavoidable environmental pollution. Waste that is of high quality and continuously can lead to a decrease in environmental quality, due to the limited ability of river water to repair itself or self-purification (Agus, Muzamil, 2020). The most obvious pollution is the change in the physical quality of river water in Pekalongan City, namely in color and



smell. River water which was originally used to meet daily needs such as washing and bathing is now no longer used because it has a thick color and a strong smell. This change will be more visible in summer due to a decrease in river water discharge in summer.

Seeing that the river water has been polluted and has lost some of its functions, the Pekalongan river is still used as a fishing ground for local residents. If the fish obtained are consumed continuously, it will have a negative impact on health considering that the river is also polluted with heavy metals. Before reaching the river, the liquid waste of the batik home industry is usually channeled into the household waste drainage channel and fills the ditches around the industry. The waste in the drainage channel not only flows into the river but also flows into the irrigation canal and into the rice fields.

Another impact of the batik industry waste pollution is that the dug wells used to meet the daily needs of the residents are also slowly starting to become polluted, especially for residents who are downstream and adjacent to the river. The use of ground water by residents, especially dug well water, has many factors that affect its quality, including the construction of dug well water, distance from pollutant sources and industrial and domestic activities. Just like the physical changes in river water, the residents' well water also begins to change color to brown and yellowish and sometimes even emits a pungent odor which according to residents smells like the smell of chemical substances. This can happen because the discharged liquid waste seeps into the soil layer and reaches the raw water source in the soil. The residue from the metal plating industry containing substances such as copper, lead, silver, chromium, arsenic and boron is a liquid waste which is highly toxic to microorganisms. Infiltration into the soil will result in the death of microorganisms that have a very important function on soil fertility and in this case also cause soil pollution.

When a hazardous or toxic substance has polluted the soil surface, it can evaporate, be washed away by rainwater and/or enter the soil. Pollution that enters the soil is then deposited as toxic chemicals in the soil. Toxic substances in the soil can have a direct impact on humans when they come into contact or can contaminate groundwater and the air above it (Muslimah, 2015). In the groundwater environment, ammonification process rarely occurs because the groundwater environment is generally an oxidizing environment due to the movement of water. Organic matter is rarely or very little in the environment. If there is, then most of the ammonification process will be



in the form of harmless ammonium (NH_3) intermediates. While the amount of ammonia (NH_4) will be less and will be directly absorbed by clay or dust particles as exchanged cations. Drainage and dilution of waste by upstream flows and rainwater will take place much more rapidly. In addition, the biological recovery mechanism in surface water can run faster due to the large number of bacteria present, whereas in groundwater it will be slower. In the dug wells analyzed in August, most of the dissolved nitrogen that contaminates is not in the form of nitrate, but in other forms such as ammonium, ammonia, fat, protein and other organic nitrogen (Djuwansah, 2009). In addition, the biological recovery mechanism in surface water can run faster due to the large number of bacteria present, while in ground water it will be slower. In the dug wells analyzed in August, most of the dissolved nitrogen that contaminates is not in the form of nitrate, but in other forms such as ammonium, ammonia, fat, protein and other organic nitrogen (Djuwansah, 2009). In addition, the biological recovery mechanism in surface water can run faster due to the large number of bacteria present, while in ground water it will be slower. In dug wells analyzed in August, most of the dissolved nitrogen that contaminates is not in the form of nitrate, but in other forms such as ammonium, ammonia, fat, protein and other organic nitrogen (Djuwansah, 2009).

Groundwater pollution can cause serious problems if left untreated. This is because ground water is a source of water used by most of the population to meet the needs of clean water and drinking water (Widiyanto, 2015). In addition, in various fields of impact caused by soil pollution, it can cause health problems such as lead is very dangerous in children, because it can cause brain damage, as well as kidney damage in the entire population. Chronic (continuous) exposure to benzene at certain concentrations can increase the chance of developing leukemia. Various solvents containing chlorine stimulate changes in the liver and kidneys as well as a decrease in the central nervous system. There are several kinds of health effects that appear such as headaches, dizziness, fatigue, eye irritation and skin rash to chemical exposure. Especially in large doses and exposure for a long time can cause death.

CONCLUSION

Based on the research that has been done, it can be concluded that the actual liquid waste discharge (DA) is smaller than the maximum liquid waste discharge (DM). The actual pollution load for heavy metal parameters namely Lead (Pb), Zinc (Zn), Chrome (Cr) and TSS parameters is smaller



than the maximum pollution load (DM) of each parameter, while for the COD parameter the results are almost close to the maximum limit and for BOD5 the actual pollution load is greater than the maximum pollution load for both daily and monthly pollution loads. From these results it can be said that the discharge and pollution load of the batik home industry wastewater have not contributed greatly to the pollution parameters COD, TSS, Lead (Pb), Zinc (Zn), and Chrome (Cr).

SUGGESTION

1. Minimize the range of pollutant load factor values for batik IKM wastewater for the three parameters (BOD5, COD, TSS) by increasing the number of repeat samples in the experimental design, so as to increase the effectiveness of pollution control planning.
2. Efforts to minimize the pollutant load can be started from each individual with a focus on optimizing the production process (clean production) as well as simple wastewater treatment but producing the minimum amount of liquid waste possible.

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