THE OPERATING EFFECTIVENESS OF WTU AND WWTP OF BATIK IN PEKALONGAN CITY

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Abstract
The objective of research is to analyse operating effectiveness of WTU (Waste Treatment Unit) and WWTP (Waste Water Treatment Plan) of Batik in Pekalongan City. This research was conducted at WTU in Jenggot Village and WWTP in Kauman Village, Pekalongan City. The results showed that WPU operated in Jenggot Village and WWPI in Kauman Village was relatively effective. The test results of waste water at outlet WPU showed, COD parameter (109 ppm) was still above the quality standard (100 ppm), while 6 other parameters (TSS, BOD_5, total Cr, phenol, pH, and ammonia) underneath/ in the specified quality standards interval. The test results of waste water at WWTP outlet showed all key parameters is underneath/within the specified quality standards interval. The test results of population wells water in Jenggot Village showed concentrations of Cr total <0,003 ppm. Total Cr with concentrations <0,003 ppm also found in the river water testing of Asam Binatur in Jenggot Village and Pekalongan river in Kauman Village. The test results of river water at Asam Binatur in Jenggot Village showed COD concentration (50 ppm) and BOD_5 (17.5 ppm) above the quality standard (25 ppm and 3 ppm). BOD_5 concentration (5.2 ppm) in the river water testing of Pekalongan in Kauman Village was above the quality standard (3 ppm).

Keywords: WTU, WWTP, batik

1. Introduction

Pekalongan City is known as batik industry with various coastal typical design as development of Patola fabric motif from India. In Pekalongan City, more than USD 100 billion of money circulation derived from batik business annually. The business activities in this city is also largely driven by businesses intersected with batik, ranging from raw material supply of cloth, paraffin, *canting* , stove, to the establishment of a number of exclusive boutiques that in particular displaying the batik motive clothing.

The textile industry characteristics is marked with the resultant of liquid waste in large number and potential containing pollutants originating from the dye, supporting materials of textile, starch, and other sources (Sugiana, 2008). The liquid waste of textile is toxic for bioindicator. The liquid waste should be processed on WTU (Waste Treatment Unit) or WWTP (Waste Water Treatment Plan). Thus, the research problem is focused on the operating effectiveness of WTU or WWTP.

The research results of Pratiwi (2010), the textile liquid waste being discarded in the Cilacap Blader River can reduce nutrient coefficient of test fish (betik fish/ Anabas testudineus BL) becomes 1.53 to 1.63, which means it does not qualified for human consumption. Sastrawidana et al

(2008) showed that the use of dyes have negative impact on the environment since it is not easily damaged by chemical treatment and potolitik treatment.

Any textile industry is always demanded to make continual improvement of production processes, so that a raw materials, water, and energy are used efficiently on generating a product. Consequently, the resulted waste can be minimized. Philosophically, the supporting capacity of environment can be maintained for long term, according to the sustainable development concept as a blend between development and conservation. The environment is no longer to be a burden and and seen as external factors of business, but environment management has become an integral part of business management. This is in line with the findings of Al-Tuwaijri et al (2004), Friedmann and Jaggi (1992), Deegan (2000, 2002), Pfleiger et al (2005), Guthrie and Parker (1989), Robert (1992), Tilt (Haniffa and Cooke, 2005), and Lindblom (Haniffa and Cooke, 2005).

2. Methods

The research was conducted on the textile (batik) SME in Pekalongan, which was divided into 2 (two) boundaries: village batik, Jenggot and Kauman Village, Pekalongan City.

The wastewater samples was taken at the WTU outlet, Jenggot Village and WWTP Kauman Village, the well water samples was taken at the resident's wells in WTU boundary, Jenggot Village, and the river water samples was taken at the Asam Binatur River (Jenggot Village) and Pekalongan River (Kauman Village). The water wells sample in Kauman Village is not taken because the Kauman residents use PDAM water to meet daily needs. The waste water sample, river water, well water was taken in August 14, 2014 when the textile (batik) SMEs operated for $BOD_{5,}$ COD, TSS, total Cr, ammonia, phenol, and pH parameters.

Data were analyzed in descriptive-comparative using various tables. The lab test results data was compared to the quality standards as set out in Regulation No. 82 of 2001 for river water, Minister Regulation No. 416/Per/IX/1990 for wells water, and District Regulation of Central Java Province No. 5, 2012 for wastewater.

3. Results and Discussion

The Results

Jenggot is one of villages in Sub District of South Pekalongan batik which became Batik center. Based on BPS data (2013), by 2012 in this village there are 123 SMEs units, which produced batik, involving 328 workers. The batik center can also be found in Kauman Village, Sub District of East Pekalongan, which already has brand of "Batik Village". Based on BPS data (2013), by 2012 in this village there are 66 SMEs units, which produced batik, involving 1 32 workers.

The City Government of Pekalongan has built and operated WTU at Jenggot Village and WWTP at Kauman Village. The test results of waste water quality at outlet WTU and WWTP are presented in Tables 1 and 2.

Table 1. The Testing Results of Water Quality of WTU Outlet in Jenggot Village

No.	Parameter	Unit	Results	Quality Standards *)	Description
Physics					
1	Total suspended solids (TSS)	ppm	11	100	Under the quality standards
Chemistry					
1	pH	-	7.2	6.0 to 9.0	Within the quality standards interval
2	Cr Total	ppm	<0.003	0.5	Under the quality standards
3	BOD_5	ppm	41	50	Under the quality standards
4	COD	ppm	109	100	Above the quality standard
5	Phenol	ppm	0,010	0.5	Under the quality standards
6	Ammonia	ppm	5.99	-	-

*) Regional Laws of Central Java Provincial No. 5 In 2012
Source: Primary Data, 2014.

Table 2. The Test Results of Water Quality at WWTP Outlet Kauman Village

No.	Parameter	Unit	Results	Quality Standards	Description
Physics					
1	Total suspended solids (TSS)	ppm	26	100	Under the quality standards
Chemistry					
1	pH	-	7.1	6.0 to 9.0	Within the quality standards interval
2	Cr Total	ppm	<0.003	0.5	Under the quality standards
3	BOD_5	ppm	11	50	Under the quality standards
4	COD	ppm	29	100	Under the quality standards
5	Phenol	ppm	0,00	0.5	Under the quality standards
6	Ammonia	ppm	0.78	-	-

*) Regional Laws of Central Java Provincial No. 5 In 2012
Source: Primary Data, 2014.

The textile (Batik) small industry operation has impact on the well water quality and river water. The test results of resident's well quality in Jenggot Village, and the test results of the river water quality in Jenggot and Kauman Villages presented in Tables 3, 4, and 5.

Table 3. The Test Results of Residents Well Water Quality in the Jenggot Village

No.	Parameter	Unit	Results	Quality Standards *)	Description
Physics					
1	Total suspended solids (TSS)	ppm	3	-	-
Chemistry					
1	pH	-	7.2	6.0 to 9.0	Within the quality standards interval
2	Cr Total	ppm	<0.003	-	-
3	BOD_5	ppm	7	-	-
4	COD	ppm	15	-	-
5	Phenol	ppm	0,00	-	-
6	Ammonia	ppm	0.58	-	-

*) Health Ministry Laws No. 416 /Menkes/Per/IX/1990
Source: Primary Data, 2014.

Table 4. The Test Results of Asam Binatur River Water Quality in Jenggot Village

No.	Parameter	Unit	Results	Quality Standards *)	Description
Physics					
1	Total suspended solids (TSS)	ppm	28	50	Under the quality standards
Chemistry					
1	pH	-	7.1	6.0 to 9.0	Within the quality standards interval
2	Cr Total	ppm	<0.003	-	-
3	BOD_5	ppm	17.8	3	Above the quality standards
4	COD	ppm	50	25	Above the quality standards
5	Phenol	ppm	0,023	1	Under the quality standards
6	Ammonia	ppm	2,32	-	-

*) PP 82 of 2001 (Class II)
Source: Primary Data, 2014.

Table 5. The Test Results of Pekalongan River Water Quality in Kauman Village

No.	Parameter	Unit	Results	Quality Standards	Description
Physics					
1	Tota suspended solids (TSS)	ppm	9	50	Under the quality standards
Chemistry					
1	pH	-	7.1	6.0 to 9.0	Within the quality standards interval
2	Cr Total	ppm	<0.003	-	Under the quality standards
3	BOD_5	ppm	5.2	3	Above the quality standards
4	COD	ppm	17	25	Under the quality standards
5	Phenol	ppm	0.027	1	Under the quality standards
6	Ammonia	ppm	2.26	-	-

*) PP 82 of 2001 (Class II)
Source: Primary Data, 2014.

Discussion

The results of well water test (Table 3) and monitoring the river water (Tables 4 and 5) indicate the degradation of environment (waters) as consequence of textile (batik) industry operation in Pekalongan City. This test results are in line with the result of residents well water quality test in Pringlangu Village by March 2014 (Cd concentration of 0.007 ppm; the quality standard of 0.003 ppm) and the monitoring result of Asam Binatur river water on May 5, 2014, which are presented in Table 6.

Table 6. The Monitoring Results of Asam Binatur River Water

No.	Parameter	Unit	Test Results	Quality Standards *)	Description
	Physical	-	-	-	Blackish color, foamy and smelly
	Chemistry				
1	BOD	mg / l	19	3	Above the quality standards
2.	COD	mg / l	59.51	25	Above the quality standards
3.	Chlorine	mg / l	0.5	0.03	Above the quality standards

*) Government Regulation No. 82 , 2001
Source: Kantor Lingkungan Hidup (KLH) Pekalongan City, 2014

The results of residents wells water test in Jenggot Village (Table 3) contains total Cr although its concentraton small (<0.003 ppm). According to Diamant (Martopo, 1992), Cr is highly toxic and can cause death or health problems that can not be recovered in a short time.

Total Cr was also found in the Asam Binatur river water in Jenggot Village (Table 4) and Pekalongan River in Kauman Village (Table 5) with similar concentration. According to Sylvester (Wardoyo, 1982), Cr heavy metals at levels of 0.1 ppm is toxic to fish. The lower concentrations of heavy metals, including Cr in a still waters should be wary since the aquatic organisms can take certain elements from water and attaches it to the body up to 100 or 1000 times greater than the levels are found in water (Vernadsky in Hutagalung, 1985). Thus, the higher the concentration of heavy metals in water the highest the heavy metals levels accumulated in the body of water biota (Connell and Miller, 1992).

Textile (batik) SMEs or large businesses of textile (batik) operated in Jenggot and Kauman Village does not equipped with WTU and WWTP. The waste (water) produced was efflorescented on water channel connected to the river. As consequence, water quality has lowered. Physically, canal water /river is seen colored.

To build and operate WTU or WWTP is required a relatively large costs, including the cost for land acquisition and equipmnent, chemicals, electricity, and wages of operational workforce. Therefore, the City Government of Pekalongan has facilitated by building WTU in Jenggot Villaege and WWTP in Kauman Village.

Jenggot WTU was operated by four workers, while Kauman WWTP involving 3 workers, who work in shifts, with salary Rp 750,000 to Rp 800,000 per month. The chemicals material are used i.e., PAC powder ($N_2 O_3$ 30%). Total cost for Jenggot WTU operation and Kauman WWTP each year was respectively Rp 50,000,000 and Rp 72,000,000.

The wastewater processing facilities that have been built and operated have not been utilized by all employers. The Jenggot WTU was used to process the waste (water) of textile (batik) around 80 business units; there are still about 20 business units that poured the waste generated directly into the river. Likewise with textile (batik) SMEs in Kauman; as many as 25 business units have utilized, while the other five business units, dispose directly the liquid waste was generated to the river. The causing factors, among others, the sewerage owned by the business units are relatively lower compared to WTU or WWTP installation, and the business actor awareness that still need to improve continuously.

To observe the effectiveness of wastewater processing in Kauman WWTP have been done the test on March 15, 2013, as presented in Table 7.

Table 7. The Effectiveness of Kauman WWTP

No.	Parameter	Unit	Result Analysis		Quality Standards (Mg / l)	Description
			Inlet	Outlet		
A. Physics						
1.	Temperature	^{o} C	28	28.4	38	< Quality standard
2.	Total Suspended solids (TSS)	ppm	606	334	50	> Quality standards
B. Chemical						
1.	BOD_5	ppm	3.56	3.15	60	< Quality standards
2.	COD	ppm	1004.64	63.01	150	< Quality standards
3.	Phenol Total	ppm	-	-	0.5	< Quality standards
4.	Cr Total	ppm	1.89	<0.05	1.0	< Quality standards
5.	Ammonia Total (NH_3 -N)	ppm	5	1	8.0	< Quality standards
6.	Sulfide as S	ppm	-	-	0.3	< Quality standards
7.	Oils and Fats	ppm	131.2	129.8	3.0	> Quality standards
8.	pH	-	7.48	6.90	6.0 to 9.0	Within quality standards
C. Debit		m^3 / hr	-	-	100	-

Source: Kantor Lingkungan Hidup (KLH) Pekalongan City, 2014

From Table 7 can be argued, Kauman WWTP can reduce effectively 5 test parameters, i.e., (1) total suspended solid (TSS), (2) BOD_5, (3) COD, (4) Cr Total, and (5) Ammonia Total (NH_3 -

N). The highest decline was achieved by COD parameters, test results (inlet) 1.004.64 ppm to 63.01 ppm (outlet) or decreased 93.73%. WWTP is not effective for lowering the concentration of oil and fats parameters, test results (inlet) 131.2 ppm into 129.8 ppm (outlet) or decreased only 1.07%. Similarly to the total suspended solids parameters, can only decrease 44.89%. The high concentration of total suspended solids parameters as well as oils and fats (above the quality standard) has potential to degrade the the river water quality and the resident well water.

By comparing the results of Kauman WWTP outlet test (Table 7) and Table 5 it can be argued, the operation of WWTP is relatively effective in lowering the parameters concentration of TSS, COD, Cr Total, and ammonia respectively by 92.22%, 53.98%, 94%, and 22%, while BOD_5 and pH parameters increased respectively 249.21% and 2.89%. Decrease/increase fluctuations each parameter was presented in Table 8.

Table 8. Decrease/Increase Fluctuations of Key Parameters Concentration in Kauman WWTP

No.	Parameter	Unit	Result Analysis		Description
			Outlet 2013	Outlet 2014	
A. Physics					
1.	Total suspended solids (TSS)	ppm	334	26	(-) 92.22%
B. Chemical					
1.	BOD_5	ppm	3.15	11	(+) 249.21%
2.	COD	ppm	63.01	29	(-) 53.98%
3.	Phenol Total	ppm	-	0,00	-
4.	Cr Total	ppm	<0.05	<0.003	(-) 94.00%
5.	Ammonia Total (NH_3-N)	ppm	1	0.78	(-) 22%
6.	pH	-	6.90	7.1	+2.89%

Source: Analysis Results, 2014

From Table 4, 5, and 8 can be argued, the synergy involving the City Government of Pekalongan and SME (batik) entrepreneurs have provided relatively good results for controlling the environmental degradation.

4. Conclusions and Suggestions

Conclusion

Based on the results and discussion can be inferential as follows. The environmental management performance of (batik) textile SMEs in Pekalongan was still need to be improved. The development and operation of WTU in Jenggot Village and WWTP in the Kamuman Village were relatively effective.

1. The results of waste water test at WTU outlet showed, COD parameter (109 ppm) is still exceeded the quality standard (100 ppm), while 6 other parameters (TSS, BOD_5, Cr total, phenol, pH, and ammonia) is still under/in the specified quality standards interval. The results of waste water test at WWTP outlet showed, all the key parameters is underneath /in the specified quality standards interval.
2. The results of residents wells water test in Jenggot village showed concentrations of Cr total <0,003 ppm. The Cr total with concentrations <0,003 ppm also found at the river water test in Jenggot and Kauman Villages.

3. The results of river waters test in Jenggot Village (Asam binatur River) showed, COD concentration (50 ppm) and BOD_5 (17.5 ppm) exceeded the quality standard (25 ppm and 3 ppm). BOD_5 concentration (5.2 ppm) at the river water test in Kauman Village (Pekalongan River) is above the quality standard (3 ppm).

Suggestions

The suggestions are proposed as follows.

1. Kantor Lingkungan Hidup (KLH) Pekalongan City should periodically test the WTU and WWTP waste water effluent to observe the effectiveness. A periodically tests should also be taken on the body of water: Asam Binatur River and Pekalongan River as well as the residents wells in WTU and WWTP boundary .
2. Textile (batik) SMEs employers which has not drained the produced waste water to WTU or WWTP should continue to be encouraged and facilitated, so they no longer pour the waste water directly into the river.

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