Effect of Batik Waste Water on Kali Wangan Water Quality in Different Seasons

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Abstract. Sokaraja Batik Center is one of batik industrial centers in Banyumas Regency. The craftsmen in Sokaraja Batik Center dispose of their waste water directly to a river named Kali Wangan. This study aims at figuring out the quality of Kali Wangan in dry and rainy seasons. The research is conducted along the Wangan River in January – November 2015. The research method used is survey with Purposive Random Sampling. The Kali Wangan water is sampled in four observation stations. The obtained data are analyzed descriptively and compared against the environmental quality standards. The research results show that the quality of Kali River water is found contaminated by the batik waste water, all parameters are below the class III standards quality based on Government Regulation Number 82 Year 2001 during dry and rainy season

1 Introduction

Sokaraja Batik Center to contaminate the environment since their batik waste water are disposed of to Kali Wangan. Kali Wangan is used by the people living along it for irrigation, fish cultivation, and even for bathing and washing clothes. The batik waste water disposed of to Kali Wangan without being treated in advance could contaminate and harm water biota life. The TSS, BOD and COD levels in Wangan River have exceeded the environmental quality standards at 540.13 mg/L; 540.42 mg/L and 672.78 mg/L respectively, and the heavy metal parameter exceeding the quality standards are Cd and Cr at 0.018 mg/L and 0.231 mg/L [1].The batik waste water contains coloring substance rhodamine Breaching to 0.344ppm,methylene blue 0.179ppmand methyl orange 0.779ppm [2].The batik waste water contains such metals as Zn, Crand Cuat 2ppm,2ppmand 0.2ppm respectively. Naphthol and indigosol colorants contain large amount of heavy metals such as zinc (Zn),chrome (Cr) and copper (Cu) [3]. Addition to colorants and heavy metals, the batik liquid waste also contains high organic materials.

Visually, the batik waste water has color. The existence organic materials in water could increase turbidity, thus prevent light penetration and oxygen diffusion to the water. The inorganic materials and heavy metals are hard to degrade in water [4]. Their existence in aquatic ecosystem will harm the metabolism process of water organisms. Any organism exposed to metals will accumulate metals in their body and experience biomagnification, thus the metal level gets increasingly higher according to the organism position in the food chain.

Seasons have some influence on the contaminant concentration in the environment. Dry season with low rainfall causes the waste concentration to be higher, while during rainy season the waste concentration is low since rainwater dilutes it. Study the quality of river water contaminated by batik liquid waste [5,6].The studies are conducted in large rivers. This research, on the other hand, study the quality of river water contaminated by batik liquid waste in a small river (primary irrigation channel). The downstream of Kali Wangan is utilized directly to irrigate the rice fields, leading any contamination by batik liquid waste to have direct impact on the plants. This research aims at figuring out the quality of Kali Wangan water that contaminated batik waste water during dry and rainy seasons.

2 Research Method

The research is conducted in January - November 2015. It is performed using survey as its method. The Wangan River water sample is taken using Purposive Sampling in 4stations (Figure 1). The first station is a place where no waste has been disposed of, the second station is a place right where the waste is disposed of, the third station is a place where the waste has been disposed of for some time and the fourth station is a place where another waste is disposed of in addition to the batik liquid waste. The sampling is performed during dry and rainy seasons each 3 times at an interval of one mouth. The parameters measured are based on the class III Water Quality Standards for agricultural irrigation, fresh water fish

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cultivation and water recreation infrastructures / facilities under the Government Regulation Number 82 year 2001 which are limited to the parameters for textile waste (Provincial Government Regulation of Central Java Number 5 year 2012),i.e. TSS, pH, BOD_5, COD, NH_3, total chrome, sulfide, oil-grease and phenol.

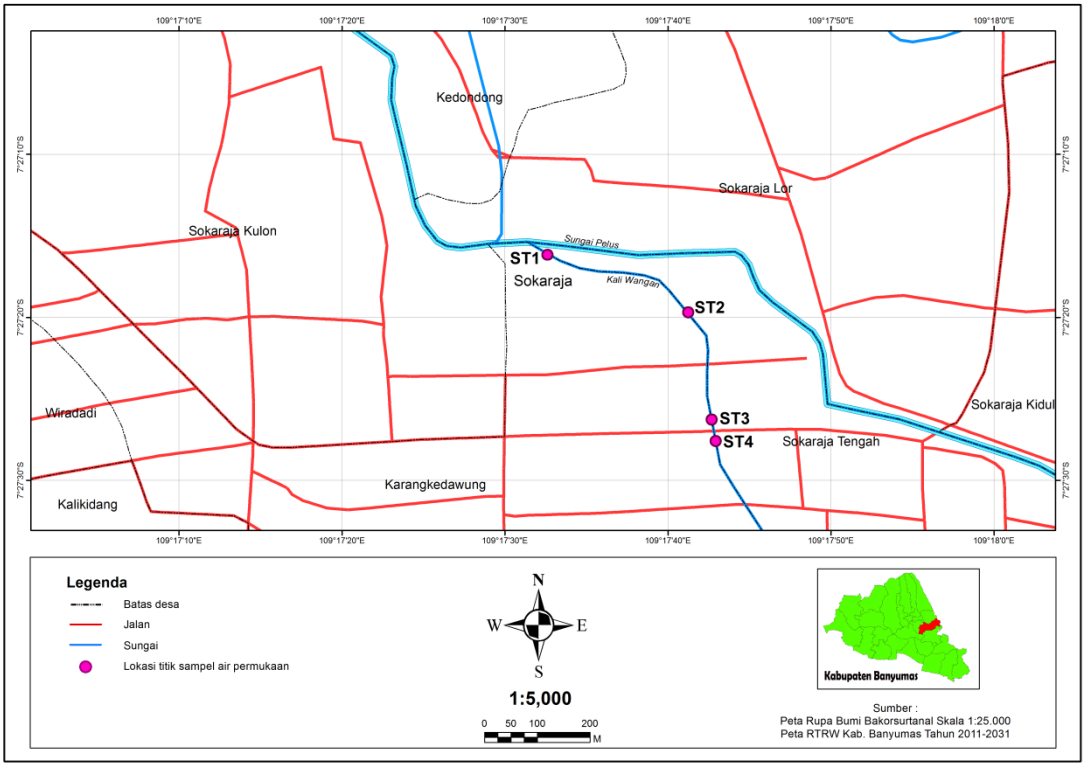

Fig. 1. Sampling location map

3 Results and Discussion

The research results indicate that the quality of Wangan River water during dry and rainy seasons is still below the quality standards. The complete data on the physical and chemical of Kali Wangan water during dry and rainy seasons are presented in detail in Tables 1 and 2.

Based on Tables 1 and 2,it is found that all parameters, both the physical and chemical ones, have the same pattern i.e. they are low in station 1 then increase in station 2 and 3 and decrease in station 4. The station 1 observation is performed in upstream part, close to the sluice of Pelus River, thus it is relatively uncontaminated by the batik waste. Stations 2 and 3 are the river segments receiving the batik waste, resulting in an increased concentration of contaminant in these segments. Meanwhile, station 4 is the river segment after receiving the disposed batik liquid waste. The contaminant concentration decreases since a dilution by the river water occurs. The BOD and COD parameters increase once again in station 4, since this is the site where other wastes of Sokaraja Soto and Gethuk are disposed.

Table 1. Physical-chemical parameters of Kali Wangan water during dry season

No	Parameter	Unit	Mean per station				Quality Standart (Class III)
			I S $07^0$25'36.0" E $109^0$14'12.3"	II S $07^0$27'19.5" E $109^0$17'41.3"	III S $07^0$27'25.4" E $109^0$17'42.4"	IV S $07^0$27'34.4" E $109^0$17'46.1"	
1.	Temperature	^{0}C	26.33±0.58	26.33±0.578	27±1	28.33±0.57	deviasi 3
2.	pH		6.92±0.02	6.64±0.18	6.77±0.14	6.20±0.025	6-9
3.	TSS	mg/L	4.0±0.01	9±1	8±1	10±1	400
4.	BOD	mg/L	1.43±0.153	2.1±0.1	1.8±0.2	1.8±0.1	6
5.	COD	mg/L	13.1±0.1	17.1±0.1	15.93±0.152	24.16±0.25	50
6.	Ammonia	mg/L	0.45±0.01	0.66±0.02	0.64±0.025	0.56±0.005	negative
7.	Total Chrome	mg/L	0.0014±0	0.0014±0	0.0014±0	0.0014±0	0005
8.	Sulfide	mg/L	undetected	undetected	undetected	undetected	0.002
9.	Oil and grease	mg/L	4.01±0.01	12.09±0.03	26.02±0.01	16.07±0.02	1000
10.	Phenol	mg/L	0.05±0.0002	0.116±0.0007	0.021±0.0003	0.066±0.0002	1

Table 2. Physical-chemical parameters of Kali River water during rainy season

No	Parameter	Unit	Mean per Station				Quality Standart (Class III)
			I S 07^{0}25'36.0" E 109^{0}14'12.3"	II S 07^{0}27'19.5" E 109^{0}17'41.3"	III S 07^{0}27'25.4" E 109^{0}17'42.4"	IV S 07^{0}27'34.4" E 109^{0}17'46.1"	
1.	Temperature	^{0}C	28.53±0.416	29.27± 0.20	30.2±0.2	30.2±0.2	deviasi 3
2.	Ph		7.2±0.1	7.1±0.1	6.7±0.2	6.67±0.15	6-9
3.	TSS	mg/L	1.8±0.6	9.033±0.15	8.2±0.264	5.567±0.378	400
4.	BOD	mg/L	2.97±0.208	4.47±0.35	5.1±0.36	4.067±0.152	6
5.	COD	mg/L	0.54±0.052	18.03± 1.040	18.433±0.503	25.867±0.568	50
6.	Ammonia	mg/L	0.54± 0.052	0.823±0.073	0.676± 0.092	0.663±0.005	Negative
7.	Total Chrome	mg/L	0.0014±0	0.0014±0	0.0014±0	0.0014±0	0.05
8.	Sulfida	mg/L	undetected	undetected	undetected	undetected	0.002
9.	Oil and Grease	mg/L	3.89±0.03	8.05±0.01	8.02±0.01	6.04±0.04	1000
10.	Phenol	mg/L	0.021±0.001	0.0719±0.003	0.054±0.004	0.046±0.004	1

The heavy metal in Wangan River is still below the environmental quality standards both during dry and rainy seasons. Even its Cr(VI) is found to be below the device detection limit. Based on Tables 1 and 2, the chrome both during rainy and dry seasons is found to be tiny, far below the environmental quality standards. It shows that despite the fact that Wangan River is where the batik liquid waste is disposed of its water quality is found to be uncontaminated. A preliminary study by measuring the concentration of several metals in Wangan River1. The concentration of several metals resulting from this preliminary study is presented in Table 3 below.

Table 3. The concentration of heavy metal on Kali Wangan water in preliminary study

No	Parameter	unit	Station			Standart Quality (Class II)
			I S 07^{0}25'46.0" E 109^{0}15'11.6"	II S 07^{0}27'19.5" E 109^{0}17'41.3"	III S 07^{0}27'25.4" E 109^{0}17'42.4"	
1.	Cd	mg/L	0.007	0.018	0.014	0.01
2.	Cr^{6+}	mg/L	0.015	0.231	0.191	0.05
3.	Cu	mg/L	0.010	0.025	0.015	0.02
4	Pb	mg/L	0.016	0.033	0.023	0.03
5.	Hg	mg/L	<0.001	<0.001	<0.001	0.002
6.	Zn	mg/L	0.028	0.044	0.034	0.05
7.	Cd	mg/L	0.007	0.018	0.014	0.01

Note: Environmental quality standards is based on Government Regulation No 81 year 2001 concerning Management of Water Quality and Class II Water Contamination Control.

Based on Table3.the Cr, Cu and Pb parameters in station II have been above the quality standards, while in station III only Cr is above the quality standards. In station I, all metals are still below the environmental quality standards. Station I is the station close to the Pelus River sluice, hence it is logical that the contaminant there is still few, while station II is the station right where the batik liquid waste is disposed of, and station III is the one after station II which receives the waste flow. The preliminary research prove that Wangan River is contaminated by chrome resulting from batik liquid waste. Batik waste water comes from basic or advanced coloring substances which use toxic, hazardous chemical mixture during the coloring process. During the coloring process, only 5%of the colorants are absorbed and the remaining 95%will be disposed of as waste[7].

The batik waste water disposed of to Kali Wangan has not deteriorate the quality of Kali Wangan water. Both physically and chemically speaking, Kali Wangan water can still serves its purpose for irrigation both during dry and rainy seasons. Even though all parameters are still below the environmental quality standards, the contaminant concentration in Kali Wangan during dry season is higher than during rainy season in each observation station (Table 1 and 2). The content of contaminants in a body of water during rainy season is lower since dilution occurs7.During dry season, however, it is higher for it is concentrated. Rainfall has some influence on the dilution of these contaminants. In addition to rainfall, the river water discharge also has some influence on the fluctuation of contaminant level in the body of water.

The fact that some batik waste water gets into Kali Wangan has not caused its water quality to decrease. This is due to the relatively stable river water discharge both during rainy and dry seasons. The Kali Wangan water discharge during dry and rainy seasons per station is presented in Table 4.

Table 4. WanganRiver water discharge during dry and rainy seasons

Season	River Water Discharge (m^3/second)			
	Station 1 S $07^0$25'36.0" E $109^0$14'12.3"	**Station 2** S $07^0$27'19.5" E $109^0$17'41.3"	**Station 3** S $07^0$27'25.4" E $109^0$17'42.4"	**Station 4** S $07^0$27'34.4" E $109^0$17'46.1"
Dry	0.309	0.267	0.276	0.049
Rainy	0.310	0.220	0.204	0.124

Based on Table4.Kali Wangan water discharge during dry and rainy seasons is relatively the same. During rainy season, the river water discharge in stations 1 and 4 is higher than during dry season, while in stations 2 and 3 the dry season has lower water discharge than the rainy season. It is because the Kali Wangan water flow depends on the activity of opening and closing the sluice of Pelus River by the Water Resources and Mineral Office of Banyumas Regency. The relatively stable river water discharge does not significantly influence the quality of Kali Wangan water. Nevertheless, if the incoming contaminants have high quantity, then it may increase the water contamination load. The high quantity may result from several things, such as increased production capacity and increased number of batik craftsmen. An increased production capacity could rise the number of liquid waste volume the industry generates. The same applies to the increased number of batik craftsmen. However, an improved knowledge of batik craftsmen on waste management could minimize the contamination load in Kali Wangan.

4 Conclusion and Suggestions

Based on the research results, it can be concluded that the quality of Kali Wangan is contaminated of batik waste water is disposed of during rainy and dry seasons still suits its utilization under the Government Regulation Number 82 year 2001 on Class III.

Continuous monitoring to the Kali Wanganis necessary as an early warning system for any environmental contamination resulting from batik waste water.

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