The analysis of wastewater management at small and medium textile (batik) enterprises in Pekalongan city

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Abstract. This study intended to analyze the wastewater management at Batik small and medium enterprise (SME). The study took place in SMEs at two boundaries in Pekalongan City. The research subject was the businessmen of SME. Observation and interview were employed to collect data and were analyzed descriptive-comparatively. The results showed that the Pekalongan City Government had built a Waste Processing Unit (WPU) in Jenggot Village and WWTP (Wastewater Treatment Plant) in Kauman Village. The operation of WPU and WWTP still needs optimization by increasing the participation of SME entrepreneurs/craftsmen so that environmental damage due to wastewater produced by textile SMEs (batik) can be minimized.

1. Introduction
Pekalongan City is well-known for its batik industry having unique littoral motifs as the adaptation of Indian, Arabic, and Chinese culture. One of which resulted in Jlamprang and Ceplok motif which could also be found in sculptures of Hindu/Buddha temples. They are mainly composed of squares, circles, animals, flowers, and diagonal lines. Moreover, Jlamprang has been the symbol of Pekalongan City. Solid waste is not yet a priority

The textile industry emits a waste variety from all production process [1,2]. Garment industrial can be sourced from (damaged textile, cut and sew waste) [3]. Solid waste is not yet a priority [4]. Liquid waste dominated the textile industry process. The textile industry does not only consist of large amounts of water for the process [5], but also requires various chemicals and coloring agents for the process [6-7]. 2-20% textile dyes flowed directly as aqueous effluents [8]. The textile coloring process has created a massive problem with pollution and has been the number 1 pollutants after agriculture [9]. The textile industry consumes large amounts of water (200 m³ / ton of product) where about 90% resulted in wastewater [10].

Textile industry and coloring waste could result in physical, chemical, biological characteristics of aquatic environment by the change of temperature, scent, and turbidity. These changes may affect the health of the community, kettle, wild animal, fish, and other biological wealth. Living fish need at least 5 ppm diluted oxygen while the minimum diluted water for the sustainability of aquatic biota is 6 ppm.

Liquid waste produced by the textile industry has the potential to contain pollutants derived from dyes, textile auxiliaries, starch, and other sources. Research by [11] showed that the colors used were
terrible for the environment because they are not easily damaged by chemical treatment and photolytic treatment.

Textile products (batik) must be designed as environmentally preferable products (EPPs) to penetrate the barrier of environmental requirements, such as EC No. 1980/2000 concerning Establishing a Community System for Eco-Labels issued by the Parliament and European Union Council. Company management is required to always make improvements to the production process on an ongoing basis (continual improvement) so that the resulting waste can be minimized.

2. Methods
This study used a survey approach. The survey activities were carried out by observing the process of production and management of wastewater, which is produced by textile SMEs (batik) located in Pekalongan City, especially Jenggot and Kauman village. The research subjects were the entrepreneurs of SMEs in Jenggot and Kauman Village, Pekalongan City. The research data were collected using observation and interview technique. Data were described by using various images and tables and comparing with Government Regulation No. 82 of 2001.

3. Results and Discussion
The observation of waste flow pattern based on WWTPs in Kauman and WPU in Jenggot is presented in Figure 1 and 2.

![Figure 1. Waste Water Flow Pattern at Kauman’s WWTP](image-url)

Information:
1: Bella Batik 2: Rizka Batik 3: Faza’s Batik Art 4: Bole Batik
5: Batik Tanah Jawa 6: Batik Pancawarna 7: Griya Batik Mas 8: Batik Seni Asli
9: Rumkamlah Batik 9*: Rumkamlah Batik Workshop 10: Batik Banyu Putra
11: Zend Batik 11*: Zend Batik Workshop 12: Batik Damond 13 : Nulaba Batik
14: Griya Batik Anak Mas 14*: Griya Batik Anak Mas Workshop 15 : 9 Batik
Figure 2. Waste Water Flow Pattern at Jenggot’s WPU

Information:
1: Kanji Removal Service  2: Qodir Batik  3: Jeans Washing  4: Maeshun Batik
5: Muntahar Batik  6: Batik SS  7: Hani Abbas Batik  8: H. Abbas
9: Batik Teratai  10: Qorina Tex

The batik production process has generated a considerable amount of wastewater which could degrade the environment. Therefore, the wastewater has to be processed first before being channeled into the river. From Figure 1 and 2, the generated waste is directed to Jenggot WPU and WWTP Kauman. The entrepreneurs generally cannot afford to build their own WPU/WWTP as it requires a lot of money covering the land, equipment, and chemicals acquisition, as well as wages for operational staffs. Hence, The Government of Pekalongan City has facilitated the waste management by providing WPU in Jenggot Village and WWTP in Kauman Village as an implementation of Local Regulation NO. 9 the Year 2015 [12]. Each textile SME has to channel its waste to WPU or WWTP according to the boundary.

Four people operate the Jenggot's WPU while the kauman’s WWTP included three people. They worked in shift having their monthly fee ranging from Rp 750,000- Rp 800,000. The chemicals used are PAC powder (N2O3 30%). The annual amount of money spent to operate the WPU and WWTP is respectively Rp 50,000,000 and Rp 72,000,000. All the entrepreneurs have not well utilized the provided facility of wastewater management. The Jenggot’s UPL, for instance, has been made use by not more than 80 business units, remaining 20 units which directly channel their waste into the river. This also happens to the Kauman’ WWTP. So far, there 25 business unit employed it while five units dispose of their wastewater to the river. The factor underlying such action is their little waterways which cannot reach the WPU and WWTP’s channel.

The data from the monitoring section and Pekalongan’s environmental recovery agency revealed that the WPU could only accommodate 1,500 m³ out of 4,440 m³ waste produced daily. The rest is disposed of directly without any processing to the river [13]. The flushing of liquid waste produced by batik SMEs directly into the river has an impact on the degradation of the waters. The results of monitoring the water quality of the Asam Binatur and Pekalongan rivers are presented in Table 1 and Table 2.
Table 1. The Observation at Asam Binatur River

| Parameter       | Unit | Testing Result | Quality Standard | Information         |
|-----------------|------|----------------|------------------|---------------------|
| Physical        |      |                |                  |                     |
| Appearance      |      |                |                  | Blackish, foamy, ask|
| Chemical        |      |                |                  |                     |
| Content         |      |                |                  |                     |
| BOD             | ppm  | 19             | 3                | Above standard      |
| COD             | ppm  | 59.51          | 25               | Above standard      |
| Klorin          | ppm  | 0.5            | 0.03             | Above standard      |

Source [14]

Tabel 2. Water Quality Test Results of the Pekalongan River in Kauman Village

| Parameter       | Unit | Result | Quality Standard | Information         |
|-----------------|------|--------|------------------|---------------------|
| Physical        |      |        |                  |                     |
| Content         |      |        |                  |                     |
| Suspended solids| ppm  | 9      | 5                | Under the quality standard|
| Chemical        |      |        |                  |                     |
| pH              |      | 7.1    | 6.0-9.0          | In the quality standard interval |
| Cr Total        | ppm  | <0.003 | -                | Under standard |
| BOD5            | ppm  | 5.2    | 3                | Above standard      |
| COD             | ppm  | 17     | 2                | Under standard |
| Fenol           | ppm  | 0.027  | 1                | Under standard |
| Amonia          | ppm  | 2.26   | -                |                     |

Source: [12]

It can be inferred from Table 1 and 2 that both rivers have been polluted. The total of Cr concentration is frankly under the quality standard yet the heavy metal of Cr at 0,1 ppm is toxic to fish. The low rate of heavy metal, including Cr, in waters has to be taken into account as the organism could take particular elements and stick to its body, which multiplies the chemical content about 100 to 1000. Thus, the higher the heavy metal content in waters, the higher the accumulation of heavy metal in water organisms. The textile water waste decreased the nutrition and did not qualify for human consumption. Nevertheless, referring to [15], environmental damage cannot be prevented or avoided but can be controlled systematically.

4. Conclusion

Based on the results and discussion, conclusions can be drawn as follows: (1) the operation of WPU and WWTP must be optimized so that liquid waste from batik SMEs does not pollute the river, and (2) about 20% of SME craftsmen remain to dispose of liquid waste directly into rivers without going through WPU/WWTP.

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