

Strategy for Liquid Waste Management for Batik Industry in Ulu Gedong Village, Jambi, Indonesia

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ABSTRACT

Batik industry liquid waste in Ulu Gedong Village, DanauTeluk District, Jambi City, must be managed so it doesn't pollute the surrounding environment. Many factors influence the need for properly treated batik liquid waste. Thus, it is necessary to know what factors cause pollution and the right strategy for managing Batik industry wastewater in Ulu Gedong Village, DanauTeluk District, Jambi City. The aims of this study were (1) to analyze aspects that influence the liquid waste management strategy for Batik industries in Ulu Gedong Village, DanauTeluk District, Jambi City, (2) to determine the appropriate strategy for managing Batik industry wastewater in Ulu Gedong Village, DanauTeluk District, Jambi City. The number of respondents in this study consisted of 20 people using the Analytic Network Process method and using the "Super Decision" software. The results showed that the most influential aspects in the management of Batik industry liquid waste in Ulu Gedong Village, DanauTeluk District, namely Cultural aspects (0.92), Economic (0.80), Social (0.45), Management (0.42), and Technical (0.41). The main priority in the Batik industry liquid waste management strategy is providing convenience and incentives to businesses participating in wastewater management, such as granting business licenses and tax breaks. So it is hoped that the role of the Jambi City government can strive to provide convenience and incentive assistance to batik entrepreneurs who have or want to build batik Wastewater Management Installation facilities.

Keywords: waste management. Environmental pollution, batik waste, wastewater, water pollution.

INTRODUCTION

The Batik industry has an impact in the form of organic liquid waste with a large volume, thick colour, pungent smell and high temperature, acidity (pH), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS) (Sirait, 2018). This industry also generated high dissolved oxygen (DO) that impacted organisms dead and disrupt the ecosystem balances i.e. microbial degradation (Muchtasjar et al., 2019). This condition is caused by using synthetic and or chemical dyes in the batik production process (Rashid et al., 2013). If wastewater is discharged into environmental media without being treated first, it can cause environmental pollution, especially in

aquatic ecosystems (Setyaningtyas et al., 2019). In addition, organic waste can increase nitrogen levels into nitrate compounds which cause bad odors. Liquid waste from the textile dyeing process significantly impacts environmental pollution. The textile dyeing process with synthetic dyes is easier to process and makes the colors brighter and more mature, but at certain levels are toxic and carcinogenic (cancer triggers) (Dwisandi et al., 2021).

Environmental pollution caused by liquid waste from the Batik industry in Ulu Gedong Village, DanauTeluk District, Jambi City. From the results of field monitoring and data on batik production in Ulu Gedong Village, DanauTeluk District, ten Batik industries spread across nine locations are actively producing Jambi Batik

using traditional techniques. The ten productive craftsmen who produce batik products, on average, it ranges from 250 to 3,000 pieces of cloth per month (Dinas Perindustrian dan Perdagangan Provinsi Jambi, 2015). Strengthening allegations related to the contamination of Batik industry liquid waste, from the results of monitoring the liquid waste quality standards carried out by the Jambi City Environment Service in 2019, there were still several Batik industry whose liquid waste quality standards needed to be revised.

The two samples of Batik industry examined the following was found for “Bahri” batik craftsmen, the value of fatty oil is 3.8, where this value is above the quality standard of 3.0. From the indicator value of liquid waste on the “Dua Putri” batik craftsmen, it was found that the value was more than the quality standard value, aTSS value of 462 was found, far above the quality standard, which was only 50. For a pH value of 2.3 (normal pH between 6.0-9.0). The BOD value is 472, above the quality standard of 60. The COD value is 688.1, above the quality standard of 150. For a fatty oil value of 6.6, this value is above the quality standard of 3.0.

Although several methods were tested to manage the waste from the Batik industry, but there is no one strategy was successful. Several studies are limited on treating Batik wastewater using several methods such as adsorption, phytoremediation, bioremediation, and filtration. But the study about strategy of several aspect still rare. Thus, this paper will describe the powerful strategy to manage the waste from Batik industry in Jambi, Indonesia. This study is very important due to successfully reduce and managing waste in this location. In this paper, holistic aspect was described well including technical aspect, social aspect, management aspect, and cultural aspect.

MATERIALS AND METHODS

This study was conducted in Ulu Gedong District, Jambi City, Jambi Province, Indonesia during October to November 2022. The questionnaires used as a tool to get the information from the legal government, batik entrepreneurs and community leaders related to the management of batik wastewater from batik industries. Analytical Network Process was used as a method in this study. The result was analyzed by Super Decision 3.2 software.

RESULTS

Technical Aspect

Technical aspects analyzed including site technical conditions, pollution loads, WWTP systems and technology. Based on the condition of the location of the Batik industry in Ulu Gedong Village, the appropriate wastewater treatment system is centralized offsite wastewater treatment. Technically, each business distributes wastewater through a closed pipe network to a centralized communal WWTP in a representative area. To determine the system and technology of wastewater treatment for the Batik industry, data regarding land conditions, quality and quantity of wastewater produced is required. Because of this, a wastewater treatment system and technology are needed to reduce the levels of these pollutant substances to meet the established environmental quality standards.

Based on questionnaires and interviews conducted with 20 respondents, it can be concluded that they do not yet have sufficient knowledge, expertise, and financial ability to provide wastewater treatment, so that suitable wastewater treatment is one that has easy technology and low operational and maintenance costs. Each technology has advantages and disadvantages related to funding variables, wastewater quality and land area. Optimization of these three variables is needed in accordance with technical, economic and social conditions to realize good processing performance and continue the sustainability of Batik industry wastewater management.

Many technologies for treating Batik industry wastewater can be used to reduce pollutant levels according to predetermined quality standards, namely color, temperature, pH, BOD, COD, TSS, total phenol, total ammonia, oil-fat and total chromium both physically, chemistry and biology. Physical and chemical processes are more expensive and produce more sludge than biological processes.

In one of the Batik industries in Ulu Gedong Village, the Batik industry "Zhorif" has built a batik wastewater treatment facility through assistance from the Ministry of Industry and Trade in collaboration with PT. Nusantara International Agency (Banana & Partners). Based on the situation in the field, these partner companies prefer chemical techniques in batik wastewater treatment due to geographical location considerations

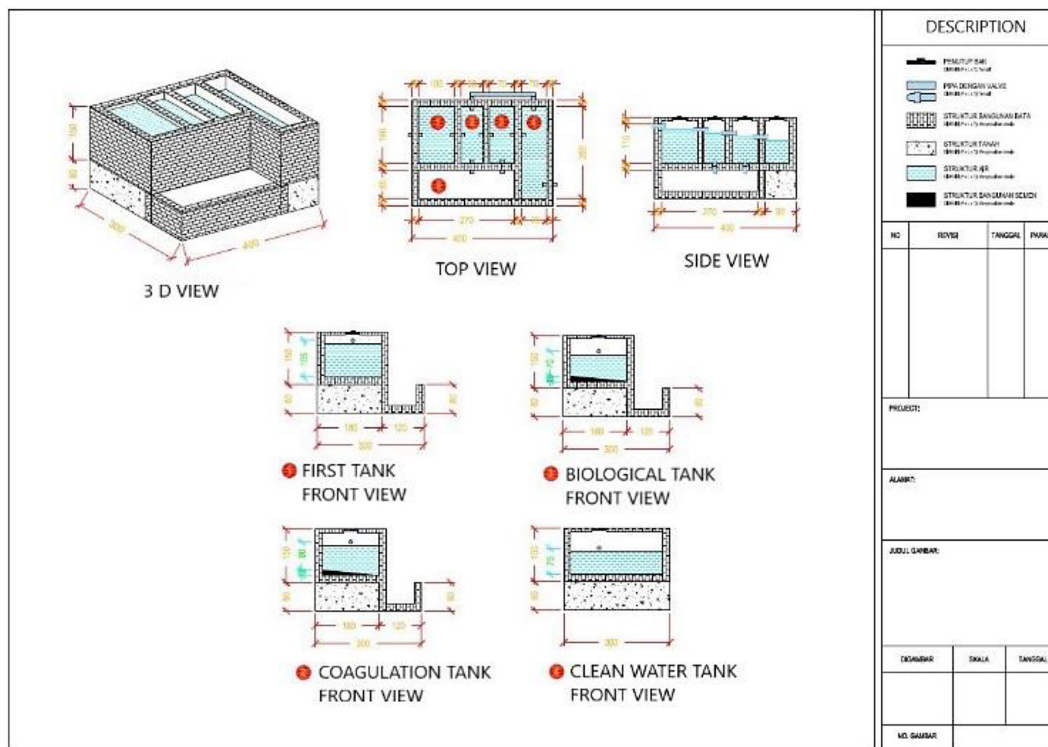


Figure 1. Plan of the “Zhorif” batik waste processing building

and the household's lack of electrical power. Detail engineering design of wastewater treatment plant (WWTP) from the Batik industry in Ulu Gedong, Jambi could be seen in Figure 1.

Based on the picture, it can be explained the process of wastewater treatment for the "zhorif" Batik industry, namely as follows:

1. Equalization Tub: The initial waste storage area
2. Coagulation Tub: Quick-stirring coagulant reservoir (PAC/alum).
3. Flocculation bath: Place for adding flocculants (anionic/cationic polymer), slow stirring, place for settling.
4. Control Tank: Storage of wastewater after it has been settled (only water) before filtration (after this the water is filtered and can be re-used for production)
5. Sludge Drying Bed: Place for storing and drying sludge after settling (residual from process tanks 2 and 3)

For mixing chemicals in the liquid waste treatment tub of the "zhorif" Batik industry, they are as follows:

1. Make each solution first, namely:
 - a) DACs;
 - b) PAC (Poly Aluminum Chloride) is a solid substance in the form of alum;
 - c) Anionic Polymers as Flocculants.

2. Do a waste dosage test, by adding the solution with the rule of looking for a pH close to 7. Do not let the pH be below 7.
3. Then put the DAC and PAC solutions into the second tub (coagulation tub) and stir.
4. Add polymer solution to the third tub.
5. Wait for the waste to precipitate.
6. Remove the precipitate.
7. Wastewater becomes clean

From the results of the wastewater treatment of the "zhorif" Batik industry, it was tested regarding the waste quality standards on November 6, 2022 according to Figure 2 and Table 1. Based on the test results on the 6 samples of wastewater, there appears to be a decrease in the level of waste according to the treatment. In the wastewater sample number 3, after the processing was carried out, it was found that the wastewater quality standard values were all below standard, in the sense that it complied with the waste quality standards, with the conclusion that the wastewater treatment of the "zhorif" Batik industry was successful and feasible. to be continued and can be applied to other Batik industry.

The advantage of this technique is that it can be done quickly, but still requires a large amount of money. Compared to the phytoremediation technique, this technique does not require much money, but requires a longer processing time.



Figure 2. “Zhorif” batik industry wastewater (Source: Banana & Partner)

Table 1. Liquid waste test results for “Zhorif” batik industry

No.	Parameter	Results					Units	Threshold
		AL-4	AL-1	AL-2	AL-5	AL-3		
I	Physycs							
1	Total Suspendid Solids (TSS)	3,940.00	986.67	415.00	18.00	12.50	mg/L	50
2	Colour	89,705.28	39,859.55	321.90	192.50	64.18	Pt Co	
II	Chemical							
1	Total Chromium (Cr)	<0.0887	<0.0887	<0.0887	<0.0887	<0.0887	mg/L	1.0
2	Ammonia (NH ₃ -N)	12.88	11.26	8.33	3.80	5.86	mg/L	10
3	Biochemical Oxygen Demand (BOD)	4,836.22	2,296.14	425.21	51.19	33.92	mg/L	60
4	Chemical Oxygen Demand (COD)	14,674.36	7,586.66	1,466.03	159.02	126.75	mg/L	150
5	Oil and grease	161.17	79.95	28.50	2.37	<1.94	mg/L	3.0

Note: declared to have passed the test if the value is below the quality standard (source: Banana & Partner).

In accordance with Suharto et al (2016), who found that the process of treating batik wastewater using the phytoremediation method with water hyacinth plants was proven to reduce levels of BOD, COD, and TSS. The best treatment based on the amount of water hyacinth and the length of exposure time for batik waste was most effective for BOD, COD and TSS content in the same treatment, which was 12 days of exposure with 7 water hyacinths.

Economic aspect

Economic aspects include regional economic conditions, investment costs, operation and maintenance of WWTPs and private CSR programs. Processing and trading industry activities by MSMEs support the economy in Ulu Gedong Village. In accordance with the concept of good corporate governance, which places the private sector

as a component of good governance, its existence is expected to contribute to development activities. The private sector or large companies, in accordance with RI Law Number 40 of 2007 concerning Limited Liability Companies, which is clarified by Government Regulation Number 47 of 2012 concerning the Social and Environmental Responsibility of Limited Liability Companies, have an obligation to carry out Corporate Social Responsibility (CSR) programs or social responsibility and the environment in the surrounding area.

CSR activities can be carried out in the economic, sociocultural, health and environmental fields. There are eight indicators in measuring CSR performance: leadership, the proportion of assistance, transparency and accountability, area coverage, planning and monitoring, and evaluation, stakeholder engagement, sustainability, and tangible results (outcomes).

Based on the results of observations and interviews, it is known that the CSR program could be more optimal according to the standard criteria for CSR programs and existing regulations. There needs to be planning and implementation of CSR programs in managing Batik industry wastewater in the Ulu Gedong Village. The weakness in dealing with the problem of batik waste is the lack of a budget from the government, the lack of a number of employees so that additional new employees are needed, the capacity of the WWTP that is owned has not been able to meet all of the total waste produced.

Management aspect

Management aspects include regulations, government policies and programs, government institutions and business institutions. Government regulations and policies from the central, provincial and district levels related to the management of Batik industry waste water are outlined in the form of laws, government regulations, ministerial decrees, regional regulations and regional head decisions, which are substantially based on various central regulations for each preamble and the contents in the articles on authority have values based on that the environmental policy paradigm must become the mainstream of policy at the central, provincial and district/city government levels.

Government regulations at the central level related to environmental policies form the basis for preparing regulations and policies at the local government level at the Jambi Province and Jambi City levels. Based on a study of regulations, policies, and programs in Jambi City, it can be concluded that there is no wastewater management planning program for Batik industry in Ulu Gedong Village. The government has a strategic role in managing Batik industry wastewater through related agencies.

Social aspect

Social aspects include perceptions, attitudes, and willingness to participate in the Batik industry. The social condition of Batik industry in Ulu Gedong Village plays an important role in planning the empowerment of Batik industry in optimal and sustainable wastewater management. The socio-cultural approach is an important part of understanding the characteristics of people's lives, especially the Batik industry community in

Ulu Gedong Village. Conducive social conditions constitute good social governance as a very important component of good governance.

Based on the questionnaire given to 10 Batik industry respondents in Ulu Gedong Village, it can be seen that the respondents have the perception that batik wastewater will pollute the environment and it is necessary to have it treated before being discharged into the environment, but they need outside assistance, both government and private, in the form of programs physical and non-physical. The physical program is the development of communal WWTP infrastructure and facilities, while the non-physical program is in the form of coaching to increase knowledge, expertise and organizational organization of Batik industry institutions.

Cultural aspect

Almost all villages across Jambi have batik workshops owned by artisans. Various reasons for engaging in batik activities are due to geographical conditions that do not support the agricultural sector, parts of the area are swamps that are prone to flooding resulting in residents not being able to rely on the agricultural sector to make ends meet. Therefore, non-agricultural activities are an alternative for survival to increase household economic income. One of them is to pursue the craft sector both as the main and side livelihood.

Another reason is that it is supported by the expertise and skills that have long been owned, especially by women, such as sewing and weaving. They have even been artisans of woven ikat, the Jambi Malay typical clothing worn by Jambi sultans for a long time. Then it lies in the ease of painting the motifs, namely the ceplik motif which is faster, easier, and simpler to make compared to the sequential and more complicated Javanese batik motifs. Another convenience lies in the relative availability of raw materials and natural dyes for batik in the environment around the craftsmen's residence

In addition, the development of the Batik industry cannot be separated from the government's role in encouraging the development of Batik industry, as well as increasing interest in wearing batik. One of them is by requiring civil servants to wear Jambi batik as uniforms on certain days during working hours. The increase in batik production has not become a concern for batik craftsmen so that the liquid waste produced is disposed of

directly into the environment without being processed first. This behavior eventually becomes a culture in society.

Criteria score

The score results of the sub-criteria compared to the criteria are depicted in Figure 3. Based on the data, the community's assumption score on cultural aspects is higher than the others with a score of 0.92. This is because batik is considered as one of the ancestral heritage. Where batik is an artistic heritage that continues to be preserved with the increasing number of Batik industry that have been established, both the MSME scale and some even large businesses. The research results show that the economic aspect is not related to the community participation factor but rather to the community's cultural values. This result also shows that the technical aspect has

the lowest score, namely 0.41, which indicates that the technical aspect is not a criterion that is considered important in choosing batik wastewater management efforts. These results reported the same result with previous studied in Depok, Indonesia with title Selection of Alternative Domestic Liquid Waste Treatment Using the Dependence and Driving Power (DDPA) Method and Analytic Network Process (ANP) (Case Study: Depok City) (Adzillah et al., 2016). The results show that technical criteria and sub-criteria are considered insignificant. Respondents focused more on economic, social, environmental, and institutional issues.

Subcriteria score

The results of sub-criteria scores that are close to suitability are depicted in Figure 4. The data shows, that the community's assumption

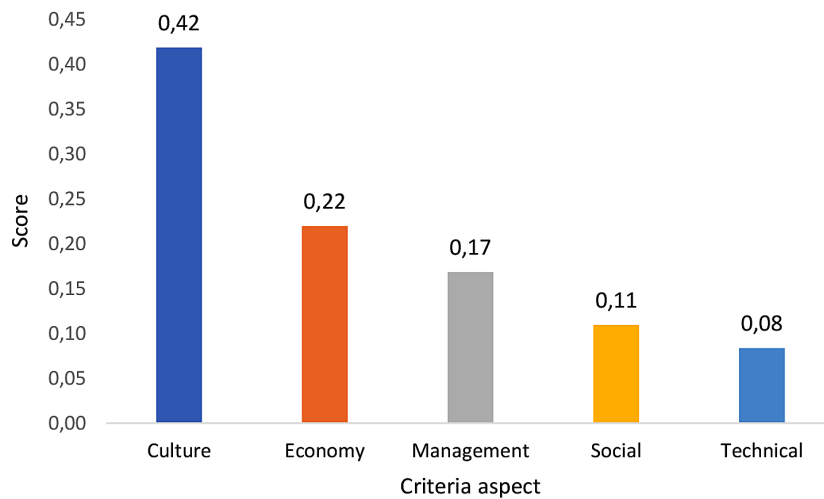


Figure 3. Criteria score value

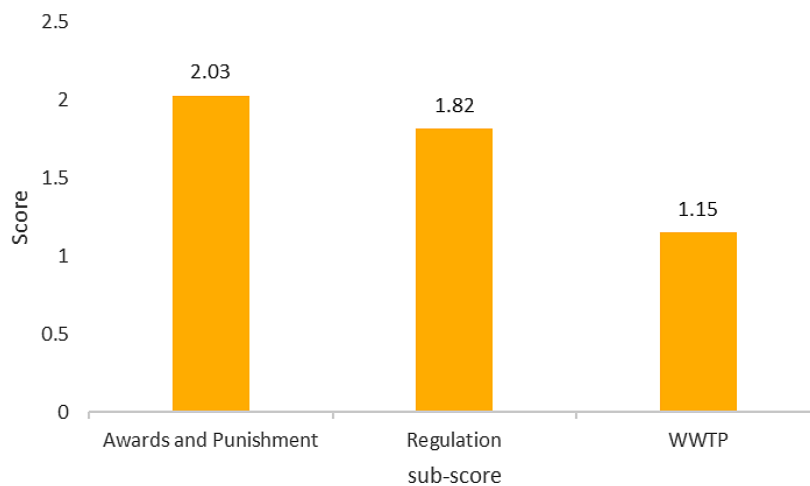


Figure 4. Sub criteria score of value

score for the reward and sanction sub-category is higher than the others, with a score of 2.03. This result illustrates that respondents think that so far, there has yet to be any real action from the government regarding how to reward entrepreneurs who follow the rules and also apply sanctions to batik entrepreneurs who do not follow the rules in managing their batik liquid waste. This is in line with which explains that in the strategy for handling batik waste, there are strategic program efforts that can be carried out, including promote the local regulation which will later be followed by imposing sanctions on entrepreneurs who do not follow regulatory rules (Mahfudloh & Lestari, 2017).

Alternative score

The results of alternative scores that are close to suitability are depicted in Figure 5. It was found that almost all respondents agreed that the appropriate alternative was incentives and granting of permits with a score of 1.25. So, it can be concluded that the strategic priority in managing Batik industry wastewater in Ulu Gedong Village, DanauTeluk District, Jambi City is to provide convenience and incentives to businesses participating in wastewater management such as granting business licenses and tax breaks. Provision of facilities and incentives can be in the form of providing government assistance, such as funding assistance for the construction of a Wastewater Management Installation facility (WWTP), or other facilities, such as assistance for permits and

providing tax relief for Batik industry that have made a batik WWTP facility.

These results are in line with previous study which states that the formulation of strategies and strategic program efforts that can be made by the Pekalongan City Environmental Agency in the implementation of handling batik industrial waste in Pekalongan City so that it is better in the future: optimizing APBD from the government to manage hazardous batik waste due to synthetic dyes in the form of utilizing the APBD from the government to increase the capacity of WWTPs (Mahfudloh & Lestari, 2017).

Meanwhile, the lowest alternative value is disseminating laws and regulations related to implementing wastewater management and enforcing sanctions, with a score of 0.63. These results are in line with previous study that reported about wastewater treatment for Batik industry in Yogyakarta, Indonesia (Indrayani, 2018). Strategic efforts can be carried out through various integrated approaches, both regulatory and policy approaches, as well as outreach and assistance to stakeholders.

CONCLUSIONS

The most influential aspects in the management of Batik industry wastewater in Ulu Gedong Village, DanauTeluk District, namely Culture (0.92), Economy (0.8), Social (0.45), Management (0.42), and Technical (0.41). These results

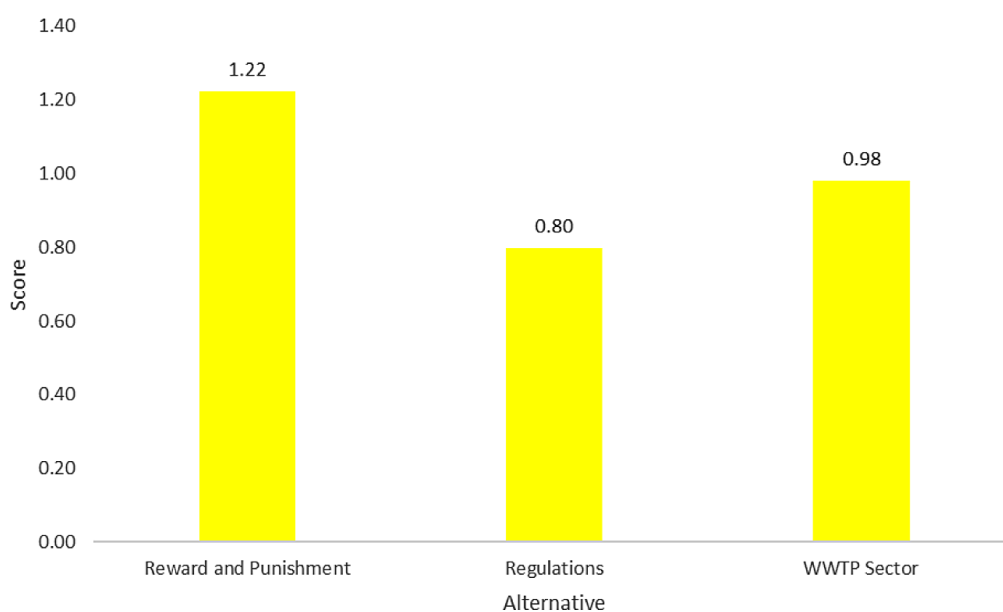


Figure 5. Alternative of score value

indicate community cultural values are more dominant than economic and other aspects. Even technical aspects are not the most important in managing Batik industry wastewater in the Ulu Gedong Village, DanauTeluk District. The priority of the main Batik industry liquid waste management strategy is providing convenience and incentives to businesses participating in wastewater management, such as granting business licenses and tax breaks. These results indicate that strategic efforts can be made, namely the provision of government assistance such as funding assistance for the construction of a WWTP or other facilities such as assistance with ease of permits and providing tax relief for Batik industry that have made a WWTP.

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