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Utilization of Mini Demin's Innovation in Processing Batik Water Waste in the Batik Crafters Empowerment Program Fostered Partners of PT PLN Indonesia Power UBP Central Java 2 Adipala

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ABSTRACT: The batik sector harms the environment because waste generated during the batik-making process might generate liquid waste, which accounts for 80% of the total water used in the batik manufacturing process. Most of Indonesia's batik industry has yet to manage its wastewater effectively. New processing technologies are needed to reduce organic pollutants and dyes in batik industry liquid waste. Adipala Village, Adipala District, Cilacap Regency, Central Java Province is one of the Cilacap area's batik industry sites with small-scale production. One of the most serious issues confronting SME Batik Saloka is the lack of manufacturing facilities and technology for handling liquid waste from batik dyeing. This caused PLN Indonesia Power UBP Central Java 2 Adipala to develop mini demin liquid waste processing equipment at the Batik Saloka manufacturing facility. The study's goal is to investigate the efficacy of mini demin innovation in processing batik water waste at SME Batik Saloka. To analyze the impact of using the mini demin, researchers observed the mini demin work system and conducted interviews with PT PLN Indonesia Power UBP Central Java 2 Adipala, Batik Saloka, and people of Adipala Village, Cilacap Regency, Central Java Province. The study's findings reveal that using mini demin innovation may convert batik water waste from dyeing into clean water with standards-compliant quality. In addition, the clean water generated can be utilized again to hydrate plants that are used as natural dyes and for the batik dyeing process.

KEYWORDS: Mini Demi, Batik Water Waste, Empowerment Program

I. INTRODUCTION

Indonesian batik was designated a Masterpiece of Humanity's Oral and Intangible Heritage by UNESCO (The United Nations Educational, Scientific, and Cultural Organization) in 2009. Following this, the Indonesian government issued Presidential Decree Number 33 of 2009, designating October 2 as National Batik Day. This condition strives to raise public awareness of initiatives to maintain and develop batik in Indonesia. Since then, the batik sector has experienced remarkable growth. As a result, besides serving as a symbolic image for Indonesians, batik provides an important source of money for local communities. This signifies that the batik industry greatly influences the national economy.

Despite its contribution to economic prosperity, the batik sector has a detrimental influence on the environment due to waste produced during the batik-producing process (Mukimin et al., 2018). Batik is made in numerous processes, including drawing the pattern (drawing batik motifs on mori cloth), waxing (attaching wax to mori cloth), colouring, and pelorodan (removing wax that has adhered to mori cloth) (Suprihatin, 2014). The dyeing process in the batik business can employ natural dyes, synthetic dyes, or a combination of both (Mustaniroh et al., 2021). Liquid waste generated during the dyeing process causes environmental issues. Batik is created through a series of processes involving a large volume of water. One of these is dying the fabric, which requires around 50 liters of water to create one piece of batik (Yuniati et al., 2022). Aside from that, the batik producing process, in particular, generates a large amount of liquid and solid waste, which includes residual natural and synthetic colours, water glass, and wax.

The color of the waste depends on the dye applied. The textile industry's wastewater is highly complex, cannot be decomposed (Raman & Kanmani, 2016), and is difficult to remove using traditional waste treatment (Khalik et al., 2015), resulting in high amounts of COD, BOD, TSS, and other dye compounds (Birgani et al., 2016). The environment has a limited capacity to break down dyes and synthetic materials. The batik colouring and dyeing process, which is one source of water contamination, can produce pollution if not processed. If waste is discarded without being processed, it will pass through the seas surrounding towns, causing environmental degradation. Batik waste can increase the overall quantity of oxygen required to decompose all organic molecules in water, known as COD (Chemical Oxygen Demand). The COD value meets an acceptable level. Excessive COD levels can cause the death of aquatic organisms, making it crucial to treat waste from the batik business.

Batik SMEs can generate liquid waste that accounts for 80% of the total water utilized in the batik manufacturing process (Setiyono & Gustaman, 2017). Many batik manufacturers discharge effluent directly into rivers or on the ground. As a result, considerable water contamination is inescapable and has more serious environmental consequences (Yuniati et al., 2022). Disposing of liquid batik waste without prior processing can have negative consequences, such as the emergence of foul odors in the water (Sumarko et al., 2013), a decrease in Dissolved Oxygen (DO) content, an increase in Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Suspended Solid (TSS) in water (Kurniawan et al., 2013). Batik wastewater is extremely hazardous due to the large volumes of water and chemicals used by the batik industry (El Enshasy et al., 2017), with the majority of these being family-run businesses that are small and lack wastewater treatment units (Birgani et al., 2016; Mukimin et al., 2018).

Water and soil contamination are now commonly documented around the world as a result of fast population growth, advanced agricultural methods, and major industrialization. The peculiarity of batik fabric, as well as the pollutants produced during its manufacturing methods, have piqued our interest. Such methods make extensive use of water, chemicals, and dyes. The dye-based sector, particularly the batik business, generates a substantial amount of highly colored wastewater (Mahmood et al., 2005). Daud et al. (2022) believe that dye-containing wastewater is the most contaminated. Batik wastewater, like dye wastewater, can affect water quality by increasing its color and turbidity. Recently, the majority of Indonesia's batik sector has been unable to properly manage its effluent. Processing is required to stop harmful effects that can upset the equilibrium of the environment and people's health so that this trash is not only tossed into river bodies. Liquid waste can be processed physically, chemically, biologically, or by combining the three. New processing methods are required to minimize organic contaminants and dyes in batik industry liquid waste (Mustaniroh et al., 2021).

The development of Indonesia's batik industry is based on household-scale manufacture. This is contingent on keeping its style and quality. Adipala Village, Adipala District, Cilacap Regency, Central Java Province is one of the Cilacap area's batik industry sites with household-scale production. The severity of the key concerns encountered by SME Batik Saloka includes limited production facilities in the technology for processing liquid waste from batik dyeing so that it does not harm the land, hence improving production quality and increasing production capacity.

The batik production at Batik Saloka has produced environmental issues in Adipala Village, including the poisoning of inhabitants' well water in locations adjacent to the Batik Saloka production site. This is because waste from washing batik textiles is simply tossed into the yard or area surrounding the batik production facility. The pile of debris containing chemicals is eventually carried away by the water, polluting residents' well water, which is utilized for daily use. As a result, PLN Indonesia Power UBP Central Java 2 Adipala assisted by constructing two IPAL (Waste Processing Plants) to process batik dyeing waste using chemicals so that it no longer pollutes the well water of local inhabitants near the Batik Saloka operational area. However, the water quality standards resulting from IPAL processing are still higher than the statutory norms. This prompted PLN Indonesia Power UBP Central Java 2 Adipala to innovate by building mini demin liquid waste processing equipment at the Batik Saloka manufacturing facility.

II. RESEARCH METHOD

This is a qualitative study, with data gathered through literature reviews, observations, and interviews. Literature studies involve gathering information about a specific topic. Observations were conducted by examining the operation of the mini demin equipment placed to handle batik water waste in Batik Saloka, Adipala Village. Interviews were held with PT PLN Indonesia Power UBP Jawa Tengah 2 Adipala, Batik Saloka, and the residents of Adipala Village, Cilacap Regency, Central Java Province.

III.RESULT AND DISCUSSION

A. Background on Mini Demin Innovation

Saloka Batik craftsmen are one of the community groups most affected by droughts since a shortage of water supply might impede operational activity. On this premise, PT PLN Indonesia Power UBP Jateng 2 Adipala innovated by implementing two IPAL systems to purify wastewater from batik manufacturing. This is consistent with PT PLN Indonesia Power UBP Jateng 2 Adipala's goal of addressing the drought calamity in Cilacap Regency.

The purification program employing the IPAL system to create clean water in response to the drought calamity resulted in improvements to the subsystem, and the firm altered the process flow. This is because, in the initial iteration of the IPAL system, the water generated did not satisfy the stated quality standards. Water that can be utilized for daily purposes, such as sanitation, must meet certain standards, including BOD, COD, Total Ammonia, Oil and Fat content, and pH level. Several criteria were discovered to be over the stipulated standards during water testing with the initial iteration of the IPAL system. The table below displays all of the data.

Table I. Quality Standards for Processed Water from the First Version of Batik Seloka IPAL.

No.	Parameters	Unit	Quality Standards	Waste Character	IPAL Processed Outcome	Description
1	BOD	mg/L	60	2.263,76	196,76	not fulfilled
2	COD	mg/L	150	4.205,71	297,82	not fulfilled
3	Total Ammonia	mg/L	8	0,392	<0,034	fulfilled
4	Fats and Oils	mg/L	3	17,8	14,21	not fulfilled
5	pH	-	> 6 - 9	8,59	11,68	not fulfilled

Source: Laboratory Test Results, 2023

As a result, the existing IPAL system installation must be updated by installing a Mini Demineralizer to ensure that the water is acceptable and safe to use.

B. Mini Demin and its Operating System

Mechanical, biological, and chemical filtration are used in the IPAL system with Mini Demineralizer. The system or procedure for purifying water with a mini demineralizer is explained as follows:

1. The waste storage section (holding tank) can retain 200 liters of liquid waste from batik processing every day. This waste is produced as a result of processing such as textile washing, dyeing, and batik wax washing. This waste will be stored in the first storage tank before being pumped to the second storage tank by a solar-powered water pump machine that is integrated with the IPAL control panel circuit. The goal is to reduce the workload on the filtration system; by using a pump system, sediment on the reservoir floor is prevented from entering the initial stage of the filtration system.
2. The waste will then be passed through mechanical filter media to remove any solids or coarse particles (suspended solids) found in batik waste. Mechanical filter media is outfitted with a variety of devices such as a japmate, sponge, and net. This mechanical filter medium is critical in reducing the occurrence of damage and increasing the filter's lifespan in the subsequent stage.
3. After a preliminary filtration operation on mechanical filter media, the waste will enter biological filter media. This method attempts to decrease organic and microbiological contamination. Biological filter media, which include bioballs, ginger coral, and zeolite stones, serve as a habitat for microorganisms that dwell in the filter media and degrade organic substances such as bacteria and fungi.

The filtered water will then be routed through a solar-powered pump machine to a silica sand filter (chemical filter) to remove any chemical particles that may have been carried over from the previous step. This filter is made up of a variety of sand, active charcoal, and resin mixtures that bind harmful chemical residues in the water.

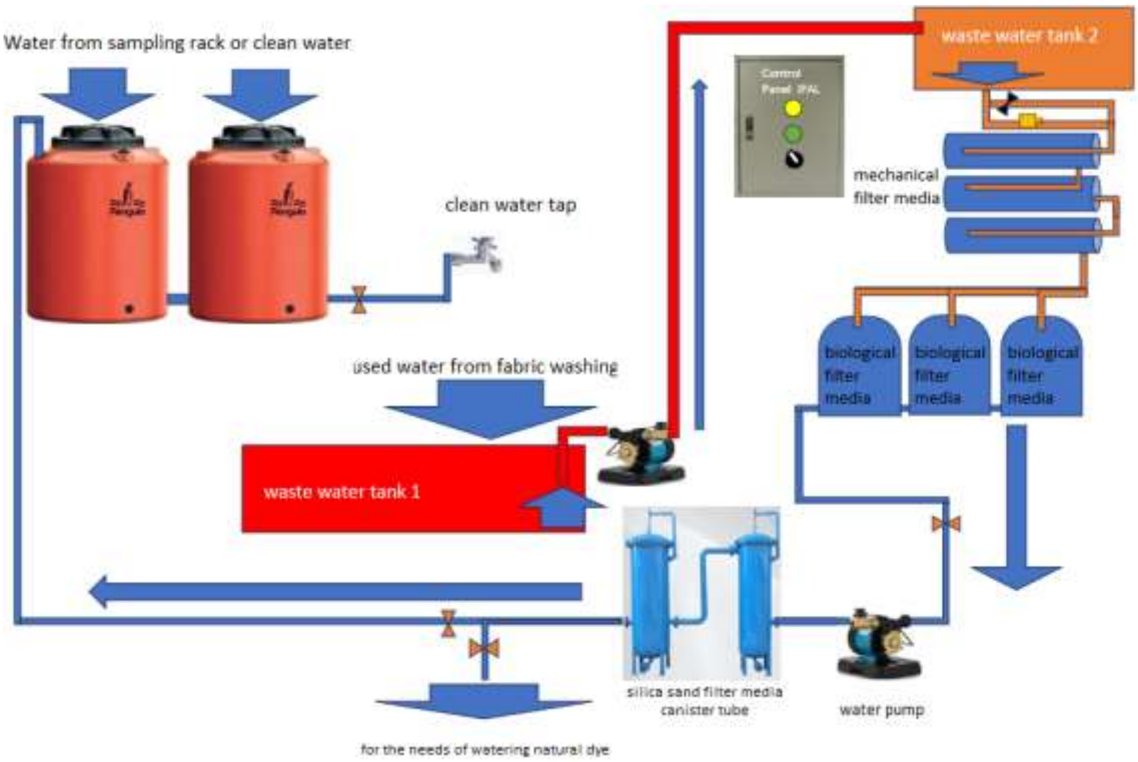
Figure 1. Mechanical, biological, and chemical filter

4. When all of the processes are completed correctly, the truly pure water will enter the clean water reservoir and be reused as part of the process of creating or dying batik, for sanitation, and even to water plants.

Figure 2. Clean Water Reservoir

The following figure depicts the water purification scheme or process using a mini demineralizer for the most recent system that has been applied.

Figure 3. Mini Demineralizer Operation Scheme



C. The Impact of Mini Demin Innovation

The results of testing on the quality of clean water after treating batik water waste with the IPAL system and mini demineralizer revealed considerable changes. The test results can be found in the table below.

Table II. Quality Standards for Processed Water from the Updated Version of Batik Seloka IPAL with Mini Demineralizer

No	Parameters	Unit	Quality Standards	Waste Character	IPAL Processed Outcome	Description	IPAL Processed + Mini Demineralizer Outcome	Description
1	BOD	mg/L	60	2.263,76	196,76	not fulfilled	<59	fulfilled
2	COD	mg/L	150	4.205,71	297,82	not fulfilled	130 - 140	fulfilled
3	Total Ammonia	mg/L	8	0,392	<0,034	fulfilled	<0,032	fulfilled
4	Fats and Oils	mg/L	3	17,8	14,21	not fulfilled	2,5	fulfilled
5	pH	-	> 6 - 9	8,59	11,68	not fulfilled	8,9	fulfilled

Source: Laboratory Test Results, 2024

Rumah Batik Seloka, which has 29 members, is a direct beneficiary of the water purification initiative, which utilizes an IPAL system with a tiny demineralizer. Rumah Batik Seloka can conserve up to 12,000 liters, or one-third of the daily water needs. The economic value of this activity is IDR 5,252,400/year or IDR 437,700/month, assuming that the water purification equipment can generate 400 liters of safe water each day.

Another immediate advantage to the community is reduced pollution of water and land ecosystems, as proven by the absence of pollution in multiple dug wells. Batik craft advocates also get knowledge about proper and accurate water treatment, increased environmental management abilities, and higher health-related living standards.

IV.CONCLUSIONS

The batik production at Batik Saloka has produced environmental issues in Adipala Village, including the poisoning of inhabitants' well water in locations adjacent to the Batik Saloka production site. This is because waste from washing batik textiles is simply tossed into the yard or area surrounding the batik production facility. The pile of debris containing chemicals is eventually carried away by the water, polluting residents' well water, which is utilized for daily use. As a result, PLN Indonesia Power UBP Central Java 2 Adipala assisted by constructing two IPAL (Waste Processing Plants) to process batik dyeing waste using chemicals so that it no longer pollutes the well water of local inhabitants near the Batik Saloka operational area. However, the water quality standards resulting from IPAL processing are still higher than the statutory norms. This prompted PLN Indonesia Power UBP Central Java 2 Adipala to innovate by building mini demin liquid waste processing equipment at the Batik Saloka manufacturing facility.

Mechanical, biological, and chemical filtration are used in the IPAL system with Mini Demineralizer. Mechanical filter media are used to remove solids or coarse particles (suspended solids) from batik waste. Mechanical filter media comes with numerous devices, including a japmate, sponge, and net. After a preliminary filtration operation on mechanical filter media, the waste will enter biological filter media. This method seeks to decrease organic and microbiological contamination. Biological filter media incorporating bioballs, ginger coral, and zeolite stones serve as a habitat for microorganisms that dwell in the filter media to break down organic substances such as bacteria and fungi. The filtered water will then pass through a silica sand filter (chemical filter) to remove any chemical particles that may have been carried over from the previous step. This filter is made up of several types of sand, active charcoal, and resin that bind harmful chemical compounds remaining in the water. When all operations are performed correctly, the truly clean water will enter the clean water reservoir and be reused.

The clean water produced is reused for the batik dyeing process, which has a significant impact on water conservation in the batik manufacturing process. Batik Saloka can reduce daily water consumption by up to 400 liters. This, of course, has consequences for reducing production costs associated with the batik manufacturing process. Aside from that, the clean water generated is used to water plants that are used as a natural ingredient in batik color.

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