Waste Identification in The Traditional Batik Industry With A Cleaner Production Approach

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Abstract: The Cleaner Production approach is a concept for preventing and minimizing waste in a production process with a strategy called 5R, namely Rethink, Reduction, Reuse, Recovery, and Recycle. The research results show the indications of waste in the batik production process. In the batik-making process, wax and fuel are used, and water is used in the washing process. Meanwhile, the causes of the waste are that there are no records, no chemical labels, no chemical labels, no tools to reduce wax drips, no warning posters, no energy-efficient production tools, no efforts to save water, no personal protective equipment (PPE), do not yet understand the waste neutralization process. The proposed Corrective Action Plan that will be carried out is for SMEs to provide stationery to record the use of materials, SMEs to make labels for chemical containers so that they do not mix up the workers understand the names of chemicals to provide mats so that wax drops do not splatter and are not dirty. Employees in the canting department were instructed to reduce the presence of wax drips. Collecting wax left over from the wax removal process, making warning posters in the production room, replacing diesel stoves with gas stoves, and providing protective equipment (PPE). SMEs learn the waste neutralization process by attending training on textile waste processing.

Keywords: Batik, SMEs, Cleaner Production

INTRODUCTION

Batik is a valuable cultural asset that requires preservation and development. As one of the defining characteristics of the nation, batik has the potential to become a competitive industry. The traditional batik industry provides employment opportunities as the production process is carried out manually. Additionally, the batik industry can contribute to the national income.

The traditional batik cloth is highly sought after in both local and international markets, creating an excellent opportunity for the growth of the traditional batik industry. However, the manual or hand-production process of batik can result in the wastage of primary raw materials, additional raw materials, supporting materials, energy, water, and more at every stage of the production process. This wastage can lead to a reduction in the entrepreneur's profits or income.

Based on the Ministry of Environment (KLH 2003) Cleaner Production is defined as a strategy for managing the production process from upstream to downstream which is carried out in an integrated and sustainable manner. These management activities include activities aimed at increasing the efficient use of natural resources, minimizing waste at each stage of the production process, and eliminating pollution to the work environment and the surrounding environment.

Cleaner Production opportunities in the traditional batik-making process can be observed at every stage of the production process, such as using the right of raw materials, saving fuel, saving electricity, saving water use, utilizing solid waste, and liquid waste, and using natural dyes instead of chemical dyes.

Based on the background stated above, the problem can be identified as: Has waste occurred in the process of making traditional batik? What are the causes of waste in the process of making traditional batik?

The aim and objective of the research carried out is to identify waste in the traditional batik production process and find out the causes of waste so that a corrective action plan can be determined The research carried out was related to the use of resources in the traditional batik production process. The names and addresses of batik SMEs studied have been disguised.

The research did not cover the handling of liquid waste from production. The batik-making process studied was making hand-written batik and a combination of stamps. It is hoped that the results of this research can be used as a guide in implementing Cleaner Production and as a reference in efforts to produce environmentally friendly products.

Conceptual Framework

Batik

Based on the National Consensus on March 12, 1996, batik is a craft or work of art on cloth using batik wax as a barrier. Batik has unique artistic value depending on the artistic level of the maker and the artistic level of the fans.

Batik cloth is a two-dimensional work of art consisting of several elements that can influence the beauty and uniqueness of a piece of batik cloth. Some of these elements include media elements, namely the type of cloth used, canting strokes in various shapes such as lines, and dots that form batik motifs, and color elements that will beautify the batik.

Sewan S, 1980 in his books explains the process of making traditional batik as follows:

1. Batik Process, namely the process of attaching wax to batik cloth
   Attach the wax to the cloth to create the desired batik motif, by writing it using a writing canting or by stamping it using a canting stamp. to write on batik, the batik wax needs to be heated first to a temperature of. Batik wax functions as a resist (repels) the color given to the fabric in subsequent processing.
2. The dyeing process is a process of inserting dye into the fibers of textile materials so that a color that is fast-resistant is obtained. The dyes used can be natural dyes derived from plants or synthetic dyes.
   Several ways can be used in the batik coloring process, namely first by dyeing, the cloth that has been batiked is dipped in the dye that has been prepared, and secondly by dabbing the color on the cloth using a brush.
3. Wax Removal Process
   Namely, the process of removing the wax that is attached to the batik cloth can be done by boiling the batik cloth with boiling water known as Ngewax removal.

Cleaner Production

According to the United Nations Environmental Program (UNEP), Cleaner Production is a strategy for preventing environmental impacts and reducing risks to humans as a result of the production process of an industry, both goods and services. This strategy must be carried out continuously and in an integrated manner so that it can increase productivity and efficiency in a production process.

Based on the Ministry of Environment (KLH 2003) Cleaner Production is defined as a strategy for managing the production process from upstream to downstream which is carried out in an integrated and sustainable manner. These management activities include activities aimed at:

1. Increasing the efficient use of natural resources,
2. Minimize waste at every stage of the production process and
3. Eliminate pollution to the work environment and the surrounding environment.
4.

So it can minimize waste, minimize risks to human health and safety, and can also reduce and eliminate environmental damage.

The main principles of the clean production strategy in the "National Clean Production Policy" are outlined in 5R (rethink, reduce, reuse, recover, and recycle). The meaning of 5R is:

1. Rethinking is the activity of thinking again before doing something for management so that the activities to be carried out can eliminate waste, increase efficiency, and be safe for humans and the environment.
2. Reduce is an activity that aims to aqueduct or reduce the waste produced in an activity in the production process.
3. Reuse is an activity aimed at reusing waste without physical, chemical, or biological treatment.
4. Recovery or reclaim is an activity aimed at reusing waste that still has high economic value, replacing materials or equipment that can increase efficiency.
5. Recycling is an activity that aims to reuse waste by recycling waste to utilize waste by processing it back to its original process through physical, chemical, and biological treatment.

Benefits of the Cleaner Production concept for an industry:

1. save production costs,
2. saves the use of raw materials and energy,
3. increases efficiency and productivity,
4. improve environmental performance,
5. improve organizational capabilities and
6. improve occupational health and safety.

RESEARCH METHODS

The Cleaner Production concept, namely a management approach pattern for raw materials and in-process. It is an effort to increase efficiency and productivity and prevent and reduce waste generation directly from the source. To solve the problems mentioned previously, it is necessary to arrange the problem-solving steps as follows:

Data Collection

a. Primary data is the stage of collecting data directly using interview methods and direct observation of an object.
b. Secondary data is the stage of collecting data by recording or recording information from existing company reports, namely general company data and waste data.

Data Processing

The stages carried out are as follows:

a. Production Process Observation (SME data, Production data)
b. Identify waste in the production area and each stage of the production process. This is done by direct observation during the production process, recording input in each process, and recording output
c. Quantification of inefficiency, namely calculating the amount of waste that occurs in the batik production process.
d. Analyze the causes of inefficiency. Analyze the causes of waste using a fish bond diagram. So that the main cause or root cause of the waste can be identified.
e. Determine a corrective action plan. By discussing with the batik industry owner, improvement plans can be carried out after the main cause is known.

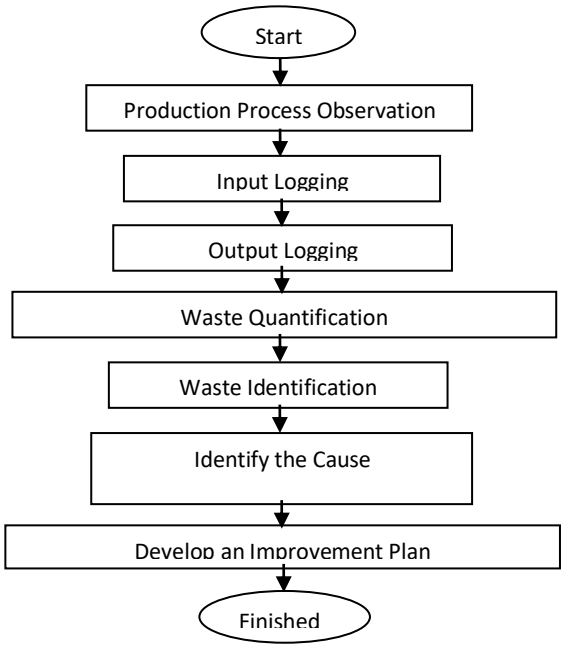

Figure 1. Research Framework Flow Chart

RESULTS AND OBSERVATIONS

The following are the results and discussion of the research.

A. Observation of the Production Process

a. SMEs data
SMEs Name: Mr. Suka
SMEs Address: Block Kebon Asem Rt/Rw. 14/04 West Trusmi Village, District. Plered, Kab. Cirebon
Start of Business: 1985
b. Production Data)
Type of Batik/Product: Combination Batik
Number of Employees: 13 people
Monthly Production Capacity: 1,920 meters per month
c. Observation Time: May 2014

Table 1. Observation Results of General Conditions of Suka Batik SMEs

Location of Chemical Placement

Number	Check	Check results *)		
		Yes	Part	No
1	Is there a special place or warehouse for chemicals?		√	
2	Is the placement of the chemical protected from rainwater and leaks which can damage the quality of the chemical?	√		
3	Has the placement of chemicals been kept away from sources of ignition that could potentially be a fire or explosion hazard?	√		
4	Is there sufficient ventilation in the room where the chemicals are stored? (minimum 2 holes)	√		

Storage/arrangement/container of chemicals

5	Does the chemical container match the characteristics of the type of chemical?	√		
6	Are chemicals that easily react (potential fire/explosion hazards) stored separately?	√		
7	Is every chemical container labeled (name and danger sign)?		√	
8	Is there documentation/recording for chemical use? (for SMEs with medium/large capacity)			√

Safety

9	Do workers in certain sections use adequate PPE?			√
10	Do SMES owners or workers know the dangers of the chemicals in the SMEs?	√		

Chemical efficiency and chemical waste

Have SMEs avoided chemical spills at weighing stations or chemical warehouses?	√		
Has the SME avoided spilling of the dye solution during dyeing?		√	
Has the SMES tried to reuse the dye solution left over from dyeing?	√		
Have SMEs avoided using naphthol dyes for the dyeing process?			√

Efforts to save energy consumption

Is there documentation/recording of energy usage?			√
Is the lighting in the production room turned off when not in use?	√		
The Batik is a cultural heritage asset that needs to be preserved and developed. As one of the characteristics of the country, batik can be developed into an industry that has its competitiveness. The traditional batik industry absorbs labor because the manufacturing process is done manually. Apart from that, the batik industry can also increase state income. Wax removal closed when heating so that energy is not wasted?	√		
Has the SMES utilized sunlight to illuminate the production room to reduce the use of lights during the day?	√		
Have SMEs utilized sunlight for the drying process to reduce energy consumption?		√	
Do SMEs already use energy-efficient production equipment?			√
Is the firewood storage protected from rainwater to keep it dry?		√	
Are there warning posters for saving energy in the production room?			√

Efforts to avoid dangerous risks due to energy use

Has the SMES repaired electrical installations in the production room that could	√		

potentially cause a fire hazard?			
Has the SMES provided adequate APAR (fire extinguisher)? (at least a wet sack)	√		
Are there work safety warning posters in the production room?			√

Efforts to save water usage

Is there documentation/recording of water usage?			√
Has the SMES repaired the water installation leaks that resulted in waste?	√		
Have SMEs made efforts to improve the way the production process works to save water?			√
Are there water storage tanks or reservoirs to collect rainwater?			√
Have SMEs made efforts to reuse used washing water to save water?			√

Wastewater treatment efforts

Are waste dyes, chemicals, and first washing water collected in separate containers?		√	
Is all liquid waste neutralized before disposal?			√
Does any SME have an IPAL (wastewater treatment plant)?			√

Efforts to save fabric usage

Is there documentation/recording of fabric usage?			√
Are there work instructions for workers to avoid errors in measuring and cutting fabric?		√	

Efforts to save on candle use

Is there documentation/recording of candle usage?			√
Does the SMES use batik technology that can reduce wax spills?			√
Does the SMES provide training/instructions on how to work batik to avoid wax spills?			√
Is the SMES trying to recapture the wax produced from wax removal?	√		
Does SMES try to recapture the wax granules from washing? (especially for large-capacity SMEs)			√

Note: *) The check results "partially" and "no" are inefficiency categories

A. Quantification of material use,

From the results of observations in the field, calculations were made regarding the use of the main materials used in the batik production process. The following calculation results were obtained:

1. Candle

- The wax used for a capacity of 1,920 meters is 960 kg per month.
  The average wax used for 1 (one) meter of cloth for combined batik types is: 0.5 kg x 1,920 meters = 960 kg
- Remaining wax from dripping during batik making = 48 kg per month.
  It was found that on average 1.9 kg x 25 HK = 48 kg of wax droplets were collected every day.
  The wax from the remaining droplets can be reused for the batik-making process, but it must be in a condition that is not dirty.
- Remaining wax from the wax removal process (wax removal process) = 350 kg per month.
  In 1 (one) month, the wax removal process is carried out 15 times. 23.3 kg of leftover wax from each wax removal process x 15 = 350 kg.
  The wax left over from the wax removal process can be reused for the batik process but must be reprocessed. Because the wax left over from the wax removal process has been mixed with dye. This wax can be collected by filtering the water used to boil batik during the wax removal process.

  So the candles used are:
  Used Wax = (batik process wax – drip wax – leftover wax removal wax) = 960 – 48 – 350 = 562 kg per month
  The wax used for 1 meter of batik cloth is: 562: 1,920 = 0.29 kg
  Efficiency Calculation:
  - Efficiency of wax droplets: if the price of wax per kilo is Rp. 25,000,- then the efficiency of the wax droplets is 48 kg X Rp. 25,000,- = Rp. 1,200,000,- per month.
  - Wax efficiency from the rest of the wax removal process: if the price of wax per kilo is IDR. 5,000,- then the efficiency of the remaining wax from the Wax removal process is 350 kg X Rp. 5,000,- = Rp. 1,750,000,- per month

  From the calculation results, it can be concluded that in the batik process, SMES Suka gets savings from wax droplets and leftover wax from the wax removal process of IDR 1,200,000 + IDR. 1,750,000,- = Rp. 2,950,000,- per month

2. Dye

The dyes used are naphthol and indigo types. For this type of naphthol color, only one coloring can be used. Meanwhile, for the indigosol color type, this type can be used repeatedly. If the dye solution remains, this type of dye can be reused. So the type of indigosol dye will be calculated so that savings can be made.
For 1 meter of fabric, you need 5 grams of dye
SMES Batik likes to use an average of 4 types of indigo colors
So that in 1 month SMEs like to need as much dye
5 grams x 1 liter of water x 4 types x 1,920 meters = 38,400 liters
Efficiency Calculation:
Dyeing can be done in 2 processes 38,400 liters: 2 = 19,200 liters
If the price of dye per liter is Rp. 1000,-, then the efficiency value is 19,200 liters x Rp. 1000,- = Rp. 19,200,000,- per month.
However, SMEs do not want to use dye for two processes because they are worried that it will reduce the quality of the batik cloth produced.

3. Water

Table 2. Water use in the batik production process

No	Process	Usage Amount (liters)	Measuring method
1	Preparation (bleaching)	960	40 liters (for 40 people)
2	Coloring (5 colors)	1920	(8 processes X 10 l per process)X 24 HK

3	Washing after color	1920	(8 processes X 10 l per process)X 24 HK
4	Washing after wax removal (8 times a month)	24800	Drum I (100 l), and Drum II (100 l) flow for 5 hours (5 x 60 = 300 minutes (100 l = 10 min)
5	wax removal (8 x a month)	200	100 l per 4 X wax removal
6	Tool Washing	1920	(8 processes X 10 l per process)X 24 HK
total usage per month		31720	

Water usage can be reduced by reusing 1920 liters of water from washing batik cloth to washing equipment used in the production process. So that
Used water capacity = Total usage – usage for washing equipment
= 31,720 – 1,920 = 29,800 liters per month

4. Fuel

Table 3. Fuel use in the batik production process

No	Process	Diesel (liter)	Firewood (m3)	Measurement method
1	Handmade batik	25	Firewood (m3)	2 stoves (for 2 pans 2 work groups) @ 0.5 liters per day x 25 working days
2	Stamp Batik	37,5		3 stoves (3 pans 3 workers) @ 0.5 liters per day x 25 working days
3	Checking	3		1 stove X 25 working days
4	Wax removal process/wax removal process		6	1 m3 for 3 x wax removal processes
Total usage per month		65,5		

Efficiency calculation:

- For the written batik process

If the price of 1 liter of diesel = Rp. 10,000,-
So the monthly diesel costs required for the hand-written batik process are
25 liters X Rp. 10,000,- = IDR, 250,000,-
Meanwhile, if diesel fuel is replaced with gas, then 1 3 kg gas cylinder can be used for 1 stove for 1 week. So for 1 month 1 stove requires 4 gas cylinders. So:
If the price of 1 tube is Rp. 20,000,-. So:
2 stoves X 4 cylinders X Rp. 20,0000 = Rp. 160,000,-
So if converted from diesel fuel to gas, SMEs can get an efficiency or savings of IDR. 250,000, - Rp. 160,000 = Rp. 90,000,- per month for the hand-written batik process.

- For the stamped batik process

If the price of 1 liter of diesel = Rp. 10,000,-
So the monthly diesel costs required for the batik stamping process are
37.5 liters X Rp. 10,000,- = IDR, 375,000,-
Meanwhile, if diesel fuel is replaced with gas, then 1 3 kg gas cylinder can be used for 1 stove for 1 week. So for 1 month 1 stove requires 4 gas cylinders. So:
If the price of 1 tube is Rp. 20,000,-. So:
3 stoves X 4 cylinders X Rp. 20,0000 = Rp. 240,000,-
So if converted from diesel fuel to gas, SMEs can get an efficiency or savings of IDR. 375,000, - Rp. 240,000 = Rp. 135,000,- per month for the batik stamping process.
From the calculation results, it can be concluded that by using SMEs Suka gas as fuel, savings from the written batik and stamped batik process are IDR 90,000 + IDR. 135,000 = Rp. 225,000 per month.

Table 4. Material Usage in 1 (one) month

No	Material Type	Observation result	Cost Rp.	The calculation results	Cost Rp.	Savings Rp.
1	Cloth	1.920 meter	-	1.920 meter	-	
2	Candle	960 kg	Rp.28.800.000	562 kg	Rp. 19.560.000	Rp. 9.240.000
3	Dyes (4 colors)	38.400 liter	Rp.38.400.000	38.400 liter	Rp.38.400.000	-
4	Water	31.720 liter	-	29.800 liter	-	-
5	Firewood	6 Kubik	-	6 Kubik	-	-
6	Diesel fuel	65,5 liter	Rp. 625.000	Gas fuel 20 cylinders @3 kg	Rp.400.000	Rp. 225.000
Total monthly savings						**Rp. 9.465.000**

A. Analysis of the causes of waste.

From the results of observations and discussions with SME owners and employees, analysis can be carried out using the fishbone diagram as follows:

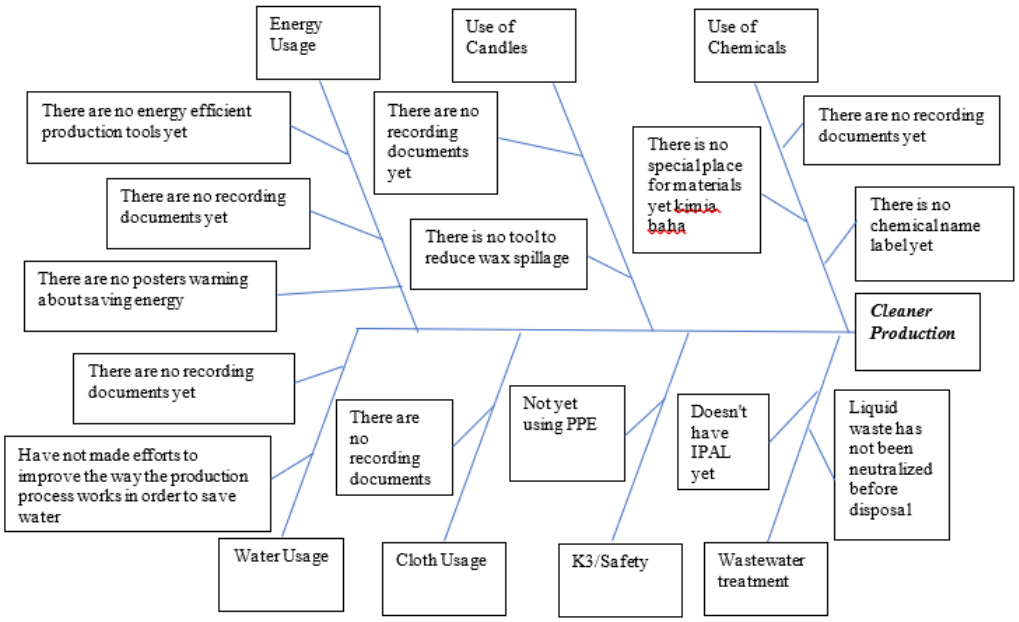

Figure 2. Fishbone Diagram

From the results of the analysis, it can be concluded that the main causes of inefficiency are as follows:

1. There is no record keeping, no documentation, or recording of material usage. SMEs feel that there is no recording because they think that production process activities have become routine.
2. There are no chemical labels yet, SMEs feel they are familiar with the names of chemicals and the types of colors.
3. There is no warehouse/special place for chemicals, limited production space means that chemicals are mixed with household materials.
4. There is no tool to reduce wax drips, SMES considers it normal for drips to occur in the canting process.
5. There are no warning posters yet, SMEs do not feel the need for posters.
6. There are no energy-efficient production tools yet. SMEs think that to save energy they must use modern equipment.

7. Have not made any efforts to save water. SMEs find it easy to get water because the source of water they obtain is groundwater.
8. Have not used protective equipment (PPE). SMEs already feel comfortable working without protective equipment.
9. There is no IPAL yet. SMEs do not feel it is necessary.
10. Don't understand the waste neutralization process. SMEs understand the dangers of chemicals but do not yet understand the easy waste neutralization process.

B. Determine a corrective action plan.

The corrective action plan was obtained from the results of discussions with the batik SME owner because the corrective action plan to be carried out must be adjusted to the SME's capabilities. So that the plans that have been prepared can be implemented by SMEs at the implementation stage.

Table 5. Corrective Action Plan and Objectives

5R	Reason	Corrective Action Plan	**Objective**
Rethink	There are no records yet	- SMEs Provide stationery to record material usage.	There are documents/records for: - Know the use of materials used in the production process. - Can calculate the cost of production according to the costs incurred in each batik production process. - Can identify inefficiencies.
	There is no chemical label yet	- SMEs Create labels for chemical containers, so that they are not confused, and employees can understand the names of chemicals.	- Avoid mistakes in taking and using chemicals. - All employees can know the names and types of chemicals used.
	There is no warehouse/special place for chemicals yet	- Due to limited space, there is no warehouse yet. However, a special place will be provided for chemicals that are separate, safe from the reach of children, and separate from food ingredients.	- Avoid dangerous chemicals so that they are not confused with food ingredients.
	There are no warning posters yet	- Created a warning poster in the production room	- To remind employees while working about the dangers of chemicals, about energy saving, and other efficiencies.
	Have not used personal protective equipment (PPE)	- - Provide personal protective equipment (PPE)	- SMIs and employees are protected from chemical hazards.

	- There is no Waste Treatment Plant (IPAL) yet	- Because building a Waste Treatment Installation (IPAL) requires quite a lot of funds, the IPAL problem has not been a priority for repair.	- The liquid waste that is disposed of has gone through a waste processing plant.
Reduce	There is no tool to reduce wax drips	- A base is provided so that the wax drops don't splatter and don't get dirty. - Employees in the canting section were given directions to reduce the presence of wax drips when canting.	- So that the wax drops don't get dirty so that the wax drops can be used again. - Wax Drops can be easily collected again, so they can be reused or sold.
Reuse	Not yet trying to save water	- Create a reservoir so that water for washing can be used repeatedly.	- Can save water usage.
Recycle	Solid waste/wax residue	- Collecting wax left over from the wax removal process. - Collecting wax droplets during the batik-making process	- Reprocess the candle so that it can be used again
Recovery	There are no energy-efficient production tools yet	Because there are no modern tools to save energy, the action plan taken is: - Replace batik stoves that use diesel fuel with gas stoves or electric stoves. - Replacing firewood with a gas stove for the wax removal/wax removal process.	- SMEs can save energy to get maximum profits.
	Don't understand the waste neutralization process	- Learn the waste neutralization process. - Attend training on textile waste processing.	- SMEs can process their liquid waste in particular.

CONCLUSION

From the research results it can be concluded that:

1. There are indications of waste in the batik production process.
   The batik-making process uses wax and fuel
   In the washing process, excess water is used, because SMEs feel that the water is obtained immediately for free.
2. The cause of waste is that there are no records, no chemical labels, no chemical labels, no tools to reduce wax drips, no warning posters, no energy-efficient production tools, no efforts to save water, and no equipment used. personal protective equipment (PPE), do not yet understand the waste neutralization process.
3. The proposed Corrective Action Plan that will be carried out is SMEs Providing stationery to record the use of materials, SMEs Making labels for chemical containers, so that they don't get mixed up, and workers can understand the names of chemicals, providing mats so that wax droplets don't splatter, and don't dirty.

Employees in the canting department were given instructions to reduce the presence of wax drips when canting. collecting wax left over from the wax removal process, making warning posters in the production room, replacing diesel stoves with gas stoves, and providing personal protective equipment (PPE). SMEs learn the waste neutralization process by attending training on textile waste processing.

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