Implementation green industry standard at textile industry and textile product

I. Indrayani¹,* and M Triwiswara¹

¹Centre of Handicraft and Batik, Ministry of Industry, Indonesia

*E-mail: indrayanililin@gmail.com

Abstract. At present industrialists must begin to shift from the industry as usual to an environmental industry or what is now known as a green industry. An important issue in the principle of green industry that needs to be understood and implemented is industries in their production processes implement sustainable efficiency and effectiveness in resources. The green industry is not only oriented towards improving the economic sector but also concerned with environmental sustainability. So the negative impact on the environment and the use of natural resources providers of industrial supports, does not result in a decrease in the carrying capacity and capacity of the environment. Therefore to realize the textile industry and textile products that are environmentally friendly, the necessity to develop industrial performance by integrating the principles of the green industry into the production process. This paper will explain the implementation of green industry characteristics that can be adapted into each stage of the production process in the textile industry and textile products, especially the batik industry. The characteristics of the green industry include the efficiency of the use of input materials, namely raw materials and auxiliary materials and the use of alternative materials that are more environmentally friendly, low energy and water intensity, minimization of waste both liquid and solid waste and reducing emissions due to the use of low-carbon technology. Each characteristic is equipped with criteria in the green industry standard (GIS) that can be used by textile and textile products industrialists, especially the batik industry in implementing the principles of the green industry.

1. Introduction

Nowadays environmental issues are becoming a global issue with more and more institutions and people caring about environmental problems. Industry improvement is considered to be one of the causes of these environmental issues. The industry is considered not only to be a contributor to greenhouse gas emissions, solid and liquid waste and even hazardous waste which has the potential to threaten environmental sustainability. In addition, the industry contributes significant quantities of waste but also claimed to be the biggest user of natural resources and energy.

Efforts to overcome environmental problems caused by industry have been developed by the public or the industry itself. It said efforts to foster the development of "green" programs in the industry had been introduced throughout the country [1]. In Europe, the eco-innovation program was introduced through the Executive Agency for Competitiveness and Innovation in 2008. With growing concern about environmental protection issues, the realization of environmental programs for industries such as green manufacture, green supply chain, green building, green construction, green product, green technology, and many others. Therefore, it said that environmental issues become very important now,
various pressures from various parties ranging from the general public to market demand require the industry to process production and produce environmentally friendly products [2].

Indonesia through the ministry of industry developed the concept of the green industry. Industry awareness is based on an understanding that the sustainable application of the green industry concept can result in increased business margins and business competitiveness. The concept of the green industry includes the selection and substitution of materials and energy efficiency but not reducing product quality, becoming green products as planned. Re-engineering of production processes and or technology is carried out continuously. With this understanding of the green industry encompasses a variety of activities since product design, material use, the energy source used, machine selection, process design (location, layout and work system design), production processes, product handling (main, by product, waste), and product distribution or logistics. The definition above generally includes aspects of input material as raw materials in the form of natural resources and energy, aspects of the production process that demand more efficient, energy-efficient and low emissions and output aspects in the form of product results that meet the green criteria and the rest of the product or process in the form of waste liquid, solid and air and dust.

The textile industry is one of the industries that is prioritized for development because it has an important role in the national economy, which is a contributor to the country's foreign exchange. In addition, the textile industry is also a reliable industry to meet the needs of national clothing. However, the textile industry is one industry that has potential waste to threaten environmental sustainability. This can be seen from various perspectives in the form of raw materials, energy, and waste treatment after the results of the production process. There are still many textile industries that dispose of liquid waste into the environment which will cause the flow of liquid waste to go through the waters around the settlements, thus the quality of the environment quality of residential area will decrease.

This paper will explain the implementation of green industry characteristics that can be adapted into each stage of the production process in the textile industry and textile products, especially the batik industry. The characteristics of the green industry include the efficiency of the use of input materials, namely raw materials and auxiliary materials and the use of alternative materials that are more environmentally friendly, low energy and water intensity, minimization of waste both liquid and solid waste and reducing emissions due to the use of low-carbon technology. Each characteristic is equipped with criteria in the green industry standard (GIS) that can be used by textile and textile products industrialists, especially the batik industry in implementing the principles of the green industry.

2. Methods
The research method approach applied is a qualitative descriptive approach covering technical requirements and management requirements. The technical management requirements include the selection of raw materials, auxiliary materials, energy, water, production processes, products, packaging, waste and greenhouse gas emissions. Whereas in the aspects of policy and organizational management, strategic planning, implementation and monitoring, management review, corporate social responsibility, and employment. The research was carried out by conducting a literature study and review of the minister of industry decree No. 13 the Year 2019 concerning Green Industry Standards (GIS) for the dyeing, printing, and refinement textile industry [3].

3. Results and discussion
The development of the textile industry has several positive impacts such as advancing the economy and increasing tax revenues, opening up many new jobs for the surrounding community. The development with the development of the industry will produce competition in the quality of clothing produced. But besides these positive impacts, the textile industry also has a negative impact. Especially in environmental problems, namely the waste it generates. Waste generated in the production process consists of various types. Solid waste and liquid waste such as the rest of the production process activities.
Waste generated by a textile factory is usually a waste of various processes carried out in making textiles. The process starts with the staging process of the refinement process. When the finishing process will be done coloring process on textiles in this process will produce ammonia in high enough levels that can pollute the environment, especially waters if the disposal process is not handled properly. At its disposal, the textile industry usually discharges its waste into the river in the area around the factory. River water is currently used by many people around, given the difficulty of getting clean water in this modern era. Especially for people who cannot afford to buy clean water, of course, they will use the river water to meet their daily needs. People who live on the edge of the river also use river water for bathing, washing and even cooking. The textile industry waste discharged into the river is feared to still contain dyes. So it is very dangerous if the fabric dye used for the production is mixed with river water and the water is used for daily use. This will certainly disturb the health of the people who consume river water mixed with dyes from the textile factory waste.

The Green Industry Standard (GIS) has been established by the government in law, the minister of industry Decree No. 13 the Year 2019 concerning green industry standards for the dyeing, printing and refinement textile industry which aims to regulate technical and management requirements [3]. The scope of the technical requirements, which includes raw materials, auxiliary materials, energy, water, production processes, products, packaging, waste, and greenhouse gas emissions. Whereas in terms of management, it covers policies and organization, strategic planning, implementation and monitoring, management review, corporate social responsibility, and employment. The following describes the criteria and parameters equipped with numbers and explanations as follows:

3.1. Raw material

3.1.1. Raw Material Sources. Raw materials for the textile industry consist of yarn or fabric originating from natural and synthetic processes. Natural raw materials for the textile industry are raw materials derived from plants, animals and organic materials. While synthetic raw materials for the textile industry are raw materials derived from the synthesis of polymerization. Textile industry raw materials are obtained from domestic and imported. Therefore, the fulfillment of certificates or permits for raw materials is intended to ensure that the raw materials used come from legal sources and pay attention to environmental management in accordance with statutory provisions.

3.1.2. Raw Material Specifications. The fulfillment of raw material specifications in the textile industry is often determined by consumers or buyers intended to ensure compliance with product requirements specified by the company. Proof of specifications of raw materials used is usually done by examining documents, data records and related supporting evidence, including Safety Data Sheet (SDS) of raw materials and/or laboratory test results.

3.1.3. Handling of Raw Materials. In the textile industry, of course, it cannot be separated from the movement of raw materials. Activities in the production process starting from receiving raw materials from the supplier, stored until transferred to be transported into the production process. Raw materials must be handled properly so as not to change the quality which will have an impact on the quality of the production process. Therefore required procedures for handling raw materials, application, supervision, and evaluation.

3.1.4. The ratio of Products to Use of Raw Materials. Fulfillment of the ratio of the use of products to raw materials is one indicator of the achievement of the green industry. Optimization of the use of raw materials into products has an impact on the efficiency of natural resources. Sources of information were obtained from data on the use of raw materials and the real production of dyeing, printing and refinement textiles in the last 1 (one) year period.
The value of limiting the ratio of products to raw materials desired in the green industry standard is 90% (ten percent), with the following calculation formula:

\[ R_{pb} = \left( \frac{R}{B} \right) \times 100\% \]  

\( R_{pb} \) is the ratio of products to raw material inputs (%)  
\( P \) is the number of textile products produced in 1 year period (m²)  
\( B \) is the number of raw materials used in a period of 1 year (m²)

3.2. Aid materials

3.2.1. Content of hazardous colors. One way to reduce the negative impact on the environment and human health is to limit the content of harmful dyes used in the process. Sources of information were obtained related to the color material used and its quality procedures or catalog of green input materials from various references or available libraries and SDS. Additional materials used or specifications of materials used are based on test results from accredited laboratories, and identification of hazardous material testing is carried out by authorized institutions. From the whole data about the limit of the content of hazardous coloring agents, it is not permissible to use reduced azo dyes to produce amine compounds of the groups MAK IIIA1 and MAK IIIA2. Azo dyes are substances whose molecular chains contain azo (-N-N-) groups of organic dye classes that have toxic, carcinogenic, teratogenic, mutagenic, corrosive properties.

3.2.2. Content of Hazardous Materials. The content of hazardous substances is not only in the dyes but also in the auxiliaries. Therefore in this GIS restrictions are placed on limiting the content of hazardous substances in additives used in the process. In the process of verifying the manufacturer's written statement about the type and nature of the material supplemented by the statement from the supplier or the report of measurement results with SDS or CoA there is a statement that contains no detectable formaldehyde content and there are no exciting metals maximum concentration for cadmium (Cd) is 0.1 ppm, Nickel (Ni) is 1.0 ppm, Cuprum (Cu) is 25 ppm, Lead (Pb) is 0.2 ppm. Other data on additives used or specifications of materials used are based on test results from independent laboratories. Verification of report results related to the testing of hazardous materials is carried out by authorized institutions. Test methods based on Indonesia National Standart (INS) 7334: 2009 concerning methods for testing extracted metal content or testing procedures that have been internationally recognized.

3.3. Energy consumption

3.3.1. Specific electrical energy consumption. Energy performance indicators commonly used are specific heat energy consumption and specific electrical energy consumption. The amount of reduction in energy consumption in the textile industry is calculated from the amount of savings obtained by implementing an energy conservation program. To quantify the large decrease in energy consumption it is assumed that there is a reduction in energy and emissions based on the type of technology implemented in a certain time period. The maximum energy consumption for specific electricity is 1,100 kWh / ton, namely the use of electric energy products in the last 1 (one) year period in the textile production process of the real production of textile dyeing, printing, and finishing. Calculation of specific electrical energy consumption by the following formula:

\[ K_{dp} = \left( \frac{K_{el}}{P} \right) \]  

\( K_{dp} \) is the specific electrical energy consumption (kWh / tone of product)  
\( K_{el} \) is the amount of electricity consumption in the last 1 (one) year (tone)  
\( P \) is the number of products in the last 1 (one) year period (tone)
3.3.2. Specific Heat Energy Consumption. In the textile industry, the use of energy does not only use electricity but it is also possible to use other types of energy such as coal or diesel for its production process. Maximum energy consumption for specific heat energy is 3,500 kWh / ton of product use in the period of 1 (one) year in the textile production process of textile production, dyeing, printing, and refining.

3.4. Water Consumption

3.4.1. Use of Process Water. The efficient use of water is one of the efforts to maintain the sustainability of water resources and industrial sustainability. The efficient use of water can be interpreted by using less water to produce the same amount of product. It is necessary to verify data on water use for industry (source and amount of water demand) for the production process and utilities, as well as real production data in the last 1 (one) year period. The maximum use of process water is 120 m³/ton of the product. The formula for calculating the use of water for utilities with the following formula:

\[ K_{AS} = \frac{K_A}{P} \]  

Where:
- \( K_{AS} \) is a specific water consumption (m² / tone product)
- \( K_A \) is the consumption of water for the production process, utilities, and factory offices in the last 1 (one) year (m³) period
- \( P \) is the number of products in the last 1 (one) year period (ton)

3.4.2. Process Water Recycling Ratio. Minimum Process Water Recycling Ratio 120 m³/ton product. The formula for calculating the use of water for utilities with the following formula:

\[ D_A = \left( \frac{R_A}{T_A} \right) \times 100\% \]  

Where:
- \( D_A \) is water recycling (%)
- \( R_A \) is the amount of water returned to the production process in the last 1 (one) year (m³) period
- \( T_A \) is the amount of water used for the production process in the last 1 (one) year (m³) period

3.5. Production Process

3.5.1. Equipment Performance stated in OEE. OEE is a method to determine the level of perfection of the production process. A perfect process is a process that only produces good output, in the quickest time possible, without any downtime. OEE is a matrix that identifies the percentage of productive time of the total time used to complete production activities. OEE calculation components include:

a. Availability Index (AI), i.e. actual production time compared to planned production time. Value Availability Index (%) shows that the process always runs in time that is in accordance with the planned production time (there is never a downtime).

b. Production Performance Index (PPI), i.e. the actual production level compared to the best production rate (ideal run rate).

c. Quality Performance Index (QPI), i.e. the actual product quality compared to the quality target. This relates to the number of defective products and scrap products. A value of 100% for Quality shows that production does not produce any defective products. Reject products are products that do not meet the quality targets that cannot be recycled or reused into the production process.

The OEE value is fulfilled under normal process conditions / there is no interruption incapacity. If there is a capacity disturbance, the OEE value is calculated based on production capacity data during the assessment period. OEE value has a minimum limit of 75% with the following OEE calculation formula:

\[ OEE = \frac{AI \times PPI \times QPI}{100} \]  

Where:
- \( AI \) is Actual production time (hour / year) / Planned production time (hour / year) x 100%
- \( PPI \) is (Total Product / Actual production time) (tone/ hour)/Ideal run rate (tone /hour) x 100%
QPI is (Good product (tone / year) / Total product (tone / year) X100%

3.5.2. Production Failure Rate (Reject Rate). The product failure rate is the percentage of failures that occur in production in a period of 1 (one) year. This relates to the amount of defect and scrap products. Source of data at information obtained from primary data by conducting discussions related to the level of production failure, and secondary data by requesting data on the number of reject, defect and scrap products, and production data in the last 1 (one) year period. Verification is done through checking documents, data records and related supporting evidence, including checking data on the number of reject, defect and scrap products in the last 1 (one) year period, checking the real production data in the last 1 (one) year period of checking the level calculation a maximum production failure of a reject product of 5% with the following formula:

\[ R_j = \frac{(\text{defect and scrap products (tons) / 1 total products (tons)}} \times 100\% \]

3.6. Products

3.6.1. Product Quality. In order to protect consumers and reduce negative impacts on the environment and health, products produced by a company must meet applicable quality standards. Textile dyeing, printing and refinement products, there are product quality standards, namely the Oeko-Tex 1000 international standard. Verification is carried out through the inspection of certificate documents that refer to Oeko-Tex or SPPT-SNI documents or their revisions.

3.6.2. PFOS content. In order to protect consumers and reduce the negative impact on the environment and health, restrictions are placed on hazardous substances in the product. PFOS is a compound commonly used as a simple salt (such as potassium, sodium, or ammonium) or can also be incorporated into a larger polymer, this compound is a sulfonate-based fluorochemicals degradation product. This data can be found by identifying SDS, identifying product test results from accredited laboratories or accredited institutions according to ISO / IEC 17025, and testing methods based on Indonesia National Standart (INS) 7334: 2009 extracted metal content test methods or internationally recognized testing standard procedures.

3.7. Packaging

The reduction of negative impacts on the environment and health is done by limiting the use of hazardous substances in packaging materials. Need to use information sources or a list of guides for various materials based on available references (regulations, empirical data, research results, etc.), and verify the packaging ratio calculation (Rk) with the following formula:

\[ R_k = \frac{\text{packaging contains PVC / PVDC (kg) / total packaging (kg)}} \times 100\% \]

3.8. Waste

3.8.1. Liquid Waste Management Facilities. Waste management is intended to reduce the level of waste pollution so that it is safe to be discharged into the environment. Therefore, the industry needs to have a waste management facility that is suitable for the type of waste produced. Some things needed to manage waste are industries that are required to have a liquid waste disposal permit (IPLC) and have facilities and infrastructure for wastewater treatment plants (IPAL) in good condition and operating.

3.8.2. Compliance with liquid waste parameters with environmental quality standards in accordance with statutory provisions. The determination of environmental pollution is measured through environmental quality standards. Textile industry companies are allowed to dispose of waste into the environment with the requirements to meet environmental quality standards and get permission from the minister, governor, or regent/mayor in accordance with their authority. Waste test results must also go through ISO 17025 accredited activities listed in environmental management and monitoring
documents in the last 2 (two) semesters. In the event that there is no accredited laboratory, it can use another laboratory that has been appointed by an authorized agency.

3.8.3. Means of Exhaust and Air Emission Management. Industrial companies that issue emissions must comply with the technical requirements, namely supporting requirements in relation to compliance with ambient emission-quality standards, and noise such as chimneys and other technical requirements. Examination of the existence and operational conditions of the means of managing exhaust emissions and air need to be considered properly.

3.8.4. Compliance with Emissions. Air Emissions and Disturbance Emissions to Environmental Quality Standards in accordance with the Regulations of the Regulations Ambient air quality protection is based on ambient air quality standards, emission-quality standards, and disturbance level standards. The level of disturbance of immovable sources consists of: noise level, vibration level standard, and odor level standard.

3.8.5. Hazardous Waste Management. Hazardous waste management is an activity that includes reduction, storage, collection, transportation, utilization, processing and/or landfill. Industrial companies that produce hazardous waste are required to manage the hazardous waste they produce. Hazardous waste management must obtain a permit from the minister, governor, or regent or mayor in accordance with their authority. Some things that need to be considered include the hazardous waste management permit document which is still valid, the manifest document of hazardous waste management in the last 1 (one) year period, and an examination of the existence and operational conditions of the hazardous waste storage.

3.8.6. Solid Waste Management Facilities. The implementation of waste management includes waste reduction and handling. Industrial companies must carry out waste reduction and waste management. Waste management includes sorting, collecting, transporting, processing and final processing of waste.

3.9. CO₂ Emission Levels
Industrial activity is one of the contributors to greenhouse gas (GHG) emissions including CO₂ emissions which are believed to be the cause of global warming. Examine documents, data records and related supporting evidence including energy use data, and check the calculation of CO₂ emissions based on the type of fuel used as an energy source. In general, the calculation of greenhouse gas emissions is carried out using the concept of a mass balance. To simplify and simplify calculations, a multiplier called an emission factor, which is a representative value, connects the number of emissions released into the atmosphere with activities related to these emissions. Emissions for the industry are generally generated by sources derived from energy use in the form of fuel and electricity, production processes and waste. Especially for electricity usage, categorized as indirect emissions.

To reduce the negative impacts of the climate change phenomenon, it is necessary to calculate the number of carbon emissions (CO₂) from industrial activities. Calculation of carbon emissions for industry includes a number of activities, including identification of the scope of emissions from industrial sources of emissions in the process of industrial sources of emissions in the combustion process, sources of emissions in electricity use, sources of emissions in the use of heat energy sources of emissions from waste, determination Emission calculation method used.

Green Industry Standard Management Requirements for the Dyeing, Printing and Improving Textile Industry [4]:

a. Policy and Organization
   a.1. Green Industry Policy

Limitation of Industrial Companies must have a written policy on the application of the principles of the Green Industry. Verification of policy documents on the application of Green Industry principles, which at least contains the target of efficiency in the use of raw materials, energy, water, CO₂ emission
reduction and hazardous and nonhazardous waste reduction in period 1 (one) year, determined by the
top management

a.2. Organization

Existence of implementing documents on the application of the principle structure of the green
industry organization. This can be demonstrated through increased training or increased the principle of
green industry human resources capacity on the principle of green industry.

a.3. Socialization

The activities of the socialization organization follow the green industry policy and organizational
documentation or copy of the application of media socialization of the principles of the Industry on
Green in the policies and companies of the Industrial organization applying the principles of the green
industry in the industrial company.

b. Planning

The Greenhouse related industry document specifies the setting of measurable goals and objectives
from the policy of applying the green industry principle of the measurable goals and objectives from the
application of green industry principles in the company. The plan can be seen through programs to
achieve measurable goals and objectives of the application of the green industry principles of the
program in the last 1 (one) year period with the stated goals and objectives, at least covering the efficient
use of raw materials, efficient use of energy, efficient use of water, GHG emission reduction, hazardous
and nonhazardous waste reduction, implementation schedule, person in charge.

c. Implementation and Monitoring

The program is carried out in the form of activities according to the schedule and reported regularly
to top management policies. Implementation of the program, at least includes efficiency in the use of
raw materials, energy use, water use, GHG emission reduction, and hazardous and nonhazardous waste
reduction. Program monitoring is carried out regularly and the results are reported as material for top
management review and input in the verification method. Verification of reports on program monitoring
results and supporting evidence both internally and externally carried out.

d. Implementation of management review

Company Implementation Management Verification Industry review management report reports that
management review is carried out periodically in the last 1 (one) year period. Industrial Company
Industry report uses before and against the report of results after the act of monitoring fulfillment, further
requirements or audit results, technical company and or industrial results.

e. CSR Program

The textile industry must have a social concern for sustainable CSR programs. Social documentation
on the environment, for example, education programs, health, environment, partnerships, local small
middle industry development, competency improvement training, infrastructure development
assistance, etc.

f. Employment

Provision of labor facilities in accordance with physical provisions, reporting regulations and their
implementation. Providing facilities at least includes training of workers, medical checks monitoring of
workplace environment provision of first aid kits, provision of personal protective equipment.

4. Conclusion

Green Industry is one solution for the industry that in its production process prioritizes efforts to improve
efficiency and effectiveness in the use of resources so that they are able to align industrial development
with the preservation of environmental functions and can benefit society. The Green Industry Standard
(GIS) has been established by the government in law, namely the regulation of the minister of industry
Decree No. 13 the Year 2019 concerning green industry standards for the dyeing, printing, and
refinement textile industry aimed at regulating technical and management requirements. The scope of the
technical requirements, which includes raw materials, auxiliary materials, energy, water, production
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References
[1] The Minister of Industry 2014 *Green Industry Concept and Implementation* (Jakarta: The Minister of Industry)
[2] Bey N, Hauschild, M and McAloone T 2013 *The Journal of CIRP Annals-Manufacturing Technology* **62** 42-46
[3] The Minister of Industry Decree No. 13 Year 2019 *concerning Green Industry Standards (GIS) for the dyeing, printing and refinement textile industry*
[4] The Minister of Industry Republik Indonesia 2019 *Green Industry Award Assessment Guidelines* (Jakarta: The Minister of Industry Republik Indonesia)