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Evaluation of clean production in the fragrance industry: Case study On PT. mane Indonesia

Rorry RINEKO [1,*] and Hari Susanta NUGRAHA [2]

Department of Business Administration, Faculty of Social and Political Sciences, Universitas Diponegoro, Semarang, Indonesia.

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Abstract

In this era of globalization, an industry that survives and is competitive is an industry that is able to compete internationally. Indonesia is also famous for the potential of fragrance commodities from plants. Unfortunately, there has been no special and maximum attention, especially from the community. In the business world, many foreign products such as beauty and body care products use original Indonesian fragrances. However, due to the lack of understanding of the potential, the appreciation of fragrances by the public is lacking. In fact, it is very unique when it raises an element or art that is not always visual. Since the industry generates quite a lot of waste that can potentially harm the environment, implementing Cleaner Production in the fragrance industry can reduce negative environmental impacts and increase operational cost efficiency. This study aims to identify factors that cause inefficiencies in the use of water, electricity, and chemicals, then evaluate opportunities to improve efficiency and the magnitude of value in relation to the implementation of cleaner production and the effectiveness of company policies towards the environment. This research is analytical descriptive research. After conducting a SWOT analysis, a gap analysis between current and ideal conditions was conducted to identify inefficiencies. Evaluation of efficiency improvement opportunities with strategic and economic evaluation. The opportunity value of clean water use efficiency is 4,752,000 L/year, equivalent to IDR 58,687,200.00 per year. Savings in electricity use amounted to 55440 kWh per year or equivalent to IDR 86,153,760.00 per year. Savings in chemical usage amounted to Rp 76,032,000.00 per year. Water inefficiency is reduced by improving consumption patterns and implementing water reuse. Electricity inefficiency is reduced by adjusting the unit's processing capacity to the incoming waste load, while chemical inefficiency is reduced by system improvements and optimization of operating processes that make company policies quite effective. Management commitment in the process of implementing environmentally friendly business policies is the main key to the effectiveness of company policies.

Keywords: Clean Production; Fragrance Industry; Case Study; Production efficiency

1. Introduction

In this era of globalization, a surviving and competitive industry is an industry that can compete in the international world. Essential oils are liquid substances that are mixed and composed of several organic compounds obtained from plant parts such as flowers, stems, roots, bark, leaves and seeds by distillation. Essential oils are aromatic substances derived from plants that are used in the food and non-food industries. Indonesia is one of the largest producers of quality essential oils in the world.

Indonesia is also famous for the potential of fragrance commodities from its plants, unfortunately there has been no special attention and maximization, especially from the public. In the business world, many foreign products such as

* Corresponding author: Rorry RINEKO

beauty and body care use original Indonesian fragrances. However, due to a lack of understanding of the meaning of this potential, the form of appreciation for fragrance by the community is felt to be lacking. In fact, it is very unique when it raises elements or art that are not always visual. People only know the natural ingredients of the fragrance or perfume only through cosmetics, perfumes, the use of salons or relaxation places, and air fresheners. Lack of knowledge of the benefits of fragrance makes improper use will affect the mood of the user, so many of the use of perfume is not in accordance with personal character or certain conditions. Due to the lack of appreciation, there are very few facilities that provide, store, and provide insight to the public about fragrance ingredients in Indonesia. Currently, there are only perfume compounding facilities at perfume collector retailers or retailers specializing in perfume sales. Meanwhile, the phenomenon of people's lifestyle, especially in urban areas that require a neat, clean and fragrant appearance when working, its relationship with prestige and for aromatherapy has encouraged the perfume business and the like to emerge. Starting from large capital with leading brands or artists, to a small perfume refill business (Astuti, 2018).

The International Fragrance Association (IFRA) and the International Organization of the Flavor Industry (IOFI) from the 2020-2021 Sustainability Report show that Asia Pacific plays an integrated role in the global supply chain and research and development activities in the fragrance and flavor industry (IFRA-IOFI, 2021). The Asia Pacific region is also a major supplier of raw materials and the largest producer of mint, cedarwood, patchouli, and a variety of other spices and herbs. The extracts of these raw materials are the main ingredients in the process of making personal care, hygiene, and sanitation products, which are widely consumed.

As is known, initially the environmental management strategy was based on a carrying capacity approach. The implementation of this environmental carrying capacity turns out to be difficult because many obstacles arise and often environmental conditions are already polluted and damaged, so it takes a lot of money to restore it. Environmental management then developed into an effort to overcome the pollution problem by managing the waste that is formed, with the hope that the quality of the environment can be further improved. The steps taken are still not enough, because the cost of Net Production appears as a practical effort to make the industry aware of the importance of environmental management that meets the requirements. It started from a problem in the first decade after the Second World War.

Clean Production, as explained above, aims to be preventive or prevent the occurrence of pollutants, by looking at how a production process is carried out and how the life cycle of a product is. Pollution management begins by looking at the sources of waste generation starting from raw materials, production processes, products and transportation to consumers and products into waste. The environmental management approach with the application of the concept of clean production through increasing efficiency is a pattern of approach that can be applied to increase competitiveness. The application of clean production in industries, until now has only been applied to the core business, the waste treatment system should also use clean technology. The selection of processes for waste treatment is based more on low cost, not on impact on the environment. This is contrary to what the community expects.

The manufacturing industry greatly influences businesses and engineering processes that function in an adaptable, sustainable, and efficient way with high quality and low cost (Oztemel & Gursev, 2020). However, these industries have been faced with dynamic market demand for a longer period of time and ended up with depleting natural resources. It requires an ineffective way to explore the underlying challenges and limitations. a traditional linear economy that can replace the concept with restoration or regeneration that leads to clean production and a circular economy. The principles of the circular economy have been widely accepted by organizations to change operational practices for ethical and sustainable production and consumption. Clean production aims to eliminate the use of toxic components and believes in remanufacturing used products that are discarded by the end consumer when they are no longer needed. In search for considerable improvements in resource use, recovery waste or to reuse products or components, advanced manufacturing strategies integrated with data acquisition systems have been developed.

PT. Mane Indonesia is a company from France engaged in the chemical industry, which is making and mixing basic chemical components into essence or powder which is the finished goods of the company's production. Some examples of production from this company are flavor and fragrance. Established in 1998, the factory located in Jababeka Cikarang is Mane's largest manufacturing factory in Southeast Asia (Hariyanto, 2016). The fragrance processing industry is one of the industries that in the production process produces waste, both in the form of liquid waste, and solid waste. Waste produced from the fragrance industry can have the potential to cause environmental pollution if not handled properly, such as the emergence of odors that can disturb the surrounding environment.

Some of the research that takes the topic of clean production is mostly in the focus of the automotive industry, electrical appliances or even small and medium industries and other industries. There are still very few studies that focus on the fragrance industry because the fragrance industry is one of the industries in the chemical field that produces fragrance products, and the products produced will have great potential for environmental impacts. The application of Clean

Production in the fragrance industry can reduce negative impacts on the environment and increase operational cost efficiency (Sulistyono, 2020).

Every company wants to create environmental management that is preventative and integrated to be applied throughout the production cycle. Clean production is a preventive (García-Ávila et al., 2021) and integrated environmental management strategy that needs to be applied continuously to the production process and product life cycle with the aim of reducing risks to humans and the environment. The company aims to increase productivity by providing a higher level of efficiency in the use of raw materials, energy and water, promoting better environmental performance, through reducing waste generation sources and emissions and reducing the impact of products on the environment. From the research gap that rarely researches about clean production in the fragrance industry, from this description, the research question that encourages researchers to formulate the formulation of the research problem is as follows: (1) How to implement the clean production policy in the fragrance industry at PT. Mane Indonesia?; (2) How to determine alternative recommendations for opportunities to improve the implementation of clean production with the current condition of the company?. The purposes of this research are to find out the application of clean production processes and to formulate alternative recommendations for opportunities to improve the implementation of the right clean production at PT Mane Indonesia.

2. Literature Review

2.1. Aroma Chemistry

Esther is the largest family of flavor chemicals. They can be easily produced by the reaction products of carboxylic acid with alcohol in the presence of an acid catalyst. At high and high temperatures, the esterification reaction known as reverse hydrolysis and the odor quality changes completely.

Understanding the release of chemicals from liquid mixtures and their dispersion through the air is an important step in designing perfume products with the desired performance. The experience per real smoke would require an evaporated odor from the liquid phase, traveling through the surrounding air space and reaching the human nose to be felt. A way to mimic this chain of processes is to frame the release and spread of perfume as Stefan's famous tube device (Santana et al., 2021).

2.2. Fragrance

The task of systematizing the creation of fragrances was received by the generation of perfumers around Jean Carles (1892-1966) at the beginning of the 20th century. Fortunately for posterity, Carls wrote a series of valuable publications entitled "How to Make Fragrances". 2 The raw materials used by Carls were not always available to modern humans. Despite the perfume, the principles that Carles applied have eternal value and explain the example of a deal. Jean Carles did not believe that perfumers should have an exceptional sense of smell, but he believed that he should develop a sense of smell which is refined through practice. Students first learn to recognize opposing odors, and then various sensory family members. Examples of contrasting tones are indole, linalool, menthol, phenylethyl alcohol and vanillin. Balsamic vinegar contains cinnamon acetate, cinnamon alcohol, ethyl cinnamate, and amyl salicylate.

2.3. Waste Treatment Strategy

Strategies to eliminate waste or reduce waste before it occurs (preventive strategy), are preferred to strategies that deal with waste treatment or disposal of waste that has been generated (treatment strategy). This can be done using the following strategies: (1) Elimination This strategy is included as a method of total waste reduction. If necessary, do not discharge waste at all (*zero discharge*). In the concept of implementing Clean Production, this is included as a pollution prevention method; (2) Reduce Waste Efforts to reduce the use/use of raw materials as efficiently as possible in a production process also pay attention to the waste that is wasted; (3) Reuse Efforts to use waste to be reused without undergoing a processing process or deformation. Reuse can be done inside or outside the production process area concerned; (4) Recycling Efforts to utilize waste by recycling through physical or chemical processing, either to produce the same product or different products. Recycling can be done inside or outside the production process area concerned; (5) Waste Utilization (*Recovery*) Efforts to utilize waste by processing to recover the material/energy contained in it.

2.4. Resource Efficient and Cleaner Production

The mission of the United Nations Industrial Development Organization (UNIDO), as described in the Five Declaration adopted at the fifteenth session of the UNIDO General Conference in 2013, as well as the Abu Dhabi Declaration adopted at the eighteenth session of the UNIDO General Conference in 2019, is to promote and accelerate the development of

inclusive and sustainable industries (ISID) in Member States. The relevance of ISID as an integrated approach to all three pillars of sustainable development is recognized by the 2030 Agenda for Sustainable Development and the associated Sustainable Development Goals (SDGs), which will frame the UN and the country's efforts towards sustainable development in the next ten years. UNIDO's mandate is fully recognized in SDG-9, which calls for "Building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation" (Unido.org, 2021). However, the relevance of ISIDs applies to a greater or lesser extent for all SDGs. Therefore, the focus of the Organization's programs is structured, as detailed in the Organization's Medium-Term Program Framework 2018-2021, in four strategic priorities: creating shared prosperity, improving economic competitiveness, protecting the environment, strengthening knowledge and institutions.

Each of these programmatic areas of activity contains a number of individual programmes, which are implemented holistically to achieve effective outcomes and impacts through UNIDO's four supporting functions: (i) technical cooperation; (ii) analytical and research functions as well as policy advisory services; (iii) functions and normative standards and quality-related activities; and (iv) meetings and partnerships for knowledge transfer, networking and industry cooperation. In carrying out the core requirements of its mission, UNIDO has significantly improved its technical services over the past ten years. At the same time, it has also substantially increased the mobilization of its financial resources, which is a testament to the growing international recognition of the Organization as an effective provider of catalytic industry development services.

The Government of Indonesia in its national development priorities has highlighted the strategic development goal of building and consolidating international development partnerships to promote Indonesia's visibility as a developing country. UNIDO's programme interventions in the context of Indonesia's development priorities aim to create an enabling environment to bring about the necessary changes as well as ensure a holistic approach to the implementation of technical programmes.

The application of preventive environmental practices and integrated and sustainable total productivity techniques to processes, products, and services to improve efficiency and reduce risks to people and the environment. In practical terms, RECP entails the continuous implementation of preventive environmental strategies for processes, products, and services to improve efficiency and reduce risks to people and the environment. The RECP addresses three dimensions of sustainability individually and synergistically: (a) improving economic performance through increased productive use of resources, (b) environmental protection by conserving resources and minimizing industrial impacts on the natural environment, and (c) social improvement by providing jobs and protecting the welfare of workers and local communities.

2.5. Principles of Handling and Quality Control

By implementing clean production, product quality and competitiveness increase. The amount of product damage is one way to reduce waste formation, so that it will provide greater profits, especially export-oriented companies and compete in the world market. When a company operates, the business processes carried out by the company have the potential to have an impact on the environment, both positive and negative impacts, in accordance with ISO 14001 but this Standard has been adopted by the Indonesian government into the Indonesian National Standard (SNI) into SNI-19-14001-1997, which is a standard that combines and balances business interests with the environment. Thus, efforts to improve the performance carried out by the company will be adjusted to the company's resources, whether it is human, technical, or financial resources. The overall purpose of the implementation of the ISO 14001 Environmental Management System (SML) as an international standard is to support environmental protection and pollution prevention in balance with socio-economic needs.

2.6. Clean Production

Clean production is a preventive and integrated environmental management strategy that needs to be applied continuously in the production process and product life cycle with the aim of reducing risks to humans and the environment (UNEP, 2003). The Ministry of Environment defines clean production as an environmental management strategy that is preventive, integrated and applied continuously in every activity from upstream to downstream related to the production process, products and services to improve the efficiency of the use of natural resources, prevent environmental pollution and reduce the formation of waste at the source so that it can minimize risks to human health and safety and environmental damage (Hens et al., 2018). From the understanding of clean production, the keywords used for environmental management are prevention, integration, efficiency improvement, risk minimization. In industrial processes, clean production means increasing the efficiency of raw materials, energy, preventing or replacing the use of hazardous and toxic materials, reducing the amount and level of toxins of all emissions and wastes before leaving the process. In products, clean production aims to reduce environmental impact throughout the product life

cycle, from the extraction of raw materials to final disposal after the product is not used. The success of the implementation of clean production in the industry (Ujianti, 2017), if it is marked by: (1) Reduced water use, so that the industry has an excess water supply; (2) Increased energy efficiency, so that the industry has excess power and can still be utilized; (3) There is a handling of industrial waste that can be used as raw materials; (4) There is a decrease in the generation of liquid and solid waste, so that the capacity of wastewater treatment plants (WWTP) and incinerators is excessive.

2.7. Leadership and Management Commitment

The organization and top management always remain responsible for the performance of the environment. Environmental policies and objectives are aligned with each other, and with strategic policies and overall business direction, including integration with other applicable business systems. Resources must be provided to ensure the SML can be operated efficiently, and top management must ensure that the people responsible within the SML have the right support, training, and guidance to complete their tasks effectively.

2.8. Environmental Policy

An Environmental Policy is a high-level document that contains a statement about the general direction of the organization, and its commitment to the environmental management system. It provides a framework for the goals or objectives of the organization. Meeting compliance and regulatory factors is definitely a key element. Policies must provide a commitment to environmental protection, preventing pollution & sustainable improvement in SML and its results. Environmental policies should be maintained as documented information, communicated within the organization, and available to all interested parties.

3. Research Methods

This research is a descriptive research, which is a research that is used to describe in detail the object of research and analyze phenomena, in this case the process of implementing clean production by PT. Mane Indonesia through descriptive research aims to describe, summarize various conditions, various situations, or various reality phenomena that exist in the company as the object of research, and try to bring this reality to the surface as a characteristic, character, trait, model, sign, or description of a certain condition, situation, or phenomenon (Sari, 2014).

The data used in this study is data sourced from PT Mane Indonesia. The data was obtained from the results of interviews conducted with PT. Mane Indonesia in Bekasi. The research informants are representatives of the board of directors as well as several levels of middle managers who work at PT. Mane Indonesia. The number of informants is 5 people including, consisting of 2 Directors of Manufacturing and Plant Manager, 1 Production Manager, 1 Manager of Health, Safety and Environment, and 1 Manager of R&D.

Data collection techniques use interviews, observations, and literature studies. The data analysis uses the Miles and Huberman analysis model (Miles & Huberman, 1994). Miles and Huberman (Sugiyono, 2017) stated that activities in qualitative data analysis are carried out interactively and take place continuously until they are complete, so that the data is saturated. There are three data analysis activities of the Miles and Huberman model, namely *Data Reduction, Data Display and Conclusion Drawing/Verification.*

The data analysis of this study has been carried out since the data collection was carried out. Along with data collection, researchers interpret the data. Data analysis is carried out by holding interpretations to solve the problems faced, in this study the researcher's position is as a research instrument.

4. Results

Business operations as previously explained that PT. Mane Indonesia is a company engaged in the field of *Fragrance* & *Flavor*. Perfume is a mixture of essential oils and aromatic compounds, binders and solvents used to provide a fragrant fragrance to the human body, object or room. To overcome problems such as the issue of odor in the human body and the lack of confidence from each appearance. The problem of perfume is something that cannot be ruled out of people's lives, because it is one of the most important needs for humans. To overcome the problem, everyone wants to look neat, fragrant, beautiful, handsome, and pleasing to the eye. Choosing clothes that suit the situation is important. Likewise, a fragrant body scent will increase confidence. One of the efforts to make the body smell good is to use perfume, hand body, and soap that have a pungent fragrance and are suitable for taste.

The solution depends on the policy of the relevant regulations or regulations including Hazardous and toxic materials, Legal and legal aspects, Financing aspects, Marketing Aspects Fundamental problems faced by the companies above, and environmental factors that will directly affect the activities carried out by these companies in the future.

PT. Every year in the current period, the company will prepare a strategic plan for its business development, plans such as sales targets, jobs, expenditures, capital needs and so on based on past circumstances, current circumstances and goals to be achieved in the future.

PT. Mane Indonesia has the following basic process flow. First, Raw Material Inspection and Replacement Process. The raw materials used for the production process are raw materials that have been inspected by the *Quality Control* department and have met the specifications of PT. Mane Indonesia. This aims to minimize raw material mixing errors during the production process and carry out the recycling process if there are production results that are not suitable for observation to prevent the generation of liquid waste when there is an error in the production pose, later it will be checked, and alternative solutions will be found for products that fail to be produced by the laboratory department.

Second, Weighing Process. Weighing must be done carefully and quantitatively so that there are no errors during the production process. Weighing for very small quantities of materials is done with an analytical balance (three numbers after a comma), while for a large number of materials is done with a gross balance (two numbers after a comma). Because the quality of the flavors produced is very influential with the weighing, so PT. Mane Indonesia set the critical point on the weighing to be ± 0.05%. The composition of weighing raw materials is contained in the *Compound Order* which is a production process procedure that has been given by the PPIC (*Production Planning and Inventory Control*) department. The method used in making products at PT. Mane Indonesia is a mixture with *a mixer*. The necessary components are mixed and then stirred until evenly distributed. This mixing is done by means of a dry and clean container made of stainless steel placed on the balance of motion and then stamped. Then the ingredients to be mixed are removed from the raw material tank arranged on the production rack so that the desired number of components can be removed by opening the tank faucet and dispensing as many formulas as needed. Every addition of raw materials to the balance sheet is marked and recorded for each weight used and then stirred. Mixing or stirring is the process of making a shape spread evenly and uniformly from several liquid-solid constituents. Mixing is a very important part of ensuring that all powder raw materials have been dissolved and the mixture has been homogeneous.

Third, Packaging Process. The results of the production process, both fragrances and flavors, will be sampled as many as 30-grams to be analyzed in the QC laboratory and if the results from QC state that the product is good, then the product will be packaged in a place that is suitable for the size of the order, then the product will be labeled green and sent by the SAD (*Staff Administration*) department.

Fourth, Recycling Process. Carrying out the recycling process if there are production products that are not suitable for observation to prevent the generation of liquid waste when there is an error in the production pose, later it will be checked and alternative solutions for products that fail to be produced by the laboratory department to reduce waste generation.

4.1. Liquid Waste Treatment PT. Mane Indonesia

In the production process, it will produce wastewater or wastewater. Process wastewater at PT Mane Indonesia is stored in the *pit*. In the *pit,* wastewater will be flowed to wastewater treatment to be treated so that it can be reused. The wastewater discharge from PT Mane Indonesia produced is 160 m3/day with an installed capacity of 240 m3/day for wastewater treatment. Liquid waste management is carried out to prevent or reduce pollution in the MM2100 Industrial Estate as a wastewater receiving body.

The liquid waste treatment process of PT. Mane Indonesia including: pit, Balancing Tank, Coagulation Tank, DAF (Dissolved Air Floatation) Tank, Cooling Tower, Scum Tank, and Belt Press Room. Pit, which is a temporary reservoir of wastewater from various processes with a capacity of 240m3/day. Water pools (from *domestic, recycling*, and *hazardous* waste) are collected in pits that are underground*.* After being accommodated in the pit*, the* wastewater is drained to the *Balancing Tank*.

The balancing *tank unit* has a volume of 120m3, in this unit the wastewater is aerated during the wastewater treatment process. This aeration activity is automatically regulated by PLC (*Programmable Logic Control*) and can be adjusted manually through a timer. The purpose of this aeration is to obtain homogeneous water and can reduce the concentration of COD and BOD in wastewater.

The *coagulation tank* unit has a volume of 2.9m3, in this unit there is a coagulation process with the addition of PAC and Alkali. The coagulant used is aluminum sulfate Al2 $(SO4)^3$. In this unit, suspended particles of very soft size and colloidal material in the water form flocculants in the water, so they can be separated by the flocculation process.

The Dissolved air floatation tank has a volume of 1.8m3, in this unit the water enters the *Reaction Tank* with a *transfer pump*. The pH is set in the range of 5.0 – 6.0 which is set by *the dosing pump controller* to regulate the dosage of PAC solution and Alkaline solution. Wastewater acts with PAC solution and forms flocs. To increase the size of the floc, an anionic polymer solution is added.

In this treatment unit, water is separated between the water and the floc that is formed so that the water that comes out is clearer. For floc that has been separated and accommodated in a tank, it will then be pressed to reduce the moisture content in the mud.

Wastewater that has been separated from the DAF tank will be flowed through *the cooling tower* to remove unwanted heat from the previous process. From the calculation table (Table 1), efficiency data for electrical energy is obtained of Rp 12,307,680.00 per year.

Table 1 Electricity Efficiency Data Per Year for *Cooling Towers*

Cooling Tower Power	Electricity Prices per kWh	Cooling Tower Operating Hours	Efficiency per Year
2.5 kW	Rp 1554,00	12 h/day	2.5 kW x 12 hour x 22 days x 12 month =Rp 12.307.680,00

Source: HSE Report (2023)

CSAS Tank is a tub with a capacity of 249m3 equipped with an aeration system. This process is the main process in the treatment of waste for COD. The process that occurs in the CSAS process consists of three phases, namely the aeration phase, the setting phase, and the decanting phase. In general, aeration is a process that aims to increase the contact between air and water, the aeration process mainly aims to increase the concentration of oxygen in this water will provide various benefits in waste treatment.

The Scum Tank is a tank with a capacity of 0.8m3 that functions to accommodate sludge formed from the flocculation process which will be flowed into the chemical sludge tank.

After the sludge reaches the Belt Press Room, the moisture content in the sludge is reduced by increasing the pressure on the belts. This reduction process is assisted by the addition of polymer through a polymer pump. The sludge from the pressing will be reprocessed by a 3rd party, namely PT. PPL

4.2. Review of PT Mane Indonesia's Waste Water Treatment System

The construction of *the Wastewater Treatment Plant* (WWTP) must be based on planning and calculations in accordance with the needs and standards that have been determined, in order to get good *effluent* and meet quality standards. In 2013, PT Mane Indonesia has built a wastewater treatment plant. The WWTP was built with a capacity of 10 m^3/hour and with *effluent* quality specifications as follows:

Table 2 Effluent Quality Specification

Parameter	Unit	Value
pH		6 – 8.5
BOD	mg/l	< 200
COD	mg/l	< 400
SS	mg/l	< 400
Oil dan Grease	mg/l	< 10
Temperature	C	<35

Source: Design Criteria PT Mane Indonesia (2023)

The wastewater treatment system is divided into two systems, namely *the pretreatment system* and *the biological system.* The wastewater produced from each production process is collected in a separate collection tank (*pit*) which is then referred to as *a pretreatment system.* From the collection tank, the wastewater is pumped to the *wastewater treatment plant* to be treated.

4.3. The effectiveness of the Waste Water Treatment Process of PT. Mane Indonesia

The Wastewater Treatment *process* carried out by PT. Mane Indonesia has been quite effective from an environmental aspect. Efficiency in terms of the environment can be seen from the quality of *Effluent* that meets the MM2100 Regional Quality Standards, while effectiveness in terms of economics is only focused on fulfilling the quality of *WWTP effluent* only, so as not to be exposed to *extra charges* due to *WWTP effluent* that is above the regional threshold. There are still several processes that, when reviewed and studied further, have the potential to have a fairly high efficiency value in economic and environmental aspects.

5. Discussions

5.1. Implementation of Clean Production at PT. Mane Indonesia

Good cooperation is needed in the Company's ecosystem to synergize with each other to create a clean production climate, in addition to because there will be many benefits produced in the process of implementing clean production, not only saving on materials but also on environmental health.

Referring to the variable operational data and questions from the researcher regarding the variables, the dimensions of the indicators and how they are measured are as follows:

Production Efficiency Dimension. The ratio of output and input is related to the achievement of maximum output with several inputs, meaning that if the output ratio is large, then the efficiency is said to be higher. The raw material selection process is carried out by the purchasing department on recommendations from the production department according to their needs and provides special standards to the supplier for the provision of the desired raw materials and the process of controlling and supervising raw materials assisted by the Quality control department and planning production and inventory control.

Electrical energy inefficiency is caused by PT Mane Indonesia's WWTP operating quite far above the incoming waste load. Even though the incoming waste load is below the design capacity, all units are fully operated.

Environmental Management Dimension. A management system that plans, schedules, implements and monitors activities aimed at improving environmental performance. Minimizing environmental and natural impacts is carried out through Liquid Waste Management. In the production process, it will produce wastewater or wastewater. Process wastewater at PT Mane Indonesia is stored in the *pit*. In the *pit,* wastewater will be flowed to wastewater treatment to be treated so that it can be reused. The wastewater discharge from PT Mane Indonesia produced is 160 m3/day with an installed capacity of 240 m3/day for wastewater treatment. Liquid waste management is carried out to prevent or reduce pollution in the MM2100 Industrial Estate as a wastewater receiving body.

Improving water efficiency by implementing WWTP *effluent water reuse* efforts for the WWTP *General Cleaning* Area process and for PAC and Polymer chemical diluents so that from an environmental aspect, the company has participated in reducing the use of water resources that can maintain the availability of water in nature.

Policy Implementation Dimension. Strategic thinking is reflected through the process of supervision and policy evaluation. Public policy evaluation is part of the policy process, which provides an overview related to the value of the results of certain policies and programs. Policy supervision is a systematic monitoring or assessment of policies and programs in order to determine the effects/impacts of policies and programs both in the short and long term. PT. Mane Indonesia has made a policy through *the green motion* program where this program is quite effective in caring for the environment through a clean production process in its business process.

Management Commitment is shown through management affective commitment. Affective commitment is one of the categories of commitment where this commitment is an emotional bond attached to an employee to identify and engage himself or herself with the organization. The top management has a strong commitment to environmental issues. Because several programs are made to participate in preserving and protecting the environment.

The following are some of the efforts made by the company as an effort to implement Clean Production at PT Mane Indonesia where the implementation is carried out thoroughly in related departments. Efforts to implement Net Production can be seen in the Table 3.

Table 3 Implementation clean production in di PT. Mane Indonesia

No	Department	Description of Clean Production Process	Objective
1	*Purchasing*	Search for Suppliers and Forwarders who meet the requirements related to SMLH and or related regulations related to Environmental Management where in conducting the assessment involves the QA and HSE Teams.	Supplier and Forwarders in collaboration with PT Mane Indonesia participate in helping the implementation of clean production through the implementation of regulations related to milieu.
2	*Production*	Modification to the washing process of 1 ton tank. Existing conditions are washed manually and require a lot of energy and water for the process. Improvements were made by making a COP (Cleaning on Place) system with pumps in the PRD area and adding accessories.	The washing process is more effective. Water and energy savings due to washing do not need to be repeated.
3	*Production*	Modification of the Tank washing process where the current condition of the Tank washing and Packing Line Modification in the Tank washing process where the current condition of the Tank washing, and the Packing Line are carried out separately. Improvements are made by combining the CIP process between tanks with Packing Line.	Lowering water and chemical use Because washing is only one process.
4	*Maintenance*	Replacement of the level control system for the Groud Water Tank from mechanical to automatic due to frequent malfunctions in the mechanical sensors resulting in uncontrolled overflow and water wastage	Avoid overflowing in the Water Reservoir Tank so that it does not occur Wastewater resources.
5	*Maintenance*	Watering plants using water from the region requires a large volume of water in 1 month. Water sources are replaced for watering by using Condensation result of Cooling Coil	Reducing water use from the area as a form of protection for the source environmental power.
6	*R&D*	R&D waste disposal is still carried out separately from production waste disposal.	Prevention of environmental pollution.
7	*Warehouse*	The CSD sink drain line goes into the containment which causes the accumulation of washing wastewater into the containment and affects the spread of Odors. Moving the discharge line from containment to the WWT pit.	Moving the disposal line so that the processing is appropriate.

After the implementation of clean production from several related departments above, the discussion will be more detailed to the Clean Production Implementation Process at PT Mane Indonesia. Before examining in more detail the main principles in the Clean Production strategy above, it is necessary to study the SWOT Analysis as a guide for the study of the implementation of Clean Production at WWTP PT Mane Indonesia.

In its implementation, the implementation of clean production is carried out through good governance, replacement of raw materials, improvement of procedure systems, modification of processes, and equipment, replacement of technology, modification and reformulation of products.

5.1.1. Elimination

The review in terms of elimination is to examine the efforts made or the opportunities for action that can be taken to prevent waste directly from the source, both from the raw materials, processes, and until the finished product. This stage is the first step to prevent and reduce the waste of energy and resources (Mózo, 2017). The uneconomical use of water where water is a natural resource is an action that is not in line with the concept of clean production. At this time,

there has been no detailed study related to the procedures from the company to minimize water use with efforts to reuse WWTP effluent, an assessment related to the effectiveness of the process to avoid energy waste.

Table 4 Calculation of Clean Water Use Costs for WWTP Operations

Process	Water Usage per day (in Liter)	Price of Water per Liter	Cost for Water Usage per year
General Cleaning	1500	Rp 6.5,00	Rp 30.888.000,00
Chemical dilution	1350		Rp 27.799.200,00
Total Saving per year			Rp 58.687.200,00

5.1.2. Reduce

The review in terms of reduce is to study reducing everything that causes waste. The best way to reduce is not to throw waste, both wastes generated from the production process. waste of energy. The way to reduce production costs is by making savings on internal or energy resources. This includes labor in the cost of raw material production which includes the cost of raw materials and raw materials, the company is indeed obliged to spend on raw materials, which does not mean that saving steps cannot be taken. Manufacturing companies usually cut operational costs of raw material spending, operational efficiency and can reduce the production process.

5.1.3. Reuse

The review in terms of reuse is to examine the potential for direct wastewater utilization without going through physical, chemical or biological treatments. All liquid waste that will be treated at WWTP PT Mane Indonesia is included in the category of mixed waste between industrial and domestic waste. Industrial waste has a much higher percentage than domestic waste that comes from non-industrial activities in factories. The nature of industrial waste has become more dominant, and the level of pollutants is still quite high, because of these dangerous properties, so far there has been no effort to utilize liquid waste that has not been treated at WWTP PT Mane Indonesia.

5.1.4. Recycle

The review in terms of recycling is to examine the potential of waste recycling treatment to utilize waste by processing it back to its original process through physical, chemical, or biological treatment. Some alternatives that can be applied for the reuse of PT Mane Indonesia's WWTP effluent include PT Mane Indonesia's WWTP General Cleaning area process water, as a diluent for Polymers and PAC.

5.1.5. Recovery/reclaim

Recovery/Reclaim is an effort to take materials that still have high economic value from a waste, then return them to the production process with or without physical, chemical, and biological treatments.

The steps taken to improve water use efficiency are to realize efforts to reuse PT Mane Indonesia's WWTP effluent, through several activities as follows: (2) The use of effluent for the WWTP General Cleaning Area; (b) Use of effluent for the dilution process of Polymer and PAC.

The steps taken to improve the efficiency of electrical energy use are through optimizing the performance of PT Mane Indonesia's WWTP so that processing efficiency can be improved. Optimization measures are as follows: (a) Implement all procedures consistently to minimize the potential for process failure due to human error; (b) Carry out preventive maintenance periodically for equipment at WWTP so that its performance does not decline and is not easily damaged.

The steps taken to improve the efficiency of chemical use are to conduct lab-scale experiments to determine the optimal amount of PAC and Polymer that must be injected into the Flocculation process, because the current PAC and Alkaline specifications are not optimal and tend to be inefficient. The experiment was carried out by determining the ratio of PAC and alkaline concentrations to pump strokes.

The steps taken to improve the effectiveness of the company's policies are: (a) Management must increase its commitment to clean production processes and environmentally friendly industries; (b) Management must supervise, monitor and evaluate regularly the implementation of policies from each process so that its main objectives are achieved.

6. Conclusion

PT Mane Indonesia's production process generally meets the criteria for clean production. However, there are several factors that cause inefficiency, namely: (1) Inefficiency in water use is caused by water consumption from the full regional supply, and there has not been an effort to reuse WWTP effluent for local/domestic needs or for WWTP operations; (2) Electrical energy inefficiency is caused by PT Mane Indonesia's WWTP operating quite far above the incoming waste load. Even though the incoming waste load is below the design capacity, all units are fully operated; (3) The inefficiency of the use of chemicals is due to the lack of a study related to the comparison of the stroke percentage of Alkali and PAC pumps, so that the operation is not optimal and inefficiency in the aspects of chemicals used.

All forms of efforts that can be made to improve the efficiency of PT Mane Indonesia are: (1) Improving water efficiency by implementing efforts to reuse WWTP effluent water for the WWTP General Cleaning Area process and for diluent of PAC and Polymer chemicals so that from the environmental aspect the company has participated in reducing the use of water resources that can maintain the availability of water in nature. Improving electricity efficiency by implementing optimization of the processing process through reducing the Blower Pump operating from 3-units to 2 working units, and by turning off the Cooling Tower equipment where both businesses can save costs and from the environmental aspect, the company has played an active role in reducing electricity consumption which can have an impact on reducing pollution from environmentally unfriendly power plants; (2) Improving the efficiency of chemical use by conducting laboratory-scale experiments implemented in the field related to the comparison of the stroke of the Alkaline Pump and PAC with the chemicals used. From this change in procedure, the efficiency of the use of chemicals and from the environmental aspect participate in reducing the consumption of chemicals that have the potential to pollute the environment if not managed properly.

The magnitude of the savings opportunity obtained from the implementation of clean production in the operation of PT Mane Indonesia's WWTP is a savings in clean water use of 4,752,000 L/year equivalent to Rp 58,687,200.00 per year. Savings in electricity use of 55440 kWh per year or equivalent to Rp 86,153,760.00 per year. The savings in the use of chemicals amounted to Rp 76,032,000.00 per year.

Recommendations

Companies are advised to increase the use of green chemical raw materials and sort raw materials that are not environmentally friendly and cause environmental pollution. The implementation of regular training and briefings to WWTP operators related to machine and process maintenance as well as consistency in the implementation of procedures that have been implemented, including improvement and efficiency in the field so that effluent quality remains below the threshold with an optimal processing process. There must be a full commitment from Top Management to environmental issues to be able to create business policies that are more concerned about the environment and be able to provide socialization and training on various types of issue updates and carry out much stricter supervision

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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