Cleaner production applications in the industrial company (Henkel case study during the period 2017-2021)

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Abstract:

This study aims to identify the extent of commitment to cleaner production applications in Henkel company, by studying and analyzing a set of indicators for the company's cleaner production during the time period between 2017-2021, which are represented in: Reducing polluting emissions to the environment of all kinds, using renewable energies , and reducing the use of natural resources during the product life cycle, as the study found that the company adopts a targeted policy to reach cleaner production, especially in the field of reducing emissions, controlling the consumption of natural resources and energy, and promoting the use of renewable and clean energies.

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Key words: cleaner production; Henkel company; the environment; renewable energies.

Introduction:

Throughout the second half of the 20th century a growing worldwide movement has attempted to change the way industry interacts with the environment. Governments and industry alike have contributed to this movement. The focus has been to reduce environmental impacts from industry through changes in industrial behaviour and technology. (Lennart , 2007, p. 19)

Cleaner Production in the process industry is not a new concept It has essentially been practised since the first chemical processes were utilised in our industrial society. Initially, the industry focused on issues such as yield improvement rather than specifically preventing pollution from entering the environment. However, the consequence of both activities was the same: less material constituting waste streams entering the environment. The application of Cleaner Production technologies and practices has already enabled the process industry to reduce and better manage pollution risks associated with wastes and other releases. Industry is now tasked with addressing emerging environmental issues, including the emissions of greenhouse gases, and providing a positive contribution to sustainable development in general. Further and renewed application of the Cleaner Production approach can provide a competitive edge for process industries while addressing those emerging environmental concerns (Berkel, 2000, p. 1).

Henkel is one of the leading industrial companies in the field of cleaning products, and in order to keep pace with modern global trends to mitigate environmental risks on the one hand, and achieve its economic goals on the other, the company adopts a set of applications to reduce emissions polluting the environment, therefore, the following problematic can be presented: **Is Henkel committed to cleaner production applications during its industrial activity?** The following sub-questions are derived from this problematic:

- Does Henkel reduce polluting emissions during the product life cycle?
- Is Henkel rationalizing the use of natural resources and energy?
- Does Henkel use clean and renewable energies in the production process?

study hypotheses : The following research hypotheses have been proposed to guide the research towards answering the sub-questions:

- Henkel focuses on reducing pollution, not only at the product presentation stage, but also at all stages of the product life cycle.
- The rational use of natural resources and energy is one of the major concerns of Henkel, due to its contribution to environmental protection and non-depletion of resources.
- Renewable energy is one of the priorities for energy use in the various production processes of Henkel.

Study Objectives: This study aims to achieve the following objectives:

- Study and analysis of cleaner production applications for Henkel company.
- Study and analysis of the amount of emissions polluting the environment for Henkel company during the life cycle of the product.
- Identifying the extent to which Henkel company rationalizes the use of natural resources and energy.
- Identifying the space occupied by clean and renewable energies in the company's combination of energy use.

Study Structure: The study was divided into the following components :

1. What is cleaner production?
2. Cleaner production objectives.
3. Cleaner Production phases and procedures.
4. Preventive practices for cleaner production.
5. Requirements for a successful cleaner production.
6. Benefits of Cleaner Production for Businesses.
7. Henkel cleaner production applications.

1-What is cleaner production?

One of the first approaches to deal with the industries' impacts on the environment was the simple dilution and dispersion of pollutants, which was only meant to make pollution less evident . In the 1960s and 1970s arise efforts for the regulation of industrial activities aimed at reducing manufacturing impacts. In response to these regulations, companies came up with solutions called "end-of-pipe", which aimed to control pollution after it had already occurred. The terms Cleaner Production (CP) and Pollution Prevention (P2) can be considered synonymous, and its distinction tends to be geographic: P2 is generally used in North America, while CP is the preferred term in other parts of the world .Both have the same goal: continuous reduction of pollution and environmental impacts through source reduction, i.e., eliminating environmental waste in the process (Queiroz, Cobra, Guardia, & Oliveira, 2015, p. 4). P2 is an approach which can be adopted within all sectors, whether it is a small service operation or a large industrial complex. CP, on the other hand, directs activities toward production aspects. Unlike in the past, when pollution was simply controlled, P2 and CP programmes attempt to reduce and/or eliminate air, water, and land pollution. Therefore, the P2 and CP approaches benefit both the environment and society. Economically, P2 and CP can actually reduce costs and in some cases, generate profit. Both approaches are practical and feasible, and can consequently contribute to a sustainable future (Lennart , 2007, pp. 20-21).

Since the development of cleaner production concept by UNEP in 1992, the vision of cleaner production has changed through the years. The change included the scope, content as well as the sectors which applying the approach. New methods and a wider approach are needed in order to target different aspect of sustainable development in various sectors such as eco-tourism, healthcare services and products, agriculture activities and smart cities rather than just industry production (Xing & Hadibarata, 2021, p. 24).

cleaner production practices approximate sustainable development to companies, as the environmental management system is robust, the results of a successful implementation are environmental and economic gains and the consolidation of an environment-conscious culture instilled in the employees (Geraldo, Henrricco, & José, 2020, p2). Several scholars and associations had defined the meanings of cleaner production. According to Nagesha (2018), cleaner production is a preventative way to reduce the bad effects of products and production towards the environment. United Nations Environment Program (UNEP) describes cleaner production as the continuous application of an integrated, preventive environmental strategy towards processes, products and services in order to reduce damage & risks for humans and the

environment (Xing & Hadibarata, 2021, p. 23). For production process, cleaner production includes conserving raw materials and energy, eliminating toxic raw materials and reducing the quantity and toxicity of all wastes (Nowosielski, Babilas, & Pilarczyk, 2007, p. 529). For products, the strategy focuses on reducing impacts along the entire life cycle of the product, from raw material extraction to the ultimate disposal of the product. Cleaner production is achieved by applying know-how, by improving technology, and by changing attitudes (Lennart , 2007, p. 20).

in year 1989 when establishing the Cleaner Production Program. Organization for Economic Cooperation and Development (OCED) defines cleaner technology as a technology that uses natural resources in most effective approach in all stages of their lives, where products are reduced or non-harmful to environment. The products shall be easy to recover and recycle, while minimum energy is used for production (Xing & Hadibarata, 2021, p. 23).

From the above it is clear that cleaner production is to reduce the negative effects on the environment along the life cycle of the product.

2-Cleaner production objectives:

Cleaner Production aims at progressive reductions of the environmental impacts of processes, products and services, through preventative approaches rather than control and management of pollutants and wastes once these have been created. It is an integrated approach, since it includes all relevant environmental aspects and impacts, and is not confined to one environmental impact category like most end-of-pipe technologies. Moreover, it serves economic and ecological efficiency (‘eco-efficiency’) and contributes to realisation of the environmental risk reduction and management objectives for humans and the environment (Berkel, 2000, p. 4). For production processes, Cleaner Production aims to (IVAM, 2008, p. 9)**:**

- Reduce at source the quantity and toxicity of all emissions and wastes generated and released;
- Eliminate as far as possible the use of toxic and dangerous materials;
- Reduce the consumption of raw materials and energy used in the production of one unit of product (efficiency improvement).

In the case of products, Cleaner Production aims at reducing the environmental impact along the life cycle of a product, from raw materials extraction to its ultimate disposal. Finally, for services, Cleaner Production entails the incorporation of environmental concerns into designing and delivering services. Cleaner Production requires changing attitudes, responsible environmental management and evaluating technology options (Berkel, 2000, p. 4)

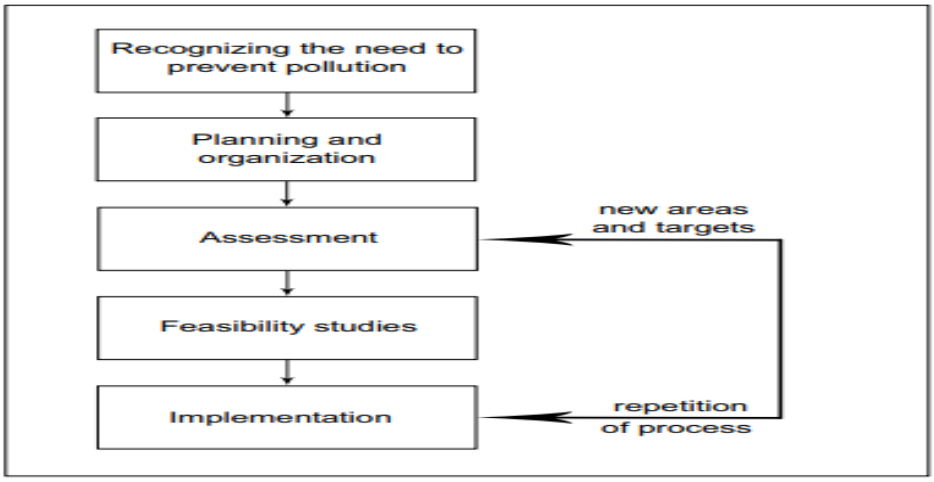
The above three slides reinforce the message that CP is applicable not just to production processes, but also to products and services. It could be mentioned that CP has been used successfully in product design and in the service sector (e.g. hotels and tourism, municipal management and hospitals) (UNIDO, 2002, p. 14).

3- Cleaner Production phases and procedures :

cleaner production options or opportunities. The definition of cleaner production as used by UNEP reflects the essence of the methodology. The essence of the methodology is first of all to

identify sources of the production of wastes and emissions inside the production process. Once such sources are identified the next step is to think about all possible ways to eliminate or reduce those sources. Once a variety of potential options is generated the methodology prescribes to engage in feasibility studies to assess the economic and environmental consequences of the options. Finally those options that prove to be feasible from an economic and a financial point of view are put forward for implementation. These subsequent steps can be characterized as (1) a planning and organization phase, (2) an assessmentphase to identify wastes and emissions and options for change, (3) a feasibility analysis phase and (4) an implementation and continuation phase(Fig. 1) (Hans, 2007, p. 81) , CP options were conducted on small-scale Batik industry located in Malang. The research was based on the CP methodology prescribed by UNEP (Sirait, 2018, p. 3)

Fig. 01. Phases in a Cleaner Production project based on the US/EPA manual



Source: (Hans, 2007, p. 81)

The method was implemented in five phases as follows (Sirait, 2018, p. 3):

- **Phase 1:** Planning and organization. At this phase, the owner and the worker have confirmed their participation and commitment to implement CP.
- **Phase 2:** Pre-assessment (qualitative review). This phase is carried out to know basic information about the enterprise. This phase is to acquire and identify all information for all stages of life cycle batik production. Review was conducted by interviewing the owners and workers. Also, inspection during the life cycle of batik industry has done.
- **Phase 3** : Assessment (quantitative review) includes measuring resource usage and waste generation throughout the process, identifying causes and solutions, and generating of CP Option
- **Phase 4** : Feasibility analysis. Each CP option is evaluated to determine the feasibility of the economic, technical and environmental aspect. Economic feasibility study was carried out by assessing the amount of the investment and Net Present Value (NPV) for each CP option.
- **Phase 5** : Implementation and continuation. The selected Cleaner production options are further implemented in Celaket batik industry to reduce the concentration and the amount of wastewater generated. The result of CP option implementation was measured using the environmental performance.

4-Preventive practices for cleaner production

The Preventive Principle It is cheaper and more effective to prevent environmental damage than to attempt to manage or "cure" it. Prevention requires examining the entire product life cycle, from raw-material extraction to ultimate disposal. It encourages the exploration of safer alternatives and the development of cleaner products and technologies. For example, prevention requires changes in processes and products—designing nontoxic products from materials than can be safely recycled or composted—in order to avoid the generation of waste that is incinerated. (Beverley , 1999, p. 4).

Product modifications change the product characteristics, such as shape and material composition Cleaner production is a preventive strategy to minimize the impact of production and products on the environment. The principal actors of Cleaner production are the companies, which control the production processes. They are influenced strongly by their customers (private, public or other companies) and politics (by laws, regulations, taxes (Fresner, 1998, p. 171)). Cleaner Production aims at making more efficient use of natural resources (raw materials, energy and water) and reducing the generation of wastes and emissions at the source. This can be achieved in various ways. A division in five prevention practices is most common (Kiran, Pati, & Kulkani, 2010, p. 3):

a) The lifetime of the new product is, for instance, expanded, the product is easier to repair, or the manufacturing of the product is less polluting. Changes in product packaging are generally also regarded as product modifications.
b) Input substitution refers to the use of less polluting raw and adjunct materials and the use of process auxiliaries (such as lubricants and coolants) with a longer service lifetime.
c) Technology modifications include for instance improved process automation, process optimization, equipment redesign and process substitution.
d) Good housekeeping refers to changes in operational procedures and management in order to eliminate waste and emission generation. Examples are spill prevention, improved instruction of workers and training.
e) On-site recycling refers to the useful application of waste materials or pollutants at the company where these have been generated. This could take place through reuse as raw material, recovery of materials or useful application.

Table No1. shows some examples of preventive practices for cleaner production

Type of prevention practice	Typical low/no cost examples	Typical medium/high cost examples
1. Product Modification	- High solids paint and inks to reduce solvent use in production and product application. - Environmentally preferred packaging (e.g. less or reusable packaging, recyclable materials).	- Develop premium products for longer service lifetime (e.g. coolants, lubricants). - Develop 'greener' products that are safer to the customer and pose fewer risks to the environment.
2. Input Substitution	- Use biodegradable detergents and cleaners	- Replace toxic catalyst by less toxic catalyst.

	- Use higher purity materials	- Replace non renewable material by renewable material - Make use of renewable energy.
3.Technology Modification	- Installation of appropriate process instrumentation to measure and optimise process conditions. - Use mechanical tank wall wipers to scrap product from tank walls after a product batch has been emptied (e.g. paint, resins, etc.).	- Better mixing design of reactors to reduce by product generation. - Adopt alternative synthesis pathway to avoid toxic by-product or toxic process intermediary. - Convert from batch to continuous processes. - Develop more selective catalyst.
4. Good Housekeeping	- Training employees in proper material storage and handling procedures. - Spill and leak detection and prevention - Use spill and drip trays to recover losses from manual material transfer operations	- Maximise batch sizes, and follow with a similar product that may not require equipment cleaning between batches. - Dedicated equipment for large volume products.
5. On Site Recycling	- Use counter-current washing, heating, etc. - Dry-clean equipment before hosing down and reuse recovered material	- Rinse with compatible solvent and store solvent for reuse in make up of next batch of compatible product. - Heat recovery from hot process streams.

Source: (Berkel, 2000, p. 6)

5- Requirements for a successful cleaner production:

Successful application of cleaner production in companies depends on property management, maintenance, adequate infrastructure and training of people. The transfer of cleaner production practises should be realized by (Nowosielski, Babilas, & Pilarczyk, 2007, p. 529):

- technological capacity (ability to adaptation clean technologies),
- training capacity (ability to training and education the ideas of
- cleaner production to various groups of people),
- institutional capacity (ability to network and co-operate among different stakeholders),
- government capacity (ability to prepare and implement policies in different policy fields).

Technological capacity is a one of the most important method to applicate the idea of cleaner production. Environmental technology is usually connected with the design and analysis of complex, integrated management systems and sustainable development (Nowosielski, Babilas, & Pilarczyk, 2007, p. 529).

6-Benefits of Cleaner Production for Businesses:

Cleaner production contributes to the model of sustainable development on a company level. The most famous definition of sustainable development was given in the Brundtland report in 1987. Sustainable development considers the necessities of present generations whilst taking into consideration the needs of future generations. Sustainable development does not allow an economy which wastes resources, which uses nonrenewable energy, or which destroys valuable natural capital (Fresner, 1998, p. 171).

Understanding and implementing cleaner production interventions is beneficial for a private enterprise in many ways. These benefits can be summarized as follows (Demirer & Alkaya, 2018, p. 9):

• Economic Benefits:

- Increase in production efficiency: As a result of the efficient use of resources, more raw material becomes a commercially-viable product. Reducing the use of energy, natural resources and raw materials provides savings for the enterprise. Thus, production costs are reduced and more production is possible with fewer raw materials. More efficient resource use can increase production speed and competitiveness.
- Reduction of waste treatment and disposal costs: Cleaner production practices reduce the amount of waste generated during the production process. As a result, energy and chemical use, man power allocation, space requirements and disposal costs are reduced.

• Environmental Benefits:

- Reduction of environmental impacts: Cleaner production practices provide efficient use of natural resources; minimization of solid waste, wastewater and emissions; and reduction of toxic contents. Thus, the negative impacts of the production processes on humans and nature are reduced. It also contributes positively to the performance of the waste management infrastructure
- Support for compliance with legislation today and preparation for the future: Cleaner production practices are advantageous in terms of compliance with applicable laws and regulations. It is the general trend that environmental legislation is becoming more demanding and is more often enforced; this trend is very relevant in the case of China. If legislation changes, it may be expensive to adapt and impossible to comply, which may lead to more costs. But, cleaner production prepares enterprises for future regulations.

• Social Benefits:

- Safeguarding and building reputation: Cleaner production practices can help manage and develop the image and reputation of a business whereas poor management of water resources, waste and wastewater can threaten the reputation of the business. Consumers increasingly demand that production does not harm the environment or detrimentally affect local people. A company that is sensitive to the environment acquires the support of society and consumers and increases its competitive advantage and market share. The implementation of cleaner production interventions can be a signal to international partners of the forward-thinking mindset of the company, its willingness to invest in its future and its knowledge of forefront technology and practices
- Support for occupational safety and worker health**:** It is possible to prevent potential accidents by improving and developing working conditions. At the same time, employees are protected from pollutants and dangerous substances

7- Henkel cleaner production applications:

1-7 Company Profile:

Henkel is a multinational company headquartered in Dusseldorf, Germany, Henkel was founded in 1876. That means the year under review marks the 145th in our corporate history. At

the end of 2021, Henkel employed around 52,450 people worldwide. is occupy globally leading market positions in consumer and industrial businesses.Henkel's innovative products and solutions create value in its business units for its stakeholders – across the entire value chain. operate 174 production sites in 56 countries worldwide, invest in research and development, maintain close cooperation with suppliers, and contribute to economic development in target markets. Henkel is organized into three operational business units: Adhesive Technologies, Beauty Care, and Laundry & Home (HENKEL, 2021, pp. 4-7). The company's production volume during the years 2017-2020, shown in Table No.02:

Table No.02: Henkel's production volumes

In thousand metric tons	**2017**	**2018**	**2019**	**2020**	**2021**
Production volumes	9,390	9,057	9,532	9,486	9,425

Source: (Henkel, 2021, p. 120)

Table No. 02 shows the development of Henkel's production volume, which is witnessing some fluctuation, but in general it was not less than 9.057 thousand tons as the lowest limit and 9.532 thousand tons as the highest, which is due to many things, the most important of which is the difference in total demand from year to year, and the periodic maintenance of the machines used in production.

2-7- Indicators for achieving cleaner production at Henkel:

The cleaner production in the company is achieved through several indicators: Reducing emissions; Rationalization of energy consumption and natural resources, and using renewable energy; Where the company aims in 2025 to achieve (Henkel, 2021, p. 74):

- Reduce the use of fossil plastics by 50%;
- ZERO waste : No plastic waste into nature;
- 100% recyclable or reusable.

2.7-1 Reducing emissions:

In light of the need to reduce emissions and decarbonize the economy, the company pursue the ambition of converting production sites to a climate-positive CO2 balance by 2030.In this regard, a significant milestone was already reached in August 2021: The Henkel Fragrance Center in Krefeld was the first Henkel site to switch its production completely to climate-neutral energy. In 2022, the Laundry & Home Care production in Düsseldorf and the Beauty Care production site in Wasser trüdingen, Bavaria, have also been converted to operate with 100 percent CO2-neutral energy. Further progress towards achieving climate-positive operations was made at our Adhesive Technologies plants in Australia, which have begun using electricity generated fully from renewable energy sources (https://www.henkel.com/, 2022).

- **Carbon dioxide emissions**: Table No. 3 shows the carbon dioxide emissions at Henkel during the period 2017-2021

Table No.03:Carbon dioxide emissions (2017-2021)

In thousand metric tons	**2017**	**2018**	**2019**	**2020**	**2021**
Henkel's own carbon dioxide emissions (Scope 1)	375	353	351	345	343
Carbon dioxide emissions from bought-in	344	329	315	191	132

energy (Scope 2)					
Total	718	682	665	536	475
CO2 emissions from biofuels	**0**	**0**	**0**	**0**	**8**

Source: (Henkel, 2021, p. 120)

From Table No. 03 it is clear that the total carbon dioxide emissions in Henkel, which can be divided into two parts, the first is the carbon dioxide emissions of the company's activities, and the second relates to the carbon dioxide emissions resulting from energy purchases, where the carbon dioxide emissions are known Related to the Corporation's activities, a continuous decline from 2017 to 2021. The highest value for 2017 was 375 tons, and it gradually decreased until it reached 341 tons. The same is true with regard to carbon emissions resulting from the purchase of energy, which in turn witnessed a gradual decrease, as it was in 2017. 344 tons until it reached 132 tons. From the above, it is clear that the company under study adopts a policy aimed at reducing carbon emissions, and it chooses its partners and suppliers carefully, as they are committed to an environmental policy aimed at reducing carbon dioxide emissions.

- **Emissions of volatile organic compounds:** Table No. 3 shows the emissions of VOCs at Henkel during the period 2017-2021

Table No.04:Emissions of volatile organic compounds (2017-2021)

In metric tons	**2017**	**2018**	**2019**	**2020**	**2021**
Emissions of volatile organic compounds	432	620	451	457	470

Source: (Henkel, 2021, p. 121)

Table No. 04 shows the emissions of volatile organic matter, which it seems that the company did not control properly, as it witnessed an increase in 2018 with a quantity of 620 tons, then a decrease in 2019 to 451 tons, then an increase in 2020 to 457 tons, and finally an increase in 2021 to 470 tons, which shows a lack of control of volatile organic emissions**.**

- **Emissions of heavy metals to wastewater :**Table No.05 shows the measurement of the pollution of wastewater with organic substances at Henkel during the period 2017-2021:

Table No.05:Emissions of heavy metals to wastewater(2017-2021)

In kilograms	**2017**	**2018**	**2019**	**2020**	**2021**
Zinc	593	445	621	468	590
Lead, chromium, copper, nickel	228	277	241	248	194
Total	821	721	862	716	783

Source: (Henkel, 2021, p. 121)

It is clear from Table No. 05 that the emissions of heavy metals in wastewater vary from year to year, as zinc in wastewater for the year 2018 witnessed a decrease to 445 kg, after it was 593 kg, and then increased in 2019 to 621 kg, and then decreased in 2020 to: 468 kg, and finally, an increase for the year 2021 to: 590 kg. As for the emissions of lead, chromium, copper and nickel in wastewater, they also witnessed a difference from year to year, so they rose in 2018 to 277 kg from 228 kg, then decreased in 2019 to 241 kg, then an increase for the following year to: 248, and finally a significant decrease for the year 2021 to 194 kg, and this is due to the difference in production from year to year and the nature of the raw materials used in the production process.

2-7-2 Energy consumption and renewable energy:

Henkel has been a founding member of the Renewable Carbon Initiative since 2020. This aims to promote acceleration of the transition from fossil-based to renewable carbon for all organic chemicals and materials. Henkel Adhesive Technologies is also carrying out pioneering work with new solutions for adhesives, sealants and functional coatings that replace fossil carbon-based raw materials with renewable materials. This reduces the carbon footprint of products and supports customers in reducing their emissions along the value chain. In addition, contribute to a circular economy by reducing the consumption of resources (Henkel, 2021, p. 7).

Table No. 06 shows the measurement of energy consumption rates at Henkel during the period 2017-2021;

Table No.06:the energy consumption(2017-2021)

In thousand megawatt hours	2017	2018	2019	2020	2021
Direct energy consumption					
Coal	109	89	84	82	77
Fuel oil	114	103	114	111	111
Gas	1,490	1,473	1,461	1,423	1,420
Other combustiles	26	20	7	4	4
Biofuels	0	0	0	0	41
Generated renewable energy	0	3	2	4	7
Indirect energy consumption					
Bought-in electricity	770	780	769	752	739
% bought-in renewable electricity	6%	11%	11%	48%	68%
Bought-in steam/heat	49	47	46	46	51
Total energy consumption	2,558	2,515	2,482	2,422	2,450
% Total renewable consumption	2%	4%	4%	15%	23%

Source: (Henkel, 2021, p. 120)

Table No 06 shows energy consumption in its direct and indirect form. As for direct consumption, coal consumption witnessed a continuous decline, producing 109 thousand megawatt-hours in 2017 to reach 77 thousand megawatt-hours in 2021. As for gas, which is considered clean energy, its consumption is stable between 114 And 111 megawatt-hours, and for other combustible materials, the reduction in their consumption is clear from 2017 to 2021, where it witnessed a stability of 4 megawatt-hours in the last two years, and biofuels were only used in 2021 to produce 24 megawatt-hours, as for indirect energy sources, The Corporation purchases less quantities every year, except for 2018, which witnessed some increase. We also note that the percentage of electric energy from renewable sources is in a continuous state of increase from 6% in 2017 to 68% in 2021, with regard to energy from thermal/steam, it is in a similar state. Stability between 46 and 51 megawatt-hours. From the above, it is clear that the Corporation focuses its energy consumption and production on clean sources such as gas and renewable energies, and continuously reduces its dependence on sources that pollute the environment.

2-7-3 Water consumption and volume of wastewater: The table No. 07 shows the number of water consumption rates and the volume of wastewater in Henkel during the period 2017-2021 :

Table No.07: Water consumption and volume of wastewater

In thousand cubic meters	2017	2018	2019	2020	2021
Water consumption	8,654	8,359	8,324	8,231	8,117
Volume of wastewater	3,423	3,544	3,485	3,616*	3,378

Source: (Henkel, 2021, p. 121)

Table No. 07 shows the water consumption and the volume of wastewater, where we note a continuous reduction in water consumption from 8,654 thousand cubic meters to 8,117 thousand cubic meters in 2021. As for wastewater, it changes from year to year, as it has known an increase during the years 2018 to 2020. While it decreased to 3,378 thousand cubic meters in 2021, where we conclude that the company is working continuously to rationalize water consumption and reduce the rate of loss, while it lacks mechanisms to control sewage water, such as reusing it in activities related to irrigation, for example.

Conclusion:

Henkel company seeks to achieve cleaner production through a number of indicators, the most important of which is the reduction in polluting emissions to the environment , the use of renewable and clean energy, and it aims in the year 2025 to reach high rates of cleaner production during the product life cycle.

Henkel company adopts a policy aimed at reducing carbon dioxide emissions, and carefully selects its partners and suppliers, as they are committed to an environmental policy aimed at reducing emissions.

hypothesis test results : After testing the hypotheses, the following results were reached:

- **H_1**: Henkel focuses on reducing pollution, not only at the product presentation stage, but also at all stages of the product life cycle, as carbon dioxide emissions, There is a lack of control of volatile organic emissions. Heavy metal emissions in wastewater of the company vary from year to year, and this is due to the different production mix from year to year and the nature of the raw materials used in the production process.
- **H_2:**Henkel company is constantly working on rationalizing water consumption and reducing waste, while it lacks mechanisms to control wastewater, such as reusing it in irrigation activities, for example.
- **H_3:** Henkel focuses its energy consumption and production on clean sources such as gas and renewable energies, and continuously reduces its dependence on sources that pollute the environment.

Recommendations:

Through the results that we reached in this research paper, we came up with a set of recommendations, which we mention as follows:

- Focusing on innovating modern ways to benefit from wastewater.
- Abandonment of dependence on coal and fossil fuels in production processes.
- Increasing the use of clean and renewable sources of energy.
- Investing in the technology of sequestering gases and polluting emissions to the environment.
- The use of the closed loop to rationalize the use of water.

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