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APPLICATION OF CLEANER PRODUCTION IN SOAP INDUSTRY FOR A HEALTHIER WORK ENVIRONMENT

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Abstract: *In the light of the increasing industrial impact on the environment, and since small industries have a cumulative effect that increases with time, the study examines the employment of Cleaner production in soap industry to achieve two goals: the first cutting back on waste produced, and the second reducing the use of toxic materials. Thus, it can contribute in the solution of chronic problems concerning the health and safety of workers and the environment as well. The study has taken place in two different developing countries, Syria and India. The current situation in every factory was evaluated considering the occupational health and safety of workers, and the influence on the environment. This includes the evaluation of energy consumption and the use of Cleaner Production alternatives. The required data is obtained originally from the direct observation of raw materials, production stages, production quantities and unsold products and from interviews with owners, engineers, and workers in the second place. It was found that waste from soap factories are not generated in large quantities, but their accumulation creates environmental and health troubles which can be alleviated by replacing chemical materials with natural ones, using hand storage and implementing cleaner production alternatives in the soap industry. This strategy can reduce waste created and energy used through benefiting from the sunlight, natural drying, reusing byproducts, which can rise the efficiency of production and management process. It also has a significant positive impact on the work environment, health and safety of workers in general.*

Keywords: *Byproducts, Cleaner Production alternatives, India, Occupational Safety Soap Industry, Syria*

INTRODUCTION

Soap industries have a significant impact on the environment, and this depends on the type of waste, the type of raw materials, which are industries generated wastes, effluent generation, heat generation, pollutants and greenhouse gases, noise generation etc. The cleaner production processes cut down on pollution to a great degree; using clean and environment- friendly technologies, and so this curtails using and releasing toxic materials. Moreover, non-renewable materials and energy are being replaced by renewable ones.

Evaluating the effect of Cleaner Production-Pollution Prevention (CPPP) is conducted by reducing the effect of chemicals on the workers' health and safety. Through recognizing the relation between the workers' safety and the environment we can determine the elements which lead us to reducing the risk of toxic materials on humans and the environment. (Karla R et., 2011)

In other words, the cleaner production is a method that aims for preserving the environment and health from pollution and saving its natural resources while treating the environmental problems at the source not after occurring, and this requires clean, environmentally friendly technology. (Hens et al., 2017)
So, we can say Cleaner Production-Pollution Preventive (CPPP) is the best technique for the environment and health protection and can replace chemical materials with natural materials.
Through searching in similar studies it was clear that the objective of this study is to determine the competitive priority that can stand for the organization's functions (Lin et al., 2007). Environmental performance, economic performance, social performance, the study of performance improving and cost control was studied by Xiong& Xiong (2010). In recent years, environmental problems and their effects have increased, and the environment is considered one of the most important topics in all countries of the world. This requires an increase in environmental awareness, including the production and product process (Pusporini & Vanany, 2017). The Cleaner production puts the whole-prevention strategy into the sustainable production processes, products and services to increase eco-efficiency and reduce human and environmental risks (Lin-xiu & Kun, 2008).
Through this paper we can recognize all soap manufacturing stages and all kinds of raw materials both natural and chemical, in addition to knowing its impacts on humans' health and environment, and Cleaner production options which makes this study unlike any other researches. It should be noted that I did a field study to complete this paper through interviewing owners, engineers and workers as well as direct observation. It began with determining the stages of manufacturing problems and the possibility of applying cleaner production. Various problems have been found throughout the study as Asian countries are some of the most polluted ones where the medium and small industries are produced and they lack energy efficiency in addition to their location near residential areas, which leads to the spread of environmental pollution in the neighbourhood. (Bantacut & Zulaikha, 2019)
Thus, research related to cleaner production helps to improve the production and environmental management practices.

MATERIALS AND METHODS

Authors listed the study into three groups: location and time, type and source of data, and research stages (Production process). We obtained my data as mentioned above from interviews and observation.

1. Location and Time:

This study was conducted in November 2019 at Al-Majd Factory for Soaps in Syria and in February 2020 at Remember India Cosmed Products in India.

2. Type and Source of Data:

Authors obtained my data as stated before from interviews and observations and we were deducted the scheme after recognizing the production line. As for the cleaner production, alternatives were obtained through interviews with employers.

3. *Research Stages:*

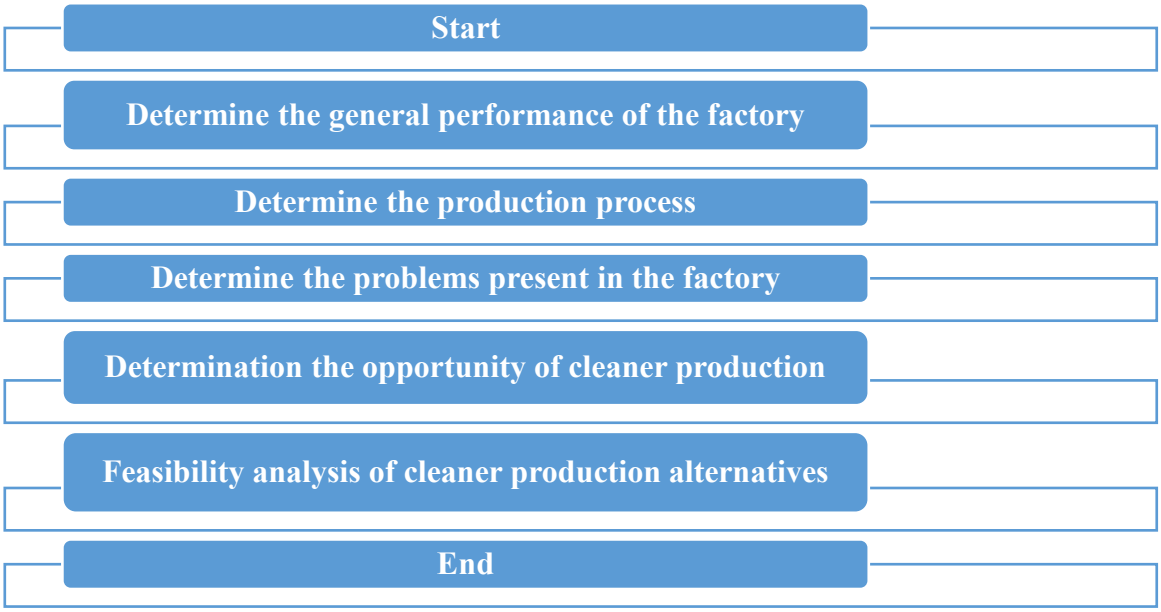


Figure (1): stages of the research
Source: (Bantacut&Zulaikha 2019)

A. Determine the general performance of the factory: In this stage, it was possible to know the general condition of the company from the date of construction, the number of workers, production capacity and management.
B. Determine the production process: Determined the sources of waste energy and water consumption based on the operating time of the machine.

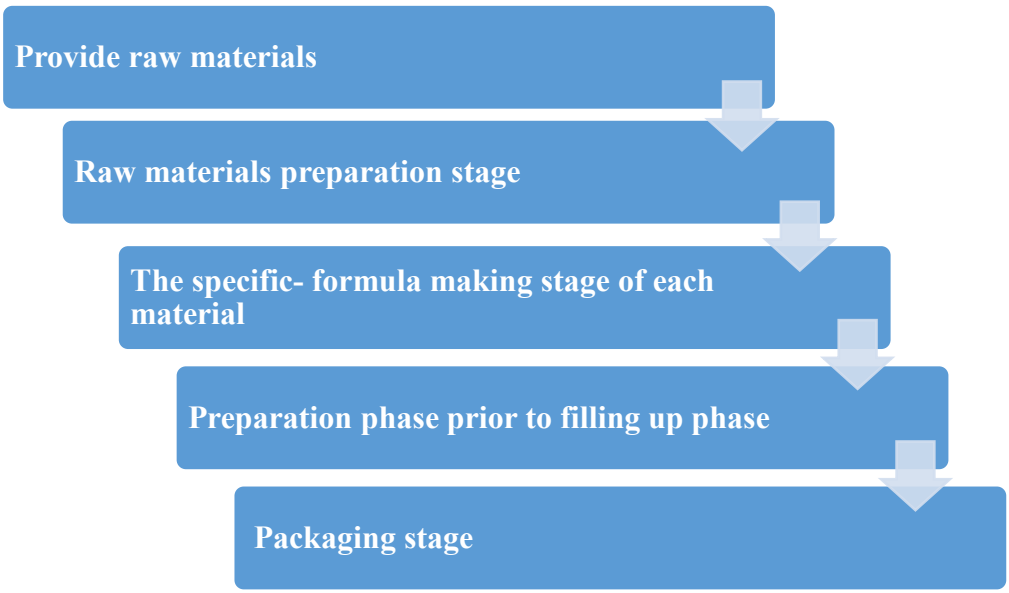


Figure (2) the production process

C. Provide raw materials
D. Those were olive oil, laurel oil fennei-flower, oleaeuropea, coconut oil and palm oil. There were chemicals such as toxapone to give the soap foam and other materials such as sulfonic acid (labsa), sodium carbonate (SODA) and sodium hydroxide (custic).

E. As for the source of the natural raw materials, they came from the same area of the factory, they were purchased from the inhabitants there, and the chemicals which were not manufactured locally were imported from abroad.
F. With regard to the effects of raw materials on the environment and people, they can be listed as follows:
G. Texabone (sodium dodecyl sulfate): It exposed humans and animals to injuries such as skin irritation and infections due to its ability to penetrate into the skin if it was used excessively. Therefore, preventive measures must have been taken and used in specific proportions and then wash the contacted skin quickly. On the other hand, it was considered safe that did not cause cancer.
H. Sulfonic acid (Labsa): there was a high risk of poisoning and high biological accumulations in the bodies of neighborhoods, which put their lives at risk.
I. Sodium carbonate (soda): It had benefits as it eliminated bacteria and removed spots and whitening, but it caused chemical burns. Therefore, preventive measures must have been taken.
J. Sodium hydroxide (Costic): also caused skin erosion and damaged the cornea, where it could have caused blindness and chemical burns.
K. Determine the problems present in the factory: it aimed to identify the problems in the detergent plant (soap) including raw materials and waste generation in each process. The data has been collected through interviews with workers and owners, and direct observation
L. Determination the opportunity of cleaner production: the use of magazines, previous studied and secondary data.

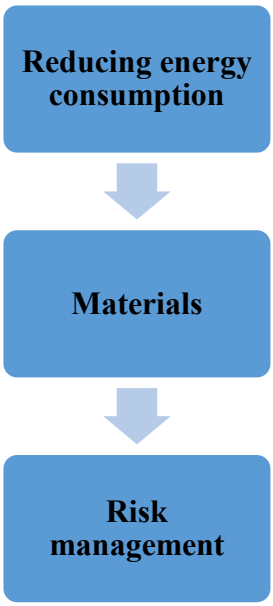


Figure (3): the opportunity production

E- Feasibility analysis of cleaner production alternatives: an analysis of all environmental, financial and technical aspects.

- Environmental: Reducing waste in the production process and avoiding the production of new waste
- Finance: by calculating cost benefits
- Technology: the compatibility of procedures and production with conditions in the industry and the efficiency of the process.

Also, the material standards consisted of the available equipment capacity, the efficiency of the use of raw materials, and the preservation of product quality. These standards were as essential as the availability of places, engine maintenance, standards for a safe work system for workers and the availability of human resources.

RESULTS AND DISCUSSION

Through this research we noticed that the environmental impact of soap factories might not be significant, but their progressive effect was large due to several factors.
This included: low level of technology, lack of trained workers, lack of space and lack of environmental protection (Erina & Andre 2016), and this was what soap factories suffered from. We noted that waste soap factories were not large, but their accumulation created an environmental problem, so there was a wide range of pollution prevention opportunities that could have been implemented and had financial advantages for the plant, as well as reducing environmental pollution.
These opportunities ranged from simple, low-cost improvements in housekeeping procedures to saving that could have been achieved from recovering chemicals used in the process, and potential products from waste (Sohair I & F.Zaher 1998).
By reducing the amount of waste produced or that could have been released, the company could cut down on waste disposal costs, improved worker safety, and reduced liability in the long run. Energy and material scales were crucial to reduce waste, as we could determine emissions and losses, and evaluated costs. Here are energy and material balance components:

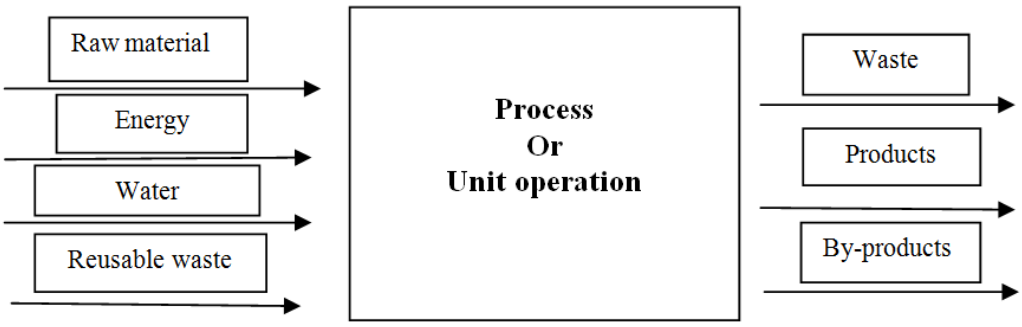


Figure (4):Components of material and energy balance
Source: waste Minimisation and Resource Conservation

Pollution prevention methods might have increased the efficiency of the production line and reduced costs, as they were consistent with the procurement process, raw materials and stock control.
Any resulting that could have changed the efficiency or expenses might have helped the company maintenance or improved its competitiveness in the market (Sohair I & F.Zaher 1998).
In light of these consequences, it was strongly recommended to follow the procedures of cleaner production through using the appropriate materials and technology, using renewable energy, reducing the process time as the energy consumption was proportional to the treatment time, and reducing / increasing the temperature as the heating and cooling process consumed the energy that changed the process current temperature of the product.
By reducing / increasing the set temperature, the power requirements would have been reduced due to the short temperature gradient (Cleaner Production Tips for Small and Medium Industries 2011).

Table (1): Unit Operation

In-put	Value	Out-put	Value
Raw Material	1000 Kg	Products	12000 pieces (900 Kg)
Energy	50 Kwh		
Reusable waste	100 Kg	Waste	27 Kg/d (3%)

Cleaner production options:

The availability of natural materials and hand storage was important to implement cleaner production in the soap industry, as soap waste was biodegradable and implementation of cleaner production succeeded in reducing the amount of waste resulting from manufacturing poor storage.

Table (2): Cleaner Production Options

Process	Problem	Current handling	Cleaner production options
Preparation stage	Size-related imperfections	Some mistakes occurred in size when cutting the formula into parts	Use the machine to set size to avoid these mistakes
Packaging stage	Waste packing boxes during the packing process	Manual packaging of soap	The packaging used for recycling is stored
Storage	A quantity of soap is damaged due to poor storage	No action Only store soap	Improve storage conditions by providing conditions such as: temperature and humidity to avoid stock damage

Table 3 Implementation of Cp in Soap Manufacturing Industry

Process	Investment/ Input	Benefits/ Output	Indian/ Syrian Soap Industry	CP Recommendations
Raw materials	• Selection of raw materials based on their properties • Material should be environment friendly	• Waste minimization • Better quality of product • Minimum consumption with maximum output	• 1000 kg	Selection of eco-friendly and non-toxic material
Energy Sources	• Environmental friendly and locally available energy source to be used	• Energy savings • Waste minimization	• Electricity (50Kwh)	• Saving of energy can be done as much as possible
Housekeeping	• It need proper planning and management practices with required goods	• Good and safe work place • Cleanliness and hygiene • Waste minimization	• 40 workers	Good housekeeping will reduce any losses during handling and storage
Waste Generation	• It is produced during production • It also can be a by-product	• Waste is an undesirable output	• 3% of total raw materials (27kg)	• Waste can be recycled • Processed again and can be a useful by-product
Product	• All the above mentioned process combine together to form product	• A product is the most desirable	• 300 boxes having 40soaps (75g per soap)	• Product can be modified like shape and size to minimize waste

CONCLUSIONS AND RECOMMENDATIONS

Through the case study, we find that the industries which perform preventive measures to preserve the safety of the workers, as they wear gloves and a periodic medical examination is carried out every six months and provide the appropriate treatment once any of that is needed and the appropriate healthy food is provided.

The research found various problems resulting from waste sources and inefficiencies that occur in the production and management process. Some of which are the lack of equipment and technology, the

lack of space, the use of lights during the day, the generation waste, the use of electric power, the lack of efficiency of workers and unsold products.
The detergent industry (soap) must have a special team to deal with the environmental aspects of reducing waste generated, applying cleaner production in an optimal way, using clean energy, rehabilitating workers, using technology more broadly, and providing space for all stages of manufacturing (Waste Minimizations and Resource Conservation).
By applying cleaner production technology, the waste ratio is halved from 3% (27,000 kg) to 1.5% or more from the previous percentage.
This strategy saves waste packaging and wasted soap packages, reduces costs and raises productivity. This technique cuts down the environmental risk and the cumulative negative impact of soap factories as well as it will be an environmentally friendly industry.

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