The importance of cleaner production in the cement industry

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Summary: This study aims to find out the effective role of cleaner production in the industry Cement, the study showed that cleaner production plays an important role in the industry due to its positive effects in reducing pollution and preserving resources and preventing waste, as well as reducing emissions and generating waste, the study found that cement material is a vital and necessary material where it helps in construction work, Cleaner production is a systematically structured approach to production activities, with positive effects on the environment, including minimizing the use of resources, improving ecological efficiency and reducing the risks to living organisms, as well as cleaner production playing a role. Important in industry by reducing pollution, preserving resources, preventing waste, and reducing emissions and generating waste... And others, In the end, the study recommended the need to review the policies of industrial enterprises to reduce pollution, rationalize energy use, rationalize the consumption of natural resources and seek renewable alternatives, avoid the use of toxic and hazardous substances in production and manufacturing processes, as well as reduce emissions and residues in Various stages of manufacturing, production and use through recycling and recycling of waste, with the need to modify the techniques used in manufacturing and production processes and use modern environmentally friendly technologies such as cleaner production.

Keywords: Cement industry, Cleaner Production.

Jel Classification Codes : Q01 ;Q55 ; Q53 ;Q52 ; Q51.

I- Introduction:

The cement industry is a strategic and development industry and is directly linked to construction and construction, on which many countries depend on it to increase its exports, as it is a simple industry compared to other industries, but the downside of this industry is its negative effects on the environment and human health.

In this context, industrial enterprises in particular are seeking to adopt a cleaner production strategy, which is in fact one of the latest developments in environmental thought in the last two decades, and aims to reduce the consumption of environmental resources, avoid the use of hazardous materials as much as possible, and raise the efficiency of the design Sustainable products in the fields (economic, social and environmental) and their production methods, as well as reducing

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emissions and waste during the production process and recycling of waste, and reducing the excessive consumption of resources harmful to the environment.

I-1- The Problematique: Through the above, the problematic features of this study are highlighted as follows:

What is the efficient role of the cleanest production in the industry of cement?

I-2- Sub-questions: From the previous problem, several sub-questions can be asked, including the following:

- How to produce cement?
- What is the concept of cleaner production?
- What effect does cleaner production have on the industry?

I-3-Study hypothesis: In order to address the problem of this study, the following hypothesis can be formulated:"Cleaner production is one of the most important innovative mechanisms aimed at optimizing the exploitation of resources as well as reducing pollution and toxic emissions in the cement industry".

I-4- The Importance of the study: The importance of the study stems from the special importance of the concept of cleaner production and its role in industry, as one of the important and modern topics that has received great attention in recent times, and since many industrial enterprises are still dominated by the obsession with cost, profit and production in large quantities without Taking into account the risks to the environment, industrial enterprises must change production patterns in accordance with market trends and standards of modern environmental industry.

I-5- The objectives of the study: The core objectives of this study can be summarized as follows:

- Learn about theoretical concepts about the cement industry;
- Learn about the role of cleaner production in industry.

I-6- Methodology of the study: This study was based on a descriptive analytical approach to clarify and interpretDifferent theoretical concepts related to the concept of cement industry and cleaner production, in addition to highlighting the effective role of clean production in the industry**.**

I-7- Study axes: The problem in this study can be addressed through the following topics:

- Theoretical concepts about the cement industry;
- Cleaner production and its role in the cement industry.

I-8- Previous studies: The most important studies on cleaner production and cement industry can be summarized in the following:

- **Study: Mahmood Zohoori and others (Relationship between Cleaner Production, Environmental Management, and Sustainable Product on Performance, 2017):**The study aims to link cleaner production and environmental management to sustainable products, innovation and performance. Based research also focused solely on financial performance, while this study applied a balanced performance card model for this purpose. As shown in the proposed framework of this study, cleaner production and environmental management can affect sustainable product innovation and thus performance (financial, customer satisfaction, learning and growth, and the internal process).

- **Study: Eliana Andrea Severo and others(Cleaner production, environmental sustainability and organizational performance: an empirical study in the Brazilian Metal-Mechanic industry , 2015):**This study found that the cleaner production mechanism affects practices on environmental sustainability, as well as on organizational performance, as cleaner production methodologies contribute to increasing and improving production capacity and flexibility, and finally, it should be noted that companies in Gaúcha Serra tend to become committed to environmental sustainability, the well-being of their employees, society, and the environment.

- Study:HrvojeMikulcic and others (Improving the sustainability of cement production by using numericalsimulation of limestone thermal degradation and pulverized coalcombustion in a cement calciner, 2014): The study found that the cement industry is one of the largest industrial sectors emitting carbon emissions, and given the impact of global warming, sustainable

cement production is increasing. The control of coal combustion and the thermal degradation of limestone, the two main chemical thermal processes that occur within the cement calciter, are of great importance, as these processes have a direct impact on cement quality, pollutant formation and overall energy efficiency of cement manufacturing.

- study: Emad Benhelal and others (Global strategies and potentials to curb CO2 emissions in cement

Industry, 2013): And, here the global strategies and potential towards reducing CO2 emissions in the cement plant were studied, and it was very promising. Moreover, the barriers to the dissemination of these strategies worldwide are specific and comprehensively described. Three strategies for reducing CO2, including energy saving and carbon separation, as well as the use of alternative substances, have been reviewed in detail. In the case of an energy saving approach, switching to a more efficient process for example from wet to dry with calciner, shows the best results since it likely reduces up to 50% of the required energy and mitigates nearly 20% of CO2 emissions in the process.

II- Theoretical concepts about the cement industry:

II-1- Definition of cement: At the basic level cement is a binding substance that is intended for use in building or construction material and can withstand varying environmental conditions. The four elements necessary for its creation are iron, aluminum, silicon, and calcium. These elements are burned together in a kiln and are finely pulverized to create the powder and used as an ingredient of mortar and concrete we then call cement. This powder hardens once it is mixed with water but water does not break the bond once it is formed. About 75% of cement production is used in ready mixed concrete to be utilized in construction. The remaining 25% is used for paving roads or extracting oil.

The most common type of cement is Portland. This category is divided roughly into gray and white: gray is the most well-known –most people refer to it when they say the word cement. White is the aesthetic alternative of gray which is used in buildings that have an aesthetic component: churches, museums, etc. Gray Portland is made from clinker and an additional substance usually calcium sulfate. On the other hand, white Portland is made from limestone, kaolin, and gypsum. A less common type of Portland cement is referred to as Pozzolana Portland cement. It is used in buildings which expect to be exposed to constant high humidity or water and it is made out of clinker, gypsum, and natural pozzolana —a raw material of volcanic rock and ash. Finally, there is a special type of cement utilized in extraction of oil and withstands high pressure areas called Oil-well cement. While other types of cement exist, the most important are gray and white Portland cement as they comprise the bulk of cement utilized in constructing roads, buildings, and other structures(Tarek H, 2010.).

II-2- The cement production process:A short description of cement production is provided to improve the reader's understanding of this process, The main raw materials for cement production are limestone and marl. The stones are quarried, crushed and ground to a raw meal. Before the raw meal is fed into the kiln, it passes a cyclone tower with a precalcinator, where the temperature rises to approximately 950 °C (not all cement plants are equipped with a precalcinator). During this calcining process, CaCO3 thermally decomposes to CaO and CO2, and the latter leaves the system. In the rotating kiln, the material moves slowly towards the burner in the end of the kiln, where the temperature is 1450 °C, and the material is converted to clinker. Finally, the clinker is ground in a cement mill with the addition of approximately 5% of gypsum to achieve the desired cement quality. The cement is now ready and is stored in cement silos ready to be sold and used, See Figure(01), which shows the cement production process(B. von Bahr, 2003).

II-3- The pros of the cement industry:

II-3-1- Uses of Cement: Following are the different uses of cement in construction works:(Home)

II-3-1-1- To Prepare Cement Mortar: Cement mortar is like a paste which is prepared by adding certain quantity of water to cement and sand mixture. Cement in this case is denoted as matrix while sand is termed as adulterant.

We know Cement has good binding properties while there are other binding materials are also available, but cement is mostly used because of its high strength and water resisting properties. It is used to create a strong bond between bricks, stones in a masonry.

Plastering is done by cement mortar which gives smooth finish to the structure. Cement molds of different shapes can be made using cement mortar. It is also used to seal the joints of brickwork and stone work or cracks.

Generally, the cement sand ratio in a mortar is in between 1:2 to 1:6. The ratio of cement and sand mix is decided based on the importance of work.

II-3-1-2- To Prepare Cement Concrete: Cement concrete is a major building material in the world which is widely using because of its marvelous structural properties. The ingredients of cement concrete are cement, fine aggregate, coarse aggregate and water respectively.

In general, ordinary Portland cement is used to prepare concrete. But for special cases or based on different circumstances many types of cements like rapid hardening cement, high alumina cement etc. are discovered.

II-3-1-3- To Build Fire Proof or Heat Proof Structures: To with stand against high temperatures and to prevent fire accidents structures should be built with great fire-resistant materials like cement. High alumina cement is more suitable material to make concrete for the structures in high temperature regions.

II-3-1-4- To Build Hydrographic and Frost Resistant Structures: Most of the hydrographic structures in the world are built using concrete with cement as binding material. The structures built in water or in contact with water should be very strong against moisture and they should be water tight.

Many types of cements like hydrophobic cement, expanding cement, pozzolana cement, quick setting cement etc. are most suitable for constructing water retaining structures. Quick setting cement is very much useful in the case when there is limited time to construct under water structures.

Hydrophobic cement had more resistance against frost actions, so it can be used to build structures in snow regions also.

II-3-1-5- To Build Chemical Proof Structures: In chemical industries, different chemicals are stored and they may damage the structure if proper resistance is not there. Acid resistant cement is very much useful in this case.

Similarly, for the constructions under marine conditions, sewage carrying structures etc. Sulphate resistant cement is useful.

II-3-1-6- For Grouting: Grouting is the process of filling cracks, joints, openings in foundations or any other structural members to improve their strength. In general, ordinary Portland cements is used as grout material to which required amount of water and sand is added.

To fill very fine cracks or to fill deep thin cracks micro fine cement is most suitable. Micro fine cement contains very finer particles than the ordinary Portland cement so it can flow into very fine and deep cracks in quick time.

II-3-1-7- To Construct Cement Concrete Roads: Cement concrete roads are more famous as high standard roads which are stronger than all other types of roads. They are also called as rigid pavements because of their rigid nature. C.C roads have long life span even without proper maintenance, Load wise also they are much capable than all other types.

II-3-1-8- To Manufacture Precast Members: Many precast members are made using cement as binding material. Cement concrete pipes are widely used as drains, pipes under culverts etc.

Cement concrete brick masonry is more famous because of the size of block, ease of construction and strength etc.

Water tanks and septic tanks are generally constructed by cement concrete rings. Many other things like garden seats, flower pots, dust bins, lam posts etc. are manufactured using cement.

II-3-1-9- For Aesthetic Structures: Now a day's cement is available in many colors. This is done by adding coloring agent while manufacturing cement but the percentage of coloring agent should be below 10%. Some of the coloring agents are iron oxide which gives red or brown, cobalt which gives blue etc.

The colored cement makes the structure beautiful without any painting. Colored cements generally used for floor finishing, stair treads, window sill slabs, external wall surfaces …etc.

II-4- Cons of cement industry:

II-4-1- Emissions from Cement Industry: Cement manufacturing is a "high volume process" and correspondingly requires adequate quantities of resources, that is, raw materials, thermal fuels and electrical power. The main environmental (air quality) impacts of the manufacture of cement in general are related to the categories as:(K.Syamala Devi, 2017)

II-4-1-1- Gases & VOCs: Gaseous atmospheric emissions of CO2, NOx, SO2, Volatile Organic Compounds (VOCs) and others Carbon dioxide is released during the production of clinker, a component of cement, in which calcium carbonate (CaCO3) is heated in a rotary kiln to induce a series of complex chemical reactions. Specifically, CO2 is released as a by-product during calcination, which occurs in the upper, cooler end of the kiln, or a pre calciner, at temperatures of 600-900°C, and results in the conversion of carbonates to oxides.

Sulphur oxides and nitrogen oxides generated from the kiln and drying processes. Sulphur dioxide is generated from the sulphur compounds in the ores and the combusted fuel and varies in amount produced from plant to plant. The efficiency of particulate control devices is inconclusive as the result of variables such as feed sulphur content, temperature, moisture, and feed chemical composition, in addition to alkali and sulphur content of the raw materials and fuel. The combustion of fuel in rotary cement kilns generates nitrogen oxides from the nitrogen in the fuel and incoming combustion air.

The amount emitted depends on several factors including fuel type, nitrogen content, and combustion temperature. Both sulphur dioxide and some of the nitrogen oxide react with the alkaline cement and are removed from the gas stream.

Volatile organic carbon compounds (VOCs) are a class of chemicals that are emitted directly to the air as a result of evaporation or another type of volatilization. Sources include stored gasoline, stored solvents and other industrial chemicals, and certain industrial processes. Incomplete combustion of fuels of many types is also an important source of VOC discharge to the ambient air.

II-4-1-2- Dust: Dust emissions originate mainly from the raw mills, the kiln system, the clinker cooler, and the cement mills. A general feature of these process steps is that hot exhaust gas or exhaust air is passing through pulverised material resulting in an intimately dispersed mixture of gas and particulates. The nature of the particulates generated is linked to the source material itself, that is, raw materials (partly calcined), clinker or cement.

II-4-1-3- Noise: Noise emissions occur throughout the whole cement manufacturing process from preparing and processing raw materials, from the clinker burning and cement production process, from material storage as well as from the dispatch and shipping of the final products, The heavy machinery and large fans used in various parts of the cement manufacturing process can give rise to noise and/or vibration emissions, particularly from: chutes and hoppers, any operations involving fracture, crushing, milling and screening of raw material, fuels, clinker and cement; exhaust fans; blowers; duct vibration.

II-4-1-4- Bad Odour: Foul smell is sometimes a direct result of the gases emitted during cement manufacturing. Moreover, since cement manufacture has life threatening impacts to plants and animals, the manufacturing process then directly and indirectly gives rise to offensive smells as the dead plants and animals decay.

II-4-2- ENVIRONMENTAL & HEALTH IMPACTS: Climate change effects can occur on atmospheric temperatures, precipitation levels and patterns, water resources, terrestrial and aquatic habitats, threatened and endangered species, agricultural productivity, and many other natural and man-made resources.

The cement industry is an energy intensive and significant contributor to climate change. The major environment health and safety issues associated with cement production are emissions to air and energy use. Cement manufacturing requires huge amount of non-renewable resources like raw material and fossil fuels. It is estimated that 5-6% of all carbon dioxide greenhouse gases generated by human activities originates from cement production. Raw material and Energy consumption result in emissions to air which include dust and gases. The exhaust gases from a cement kiln contains are nitrogen oxides (NOx), carbon dioxide, water, oxygen and small quantities of dust, chlorides, fluorides, sulfur dioxide, carbon monoxide , and still smaller quantities of organic compounds and heavy metals. Toxic metals and organic compounds are released when industrial waste is burnt in cement kiln. Other sources of dust emissions include the clinker cooler, crushers, grinders, and materials-handling equipment.

These emissions are not only deteriorating air quality but also degrading human health. Emissions have local and global environment impact resulting in global warming, ozone depletion, acid rain, biodiversity loss, reduced crop productivity etc. Scientific evidence indicates that air pollution from the combustion of fossil fuels causes a spectrum of health effects from allergy to death. The results of several studies showed that these emissions are adversely affecting human health in a variety of ways, like itchy eyes, respiratory diseases like tuberculosis, chest discomfort, chronic bronchitis, asthma attacks, cardio-vascular diseases and even premature death.

NOx causes a wide variety of health and environmental impacts because of various compounds and derivatives in the family of nitrogen oxides, including nitrogen dioxide, nitric acid, nitrous oxide, nitrates, and nitric oxide. Similar to sulphur dioxide, NOx react with water and other compounds to form various acidic compounds. When these acidic compounds that are deposited to the earth‟s surface, they can impair the water quality of different water bodies and acidify lakes and streams. Acidification (low pH) and the chemical changes result in making it difficult for some fish and other aquatic species to survive, grow, and reproduce. Acid rain can also harm forest ecosystems by directly damaging plant tissues. Nitrous oxide is a greenhouse gas and it accumulates in the atmosphere with other greenhouse gasses causing a gradual rise in the earth's temperature. This will lead to global warming and climate change. NOx and volatile organic compounds react in the atmosphere in the presence of sunlight to form ground-level ozone, which causes smog in cities and rural areas. This ground level ozone when breathed, it causes respiratory disease and other health problems. Nitrogen dioxide affects body functions such as difficulty in breathing, chronic lung diseases, such as chronic inflammation and irreversible structural changes in the lungs, which with repeated exposure, can lead to premature aging of the lungs and other respiratory illness.

The principal harmful effects of VOCs are toxicity, possible contribution to smog via photochemical reactions in the atmosphere, and possible contribution to the “greenhouse effect” and consequent global warming (Woodard). Dust emissions have been linked to respiratory problems such as Tuberculosis(K.Syamalsa Devi, 2017.).

III- Cleaner production and its role in the cement industry

III-1- Definition of cleaner production:

- Cleaner production is known asis a "systematically organized approach to production activities, which has positive effects on the environment. These activities encompass resource use

minimization, improved eco-efficiency and source reduction, in order to improve the environmental protection and to reduce risks to living organisms(Peter Glavic, 2007.)", See Figure (02) which illustrates the concept of cleaner production.

III-2- Benefits of Cleaner Production: The most important benefits of cleaner Production is the following:(Ministry of Environment F. a., 2016.)

III-2-1- Less use of raw materials and energy: The most convincing benefit of cleaner production is its ability to reduce the consumption of resource and materials. Savings in energy and materials bring direct reductions in production costs, which again make the company more competitive. With increasing cost of raw materials, energy and water, no company can afford to lose these resources in the form of waste.

III-2-2- New and improved market opportunities: Increasing consumer awareness of environmental issues has led to a spurt in demand of green products in the international market. Consequently if you put in conscious efforts towards cleaner production, you open up new market opportunities and produce better quality products, saleable at a higher price.

III-2-3- Better access to finances: Investment proposals based on cleaner production contain detailed information on the economic, technical and environmental feasibility of the planned investment. This gives a very solid basis for achieving financial support from banks or environmental funds. On the international market, financial institutions are awakening to the problems of environmental degradation, and are now scrutinizing applications for loans from an environmental angle.

III-2-4- ISO 14000 & ISO 50001: Cleaner production will make it much easier to implement an environmental management system such as ISO 14000 and energy management system ISO 50001, because most of the initial work already has been carried out through the cleaner production assessment.

III-2-5- Better working environment: Apart from improving the economic and environmental performance, cleaner production can also improve the occupational health and safety conditions for the employees.

Favorable working conditions can boost the morale of staff and at the same time foster a concern for controlling waste. Such actions will help your company gain a competitive edge.

III-2-6- Better compliance with environmental regulations: Meeting the regulatory standards for discharge of wastes (liquid, solid and gaseous) requires often installation of expensive and complex pollution control systems like wastewater treatment plants.

With cleaner production the treatment of residual effluents normally becomes easier and cheaper. This is because cleaner production leads to an all-round reduction in wastes: volume-wise; load-wise; and even toxicity-wise!**.**

III-3- Steps the cleaner production: The most important stages of cleaner production are the following:(Ministry of Environment F. a., 2016.)

III-3-1- Step 01:

- Ensure top management commitment;
- Form a cleaner production team;
- List process steps and identify waste streams;
- Prepare process flow charts; and
- Select focus areas.

III-3-2- Step 02:

- Make material and energy balances;
- Characterize waste streams;
- Assign costs and waste streams; and
- Identify causes of waste generation.

III-3-3- Step 03:

- Generate workable cleaner production options; and

- Sort options into: “directly implementable”; “needs further study”; and “rejected options”.

III-3-4- Step 04:

- Analyze technical feasibility of cleaner production options
- Analyze economic viability of cleaner production options
- Analyze environmental feasibility of cleaner production options; and
- Select cleaner production options for implementation

III-3-5- Step 05:

- Make cleaner production action plan;
- Implement the cleaner production options.

III-3-6- Step 06:

- Monitor and evaluate results;
- Report cleaner production results;
- Prepare for a new cleaner production assessment; and
- Continuously integrate cleaner production activities into daily management.

III-4- Impact Of Cleaner Production: Implementation of CP has successfully providing the promising effects to the manufacturing firms. The appropriate implementation of CP will influences the economic, environmental and manufacturing competency and provide as a basis practice of the circular economy. Through the proactive action, manufacturing firms could create additional business opportunities to establish the new way to manufacture the product for the sustainable development. In new sustainable manufacturing paradigm, CP can be fairly implement at the beginning stage of product development Literature shows that the implementation of CP can offer three main impacts on the sustainability development as follows:

- Impact on competency performance;
-; Impact on environmental performance
- Impact on economy performance.

These performance elements were the basis in providing a sustainable manufacturing system where the performance level identified influence by the successful implementation of CP. The relationships between CP practices with the three performance elements identified are illustrated in Figure (03).

The implementation of CP through the meticulous strategy provides a direct impact on the level of environmental and competency performance, thus contribute to the improvement in economic performance as illustrated in Figure (03.) Factors that mostly influence the competency performance are from the strict enforcement of laws and the increasing global awareness on environmental. This has urged manufacturing firms to take a proactive action to address any issues arising from their operations activities. Proper translational process towards CP primarily through successful innovation process will enhance this performance level, particularly through the development of environmentally friendly products. This further motivated the manufacturing firm to provide the best facilities and production system to meet the critical elements in product development and production stage. Integration of employees in this process will urge them to increase their knowledge and skills in ensuring the innovation processes are fully achieved. This will provide a better product design, better process optimization, better monitoring, better training and management in achieving sustainable manufacturing practices, See Figure (03), which shows the impact of cleaner production on sustainability performance.

Meanwhile, the increasing of environmental performance was mainly affected from the worthy practice in managing the environmental issues. Integration of each environmental requirements and laws in every stage of product development and production will lead to a new paradigm of sustainable manufacturing. Efficient use of recycled materials in material composition of products and selection of appropriate manufacturing system will reduce the consumption of natural resources and energy. This will ensure waste and pollution generated from the manufacturing activities will be minimized. Attain the higher level of energy and resource

management will improve the environmental performance continuously from a proper establishment of manufacturing process standard.

High performance in both environmental and competency elements will directly influence the level of economics performance. Reduction of material use in production and careful planning in the selection of efficient technology and equipment will reduce the total investment cost. Reduction in raw material, energy costs and waste disposal costs will provide a beneficial economic impact to the manufacturing firm. Trade-off between sustainability cost and technology of proper CP practice will benefit to the economic growth. Manufacturing firms with good financial performance will have ability to provide additional budget and make additional investments in equipment, technology and provide more training to enhance the skills of their employees with new approach in dealing with environmental legislation requirement. The worthy level of economic will become the main input in improving the environmental and competency performance of the manufacturing firm(Yusup, 2013, Not mentioning the page).

III-5- cleaner production process: See Figure (04), which shows the process of cleaner production**.**

III-6- Environmental actions and cleaner production: Reactions to environmental problems began with local movements in the 1960s, leaving the place to environmental organizations and parties in the 1970s. The Quality Management System (ISO 9000), published by ISO in 1987, forced industrialists to contemplate the environment by minimizing the raw materials usage, reducing the use of energy in processes or searching for clean energy sources, using non-harmful packaging materials and destroying them easily. Therefore, cleaner production and sustainability have been offered as solutions to environmental problems. The concept of "cleaner production", which is often used in many countries, has evolved into the concept of "sustainable production" in the last 10 years in order to prevent possible future bigger catastrophes. Sustainable production has become widespread with the cleaner production concept used by many organizations.

Cleaner production definition was made by UNEP in 1989 as “continuous application of an integrated, preventive environmental strategy towards processes, products, and services in order to increase overall efficiency and reduce damage and risks for humans and the environment”. Later, this definition was widened via joining the sustainable development orientation. For example, in 2004, direct participation in the economic dimension of recognition by means of "using better management strategies, methods, and tools" was provided. Cleaner production has been applied as for production processes; protection of raw materials and energy, removal of poisonous substances and accordingly abatement of toxic emissions and waste of products, for products; preventing or reducing the adverse effects of a product throughout the life cycle, for services; including environmental anxiety to design and distribution services. In summary, cleaner production; continuous implementation of an environmental protection strategy integrated with processes, products, and services.

The first approach, which is used extensively to protect environmental values, is to eliminate pollution after it has been formed. "Pollution control", also referred to as the "end of pipe” approach focuses on the ways in which production and design phases are invariably adopted, and that pollution is the inevitable consequence of this, and therefore the better definition and elimination of pollution. This brings significant additional investment costs to the organization and high investment requirements are met with frustration by individuals or institutions in some areas and countries. Continuous increase in the amount of wastes generated in the process and the cost of the purification treatments, the continuous improvement of the receiving environment discharge standards and the environmental consciousness of public has forced the product and service sectors to find cheaper solutions. As a result of this tendency, with simple measures, more effective use of raw materials that do not form beneficial products at the end of production and become waste, they have been seen that these losses are reduced, therefore, waste production can be reduced. This has been followed by approaches such as increasing the productivity, replacing the raw materials with those less harmful to the environment and reducing water and energy needs in the production and

usage processes. These have contributed to the acceleration of work on waste reduction, recycling, reuse, environmentally sensitive product and service design, etc. and ensured that the "cleaner production" approach instead of the "end of pipe".

IV- The conclusion:

Cleaner production in the industry is the best way to reduce pollution, it works to achieve balance in three ways at the same time, by maintaining energy and water by reducing its expenses and excluding hazardous materials with less hazardous materials, as well as reducing emissions and waste generation, following the strategy of cleaner production It will rely on advanced global technologies and technologies and this allows access to an environmentally friendly product with the lowest costs, fewer and better resources, which can reach the right environmental label.

IV-1- Testing the hypothesis of the study: The study's hypothesis is: 'Cleaner production is one of the most important innovative mechanisms aimed at optimizing the exploitation of resources, as well as reducing pollution and toxic emissions in the cement industry', through this research has been found to confirm the validity of this hypothesis as cleaner production is a fundamental pillar on which the various economies of the world depend for sustainable green economies, due to their positive effects by pushing for such clean innovations and productions and working on their success and providing necessary in order to reduce pollution rates from.

IV-2- Study results: Through this study, a series of results were reached, the most important of which are:

- Cement is a vital and necessary material for use in construction work, and is characterized by the characteristic of withstand the different environmental conditions;
- One of the most important uses of that find (To Prepare Cement Mortar, To Prepare Cement Concrete, To Build Fire Proof or Heat Proof Structures, To Build Hydrographic and Frost Resistant Structures, To Build Chemical Proof Structures, For Grouting, To Construct Cement Concrete Roads, To Manufacture Precast Members);
- Cleaner production is a systematically organized approach to production activities, which has positive effects on the environment. These activities encompass resource use minimization, improved eco-efficiency and source reduction, in order to improve the environmental protection and to reduce risks to living organisms;

One of the benefits of cleaner production is that we find (Less use of raw materials and energy, New and improved market opportunities, Better access to finances, ISO 14000 & ISO 50001, Better compliance with environmental regulations, Better working environment);

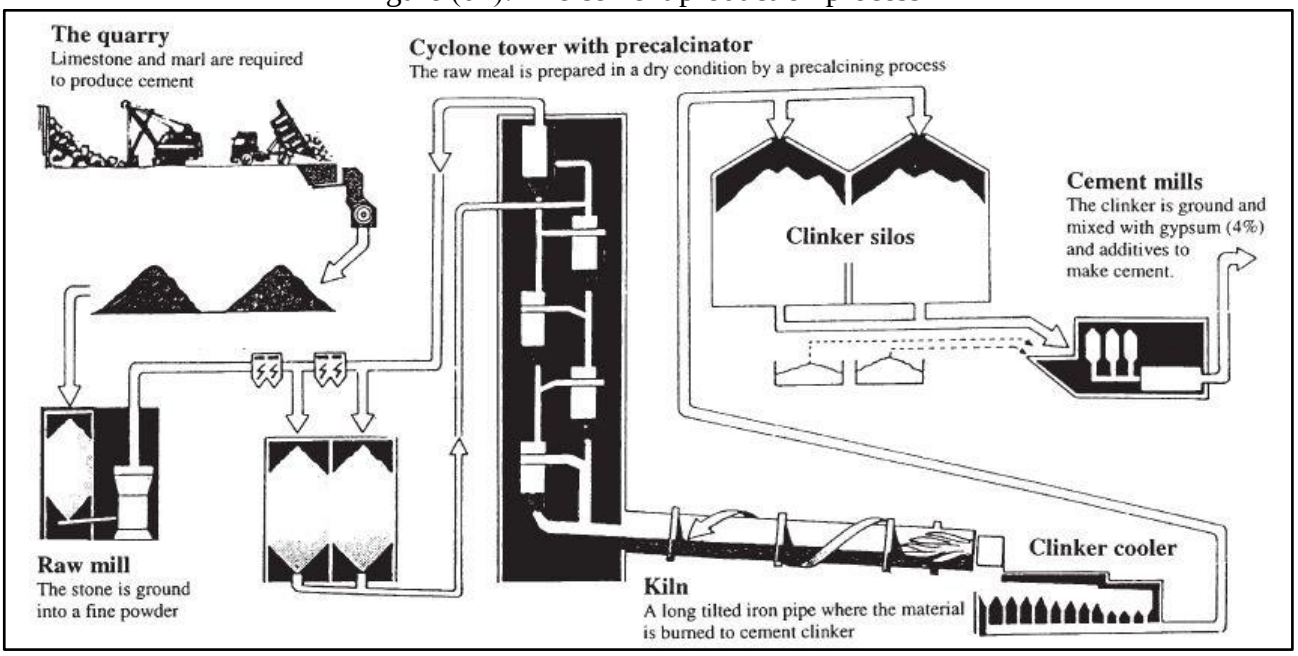
- The effective role of cleaner production lies in the cement industry by reducing pollution, preserving resources and preventing waste, as well as reducing emissions and generating waste, in addition to cleaner production is a mechanism and method for producing environmentally friendly products.

IV-3- Study recommendations: Through this study, a series of proposals were reached, the most important of which are:

- Review industrial enterprises to reduce pollution, rationalize energy use, rationalize natural resource consumption and seek renewable alternatives;
- Avoid the use of toxic and hazardous substances in production and manufacturing processes;
- Reducing emissions and residues at various stages of manufacturing, production and use by recycling and recycling waste;
- Modifying the techniques used in manufacturing and production processes and using modern environmentally friendly technologies such as cleaner production.

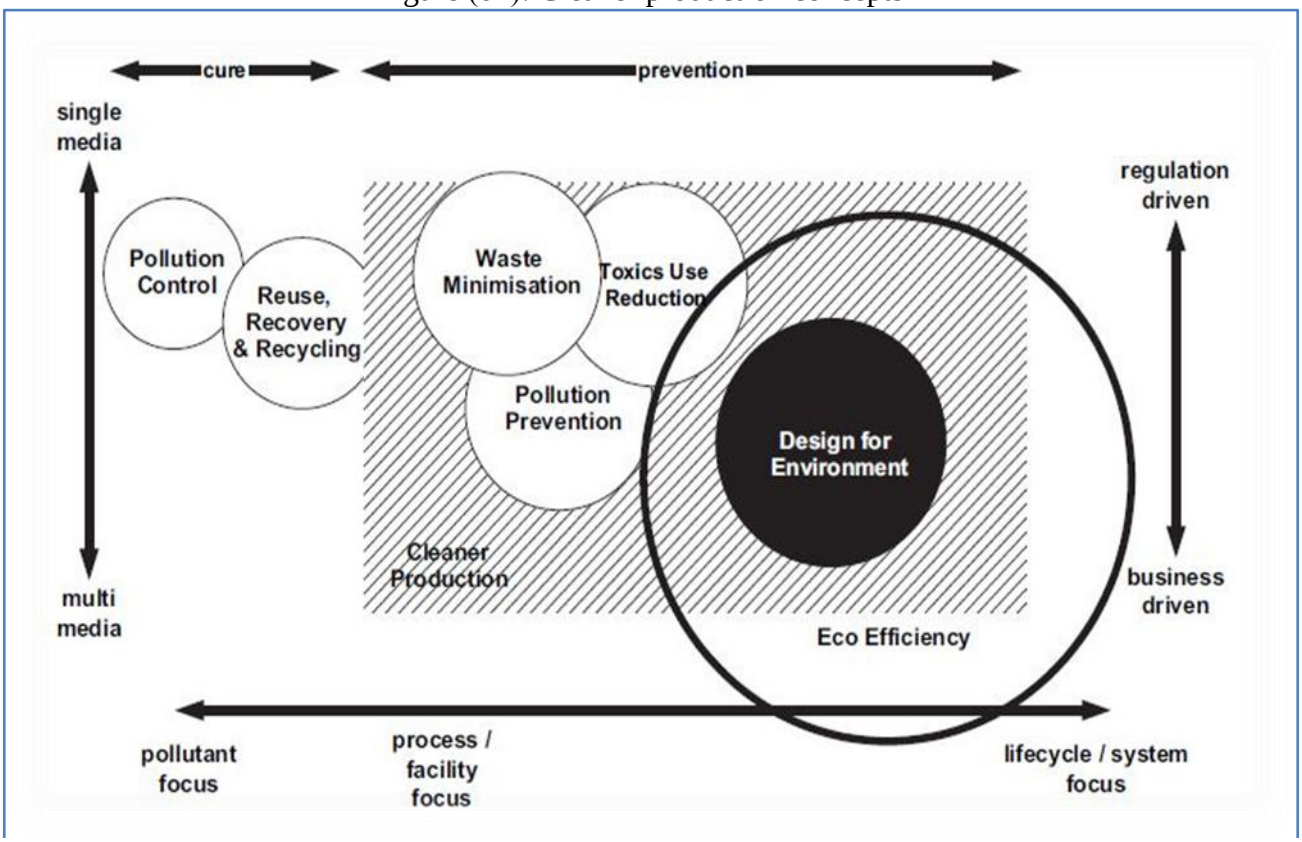
- Appendices:

Figure (01): The cement production process



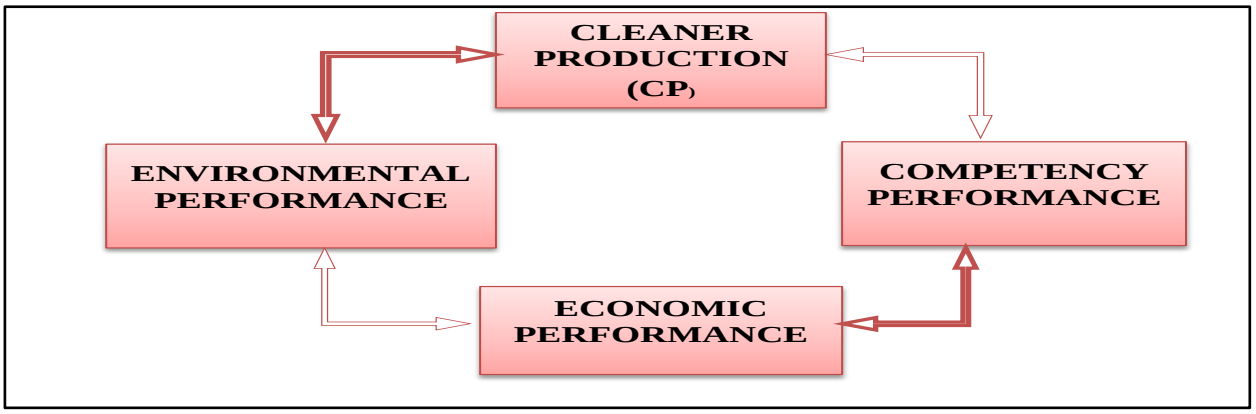
The Source: (B. Von & and others, 2003, p. 175)

Figure (02): Cleaner production concepts



The Source: (Rene, Cleaner production and eco-efficiency initiatives in Western Australia 1996-2004, 2006, p. 03)

Figure (03): The impact of CP on sustainability performance



The Source: (Muhamad, 2013)

Figure (04): cleaner production process

The Source: (Guidance Notes on tools for pollution managment)

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