



APPROPRIATE METHODS FOR ANALYZING ENVIRONMENTAL COSTS AND ITS ROLE IN IMPLEMENTING THE STRATEGY OF ENVIRONMENTAL EFFICIENCY AND PROTECTING THE ENVIRONMENT FROM POLLUTION-AN APPLIED STUDY IN KARBALA CEMENT FACTORY

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Article history:	Abstract:
Received: 26 th November 2025 Accepted: 24 th December 2025	The research aims to determine the appropriate methods for analyzing environmental costs and showing the importance of this in implementing the strategy of environmental efficiency and protecting the environment from pollution to help provide information on environmental costs and on the efforts and amounts spent to protect the environment and to reach accurate results that show the extent of the company's success in achieving its environmental goals. Activity-based costing was used to examine the environmental costs in the Karbala Cement Factory, one of Southern Cement Company's operations, using data from the fiscal year 2022. The study came to a number of results, the most significant of which was that environmental costs might be analyzed using the costing technique based on laboratory operations, or the research sample. Also, analyzing environmental costs in this way can help implement the environmental efficiency strategy and provide information on environmental costs and on the efforts and amounts spent to protect Environment and reaching accurate results that show the extent of success in achieving environmental goals.

Keywords: Environmental costs, activity-based costing (ABC) technique, environmental efficiency strategy, environmental pollution.

INTRODUCTION:

Environmental pollution from companies not only threatens society, But the continued pollution and destruction of natural resources also harms economic interests. With the enactment of environmental laws, industrial companies engaged in polluting activities have come under scrutiny. Through appropriate and environmentally responsible garbage disposal, environmental organizations are advocating for the preservation of the environment and the sustainable use of its natural resources for future generations. Cement plants in Iraq cause significant pollution through the use of outdated technologies that release large quantities of dust into the air. Cement dust rises over residential areas near Iraqi cement plants, some of which are located up to a kilometer away. Despite this distance, the dust's effects on human health are clearly noticeable. In addition, industrial facilities dump waste in open areas near main roads or into rivers. These pollutants also have negative impacts on human health. Therefore, industrial areas should be separated from residential areas and modern methods used to protect the environment from pollution should be implemented.

The first topic: research methodology and previous studies

1-1 Research Methodology:

In this paragraph, the research problem, objectives, significance, hypothesis, scientific approach, and sample will be examined.

1-1-1 Research problem:

The research problem lies in the lack of interest among Iraqi industrial companies in analyzing environmental costs, which could provide information on the costs, efforts, and expenditures related to environmental protection. The research problem centers on the following question: Does analyzing environmental costs using activity-based costing (ABC) help in implementing an environmental efficiency strategy?



1-1-2 Research importance:

The significance of the study stemmed from the necessity of using activity-based costing technology to analyze environmental expenses, as well as an indication of how these costs contribute to the implementation of the environmental efficiency strategy in a manner commensurate with the changes and developments accompanying the contemporary manufacturing environment, as calculating and analyzing environmental costs on the basis of activities gives accurate identification The environmental costs of each of the activities within the company and work to reduce the environmental costs of each activity through the implementation of the environmental efficiency strategy effectively and efficiently.

1-1-3 Research objectives:

The research aims to determine the appropriate methods for analyzing environmental costs and showing the importance of this in implementing the strategy of environmental efficiency and protecting the environment from pollution to help provide information on environmental costs and on the efforts and amounts spent to protect the environment and to reach accurate results that show the extent of the company's success in achieving its environmental goals.

1-1-4 Research hypothesis:

The research is based on the following basic hypothesis: (The analysis of environmental costs using the activity-based costing technique helps in implementing the strategy of environmental efficiency and protecting the environment from pollution).

1-1-5 Research methodology:

Both the deductive and the inductive approaches were used to accomplish the research's goals. Theoretically, the deductive technique was used, depending on the researchers' findings from the sources found in books, journals, scientific treatises, and studies pertaining to the research topic. In the applied portion of the study, either an interview and field coexistence were used to apply the inductive approach. Officials in the research sample, and review documents, financial reports, records, performance reports, production reports, pollution control reports, analytical statements, in addition to the laws and instructions for the research sample.

1-1-6 Research sample:

The research sample is represented by one of the factories affiliated to the General Company for Al-Jununiah Cement, which is Karbala Cement Factory for the financial year 2022 data, because it is close to the current reality of the factory's performance from other years. Environmental efficiency strategy.

1-2 Previous studies and the contribution of the current research:

This paragraph will discuss earlier research on the subject of the current study and provide an indication of the contribution of the current study and how it differs from earlier research.

1-2-1 Previous studies:

Previous studies that related with current research topic can be illustrated as follows:

1. **A study (Norman,2015) entitled "(Cost and Environmental Impacts in Manufacturing: A Case Study Approach)":** The study aimed to analyze the interplay between sustainability and costs. This analysis identifies where most environmental impacts occur in the manufacturing process and compares them to costs. The study concluded that most environmental impacts from companies occur during the raw material stage and that optimizing production processes reduces these impacts. Furthermore, improved production not only contributes to a cleaner environment but also saves companies money.
2. **A study (Ali,2016) entitled "(Environmental costs and their role in improving accounting information provided for decision-making - a field study in industrial companies)":** This study sought to elucidate how environmental expenses contribute to the provision of appropriate data for administrative decision rationalization. The study concluded that environmental costs were not taken into account in the companies studied due to a lack of qualified personnel, insufficient environmental awareness, the absence of Iraqi laws on environmental accounting, and their inadequate enforcement. The study also discovered that the environment, its natural resources, and human health are all negatively impacted by industrial development.
3. **A study (Omar, 2017) entitled "(Environmental Cost Accounting and its Role in Improving the Quality of Financial Reports - A Field Study on Industrial Companies in the Industrial Zone, Khartoum)":** The purpose of this study was to emphasize how crucial cost accounting is to enhancing productivity in Sudanese industrial companies. Additionally, it looked at how various environmental costs are



presented in financial reports. The study came to the conclusion that by offering data on recycling and industrial enterprises' environmental performance, environmental cost accounting enhances the quality of financial reports.

4. **A study (Aziz, 2018) entitled ("The Role of Accounting Disclosure of Environmental Costs in Iraqi Industrial Companies - An Applied Study on Some Companies Listed in the Baghdad Stock Exchange"):** The purpose of this study was to show how crucial it is for Iraqi industrial enterprises to disclose environmental expenses in their accounting in order to remain competitive. The study came to the conclusion that environmental accounting is essential to industrial enterprises' competitiveness and that measuring, documenting, and revealing environmental consequences in these businesses affects both the environment and our daily lives.
5. **A study (Ammar and Bin Wahid, 2018) entitled ("The Impact of Environmental Costs on Quality Costs in Algerian Industrial Enterprises - A Case Study of Biskra Province"):** The aim of this study was to identify environmental costs and quality costs and to examine their relationship in Algerian industrial companies. Quality costs were considered the independent variable and quality costs the dependent variable. The study concluded that the industrial plants examined incur environmental costs, which manifest themselves in costs for prevention, assessment, and disruption. Furthermore, a correlation was found between environmental costs and prevention costs in Algerian industrial plants, achieved through employee training and continuous production improvements.
6. **A study (Ibrahim, 2019) entitled ("The Impact of Environmental Cost Measurement on the Rationalization of Administrative Decisions - A Field Study on a Sample of Industrial Companies in Khartoum State"):** This study aimed to identify environmental costs and their various types, and to clarify the extent to which companies consider environmental costs and contribute to environmental protection. The study concluded that measuring environmental costs contributes to pollution prevention and protection, that management's focus on cost measurement strengthens internal and external relationships, and that measuring environmental costs increases profitability.

1-2-2 The contribution of the current research and its difference from previous studies:

The contribution of the present study and its differences from previous studies can be explained as follows:

1. The current study connected the strategy of environmental efficiency with the analysis of environmental costs based on activities and dealt with the importance of cleaner production and the obstacles that prevent the application of the strategy of environmental efficiency in the research sample.
2. An analysis of environmental costs based on activities and an indication of their influence on the environmental efficiency strategy were included in the current study within the research sample by dividing and tabulating the environmental costs, each according to the most appropriate activity for it, so that each section of the environmental costs is accurately identified using non-productive activities and activity Sediment removal, pollution control activity, gaseous emissions, and prevention activity, as these activities help to know what costs have been charged to its various departments and work to implement the environmental efficiency strategy successfully and protect the environment from pollution.

The second topic: the theoretical framework of the research

2-1 The concept and importance of environmental costs:

Environmental costs are defined as the total costs incurred by the business to prevent, lessen, or compensate for environmental harm caused by its operations. Environmental costs are defined as the expenses incurred by the business to prevent, reduce, or repair environmental damage, to reduce environmental impacts, and to reduce environmental risks (Rakos & Antohe, 2014:168).

Environmental costs include all expenses that have a direct financial impact on the business, people, society, and the environment in order to prevent, detect, and report all environmental impacts. They are both internal and external costs associated with environmental damage and protection from these damages. They also include the treatment and prevention of waste and emissions (Keit, 2011:12).

Environmental costs include all elements of costs related to reducing losses in services, economic resources, and available energy, in addition to the cost of recycling waste, meaning that environmental costs have a positive return, because they identify and measure costs related to available and used economic resources (Ali, 2016: 530).

The amount of money spent by the business to both improve productivity and safeguard the environment is known as environmental costs. Given the notion of environmental costs, the business needs to consider the following: (Nasser and Al-Khaffaf, 2012: 70)



1. Elimination of environmental pollution through the use of materials that are less harmful to the environment.
2. Preventing the depletion of natural resources.
3. Work to protect the environment and preserve the environmental areas and resources surrounding the company and provide assistance to social organizations working in the environmental field.
4. Eliminating environmentally hazardous industrial waste by selecting suitable disposal techniques.

As for the importance of environmental costs, its importance is highlighted by the following: (Selig, et.al., 2012: 335), (Tayoub, 2016: 36), (Al-Lami, 2019: 39)

1. Providing appropriate environmental reports and information to decision makers.
2. The financial statements, when they include data on environmental costs, will contribute to improving the company's results and make them more reflective of the practical reality from the social angle.
3. The increase in environmental problems caused by the company to give the greatest amount of attention in the data of environmental costs and found itself in a special position, it must respond to social needs in order to avoid any penalties or legal procedures.

Thus, the environmental costs are the economic sacrifices that the economic unit spends in order to preserve the environment and protect it from the effects of environmental pollution caused by its industrial activities. And energy sources that are harmless, and its interest in accounting in terms of the environment and helps in preserving the environment, and also leads to the success and continuity of the company.

2-2 Classification of environmental costs:

When companies carry out their production activities, waste harmful to the environment is generated, so these companies spend environmental costs in order to reduce these wastes and protect the environment from pollution. The most important classifications of environmental costs can be clarified through the following: (Hojna & Kafkova, 2011:4)

First: Classification of environmental costs according to the causes of cost occurrence: Environmental costs can be classified according to the causes of cost occurrence as follows: (Mustafa, 2017: 8)

1. **Capital costs:** They are the costs incurred by the company to reduce the severity of harmful effects on the environment, such as the costs of dealing with harmful environmental emissions, for example, machinery and equipment that are purchased to treat pollution and harmful environmental emissions.
2. **Current costs:** These are expenses that the business bears in order to protect the environment, such as the running costs of the water and air treatment plant and the environmental protection system. These costs are allocated over a fiscal year and are included in the profit and loss statement.

Second: Classification of environmental costs according to activities: Environmental costs can be classified according to activities as follows: (Ammar & Bin Wadh, 2018: 40)

1. **Prevention Costs:** These are the costs incurred by all activities undertaken by the company to reduce or eliminate the causes of potential future negative environmental impacts. These costs are limited to the cost of redesigning production processes.
2. **Control Costs:** These are the costs incurred by the company's activities to monitor and control all sources of pollution within the economic unit. This includes activities involving the use of environmentally friendly materials, environmentally friendly production methods, and others.
3. **Inventory and Measurement Costs:** These are the costs incurred by the company's activities to measure and monitor potential sources of environmental damage, such as monitoring pollution levels in materials and other substances.
4. **Environmental Failure Costs:** These are the expenses incurred by the business's efforts to stop environmental harm that unavoidably resulted from earlier attempts to prevent it. This includes the costs of treating hazardous production waste and other related expenses.

Third: Classification of environmental costs according to their association with products: Environmental costs can be classified according to their association with products as follows: (Normann, 2015:167)

1. **Operating costs:** These are the costs directly associated with the products and include raw materials, equipment, operating costs, training, energy, costs of using buildings, workers, and these costs are borne in the traditional way on the products.
2. **Explicit costs:** These are the costs related to compliance with government laws and regulations. They are classified according to the company's accounting system as environmental costs, including the costs of treating air pollution from which factory smoke is emitted.
3. **Potential costs:** These are the expenses related to anticipated future occurrences that fall under the category of risk provisions, including fines, penalties, personal injuries, environmental accidents, and others.



4. **Legal costs:** These are government costs related to submission to government legislation, including reports, media expenses, permits, training, examinations, tests, complaints, and others.
5. **Implicit costs:** These are the costs that include other accounts that have an impact on the total costs, especially in the chemical, iron and steel, and paper industries. They also appear in other accounts within indirect industrial expenses.

Based on the foregoing, it can be said that the costs incurred by a company through its commitment to implementing measures to protect the environment from harmful environmental influences are referred to as environmental costs. Classifying environmental costs according to individual activities is the best method, as it provides a clear picture of these costs.

2-3 Steps of analyzing environmental costs on the basis of activities:

The problem of allocating and charging environmental costs is one of the most important problems faced by companies that still requires a radical solution, as we find that most companies are still using traditional methods of charging these costs, and to solve this problem it is possible to rely on the activity-based costing technique, and the steps for applying the analysis can be clarified Environmental costs based on activities through the following: (Drury, 2012:257)

1. **Determining environmental costs:** Environmental costs are determined based on a group of classifications within the company, which are the costs of producing units (commodity), costs of non-productive units (non-commodity), costs of removing sediment (solid waste), costs of controlling pollution and gaseous emissions, costs of prevention Research and development costs, and other costs (IFAC, 2005:54).
2. **Defining activities:** The process of identifying activities that consume environmental costs within the economic unit is one of the important steps in analyzing environmental costs on the basis of activities, as activities represent a process for assembling units or work duties required by the process of producing goods or providing services (Horngren, et.al., 2015: 172).
3. **Allocating costs to activity cost centers:** After the activities are identified within the company, the environmental costs that each activity consumes during a specific period are allocated and tracked separately. The objective of this process is to determine the amount of environmental costs that the company spends on each of these activities (Hens, et.al., 2018: 3324).
4. **Determining cost vectors for activities:** For the purpose of allocating environmental costs to all activity centers, a vector for environmental costs must be identified for all activity centers. When choosing the appropriate cost vector, the following must be taken into account: (Moors, et.al., 2015:656)
 - a. It should provide a good explanation of environmental costs across the entire activity cost pool.
 - b. Obtaining data should be relatively easy and identifiable with products.
5. **Charging the costs of activities to products:** This is the last stage in which the environmental costs are charged for each activity, and this is by collecting the environmental costs vectors for all activity centers, to determine the share of the cost of one unit of the environmental costs, by dividing all the environmental costs that activity on the total number of its units, then add the cost of each unit of each wave of a specific activity with the cost of the activity from the environmental costs to reach the cost of one goal "the productive unit" of the activities that were consumed (Al-Fatli & Al-Hasnawi, 276: 2016).

Accordingly, the analysis of environmental costs on the basis of activities requires five basic steps, which are the identification of environmental costs, the identification of activities, the allocation of costs to activity cost centers, the identification of cost drivers for activities and the charging of activity costs to products, and these steps must be adhered to in order to analyze environmental costs on the basis of activities correctly.

2-4 The relationship of environmental cost accounting based on activities to the strategy of environmental efficiency and environmental protection from pollution:

Efficiency: This approach is regarded as a more ecologically friendly method of production. In order to attain a particular economic outcome with the least amount of environmental impact, it seeks to minimize the environmental impact of the economic unit is products and to lessen the environmental harm related to the manufacture of each product over its whole life cycle (Al-Tami & Al-Zaidy, 2012: 220).

The goal of the environmental efficiency approach is to lessen or completely eradicate a product's environmental impact over the course of its life cycle. Using an environmental efficiency strategy helps reduce environmental costs and increase company profitability through the optimal use of economic resources (Al-Tami & Al-Zaidy, 2016: 266).

Environmental efficiency refers to the relationship between desired outputs and environmental impacts. Environmental efficiency is measured according to the following equation: (Al-Sultani, 2020: 35)

$$\text{Environmental efficiency} = \frac{\text{required outputs (quantity of production)}}{\text{environmental impacts (quantity of waste and waste)}}$$



The efficiency strategy is used to measure the environmental costs of the economic units, and accordingly, environmental cost accounting provides the information needed to apply the environmental efficiency approach, which calls for knowledge of the physical movement of materials (Nowak & Cichy, 2008:7).

The quantity of production and environmental waste determines the economic unit is measurable environmental efficiency. When applying the cleaner production performance strategy that requires a reduction in environmental impacts (the amount of waste and emissions), the environmental impacts can be reduced within the economic unit and thus improve environmental performance and increase productivity, through the use of The following equation: (Schaltegger, et. al., 2008:9)

The amount of dust and sediment after applying the environmental efficiency strategy = the amount of dust and sediment ÷ the amount of production

Using the above equation helps the company's management to reduce environmental impacts (from the amount of waste and emissions) and thus enhance environmental performance and boost output in a way that is appropriate for the demands of the modern industrial environment (Wairon, 2018:12).

The consumption of raw materials, black oil, other petroleum materials, oils, grease, and electrical energy used in the economic unit in large quantities requires a reduction of these main used materials through the application of the cleaner production performance strategy through the use of the following equations: (Tsang, 2009:10)

The amount of reduction in the quantity of raw materials = (the amount of raw materials ÷ the quantity of production) x 100%

The amount of reduction in the amount of electrical energy = (the amount of electrical energy ÷ the amount of production) x 100%

It is clear from the foregoing that there is a relationship between environmental cost accounting based on activities and the environmental efficiency strategy, as this can provide management with indicators that help implement the environmental efficiency strategy and protect the environment from pollution.

The third topic: the applied side of the research

3-1 An introductory brief about Karbala Cement Factory:

One of the General Company's factories is Karbala Cement Factory. One of the most significant businesses under the Iraqi Ministry of Industry and Minerals is the Southern Cement Company, specializes in the production of various types of cement, including sulfate-resistant and ordinary cement. Founded in 1984 by the German company Krupp Polysius, it is located in the Karbala Governorate, in the Al-Hajj Al-Bari district, with a design capacity of 1,862,000 tons per year. The company utilizes the dry process, which is characterized by its lower environmental impact compared to the wet process used by some other factories. Its main products are ordinary cement and sulfate-resistant cement. These products are distinguished by their high quality, which has led to a continuous increase in demand from both the public and private sectors, including traders and customers, despite the changes Iraq has undergone since 2003, most notably the opening of the Iraqi market to global markets, which led to a decrease in production levels. approved by the Ministry of Industry and Minerals.

3-2 Measuring environmental costs in Karbala Cement Factory:

For the purpose of measuring the environmental costs in the Karbala Cement Factory, each type of environmental costs must be identified in this factory, as there are four types of environmental costs in the factory, which are the costs of unproductive materials, the costs of sediment removal, the costs of controlling pollution and gaseous emission, and the costs of prevention. Clarification of environmental costs in Karbala Cement Factory during the year 2022 through the following schedule:

Schedule (1): Environmental costs in Karbala cement plant during the year 2022

No.	Details	Costs	Total cost
1	Unproduced material costs		
	The main raw materials	213644036	
	Water	21364403	
	energy	477138346	
	Secondary raw materials	192043122	
	Waste solids	172431691	
	Missing cement	331790192	
	Packing materials	8428907	
	Costs of black oil	2531391453	



	Oil and grease costs	278799746	
	Total unproductive material costs		4227031896
2	Descaling costs		
	Descaling costs		160401573
3	Costs of controlling pollution and gaseous emissions		
	Extinctions	169840593	
	Operating materials	1086213	
	Water and energy	1172616	
	Other	419574473	
	Total costs of controlling pollution and gaseous emissions		591673895
4	prevention costs		
	Operating materials and power for the laboratory	1234333	
	Protective number	233720124	
	External services	31105192	
	Other	150235607	
	Total prevention costs		416295256
	Total environmental costs		5395402620

Source: prepared by the researchers.

It is clear from schedule (1) that the costs of non-productive materials were in the amount of (4227031896) dinars, the costs of descaling removal were in the amount of (160401573) dinars, the costs of controlling pollution and gaseous emission were in the amount of (591673895) dinars, and the costs of prevention were in the amount of (416295256) dinars. Thus, the total environmental costs of Karbala Cement Factory during the year 2022 were in the amount of (5395402620) dinars, and the following schedule clarifies the components of the environmental costs as well as the proportion of each to the overall environmental costs in the Karbala Cement Factory in 2022:

Schedule (2): Elements of environmental costs in Karbala cement plant during the year 2022

No.	Details	Total environmental costs	Percentage
1	Unproduced material costs	4227031896	78.35%
2	Descaling costs	160401573	2.97%
3	Costs of controlling pollution and gaseous emissions	591673895	10.96%
4	Prevention costs	416295256	7.72%
	Total environmental costs	5395402620	100%

Source: prepared by the researchers.

It can be seen from schedule (2), that the percentage of unproductive materials costs to total environmental costs was (78.35%), the percentage of sediment removal costs to total environmental costs was (2.97%), and the percentage of pollution and gaseous emission control costs to total environmental costs was (10.96%), and the percentage of prevention costs to the total environmental costs was (7.72%). It is noted that the costs of non-productive materials achieved the highest percentage of environmental costs, which indicates that the Karbala Cement Factory has incurred additional environmental costs that it does not mean. The factory may reduce these costs and manage them effectively and efficiently in order to preserve the environment and protect it from pollution.

3-3 Analysis of environmental costs based on activities in the Karbala Cement Factory:

The following procedures must be taken in order to assess environmental costs based on operations at the Karbala Cement Factory:

1. **Determining the environmental costs:** the amount of environmental costs was determined in the previous paragraph, and the environmental costs of the plant amounted to (5395402620) dinars.
2. **Determination of environmental activities:** There are four environmental activities in the Karbala Cement Factory, which are the activity of handling non-productive materials, the activity of sediment removal, the activity of controlling pollution and gaseous emissions, and the activity of prevention. Note that these activities



are carried out by the factory in order to protect the environment from pollution represented by deposits and various gaseous emissions.

3. **Allocation of costs to activity cost centers:** Here, the amount of environmental costs spent by the laboratory on environmental activities is determined, as the costs of non-productive materials were in the amount of (422,703,1896) dinars, and the costs of removing sediment were in the amount of (160,401,573) dinars, and the costs of controlling pollution and emission The invader was in the amount of (591,673,895) dinars, and the costs of protection were in the amount of (416,295,256) dinars.
4. **Neutralization of cost vectors:** After the environmental activities have been determined in the Karbala Cement Factory, in this step the cost vectors will be determined for each activity, as the guide for the unproductive material handling activity is the cost of direct materials, and the guide for descaling activity is the operating hours of the machines, and the guide for the activity of descaling is the hours of operation of the machines. Pollution and gaseous emission control activity is direct work hours, and prevention activity is directed at indirect materials cost.
5. **Allocating costs of activities to products:** Karbala Cement Factory produces two types of products, which are resistant cement and ordinary cement. During this step, the share of each product in environmental costs is determined.

The environmental costs can be analyzed based on the activities of the Karbala Cement Factory during the year 2022 through the following schedule:

Schedule (3): Analysis of environmental costs based on activities in Karbala cement plant during the year 2022

Products	Activities	Amounts of environmental costs	Allocation basis		Environmental costs for each product
			Drivers	Calculations	
Resistant cement product	Non-productive material handling activity	4227031896	Direct materials cost	$15677990452 \div 22667453122$	2923635282
	Descaling activity	160401573	Machine operating hours	$11223 \div 18728$	96122749.56
	Pollution and gaseous emission control activity	591673895	Direct working hours	$10410 \div 14667$	419944449.9
	Prevention activity	416295256	Indirect material cost	$8908555342 \div 13667545231$	271342751.3
	Total	5395402620	-	-	3711045233
Ordinary cement product	Non-productive material handling activity	4227031896	Direct materials cost	$6989462670 \div 22667453122$	1303396614
	Descaling activity	160401573	Machine operating hours	$7505 \div 18728$	64278823.44
	Pollution and gaseous emission control activity	591673895	Direct working hours	$4257 \div 14667$	171729445.1



	Prevention activity	416295256	Indirect material cost	4758989889 ÷ 13667545231	144952504.7
	Total	5395402620	-	-	1684357387

Source: prepared by the researchers.

Schedule (3) shows that the resistant cement product's portion of environmental costs was (3711045233) dinars, whereas the regular cement product's share was (1684357387) dinars. It is clear that the resistant cement product may bear more environmental costs than the ordinary cement product, due The reason for this is the different nature and quantities of materials involved in the manufacture of these two products.

The environmental costs can be distributed on the basis of activities for each product in the Karbala Cement Factory for the year 2022, as shown in the following schedule:

Schedule (4): Distribution of environmental costs based on activities for each product in Karbala Cement Factory for the year 2022

No.	Details	Resistant cement	Percentage	Ordinary cement	Percentage
1	Unproduced material costs	2923635282	78.78%	1303396614	77.38%
2	Descaling costs	96122749.56	2.59%	64278823.44	3.82%
3	Costs of controlling pollution and gaseous emissions	419944449.9	11.32%	171729445.1	10.2%
4	Prevention costs	271342751.3	7.31%	144952504.7	8.60%
	Total environmental costs	3711045233	100%	1684357387	100%

Source: prepared by the researchers.

Schedule (4) shows that the percentage of unproductive materials costs to the total environmental costs for resistant cement was (78.78%) and for ordinary cement it was (77.38%), and the percentage of descaling costs to the total environmental costs for resistant cement was (2.59%) and for ordinary cement it was (2.59%) (3.82%), and the percentage of pollution and gas emission control costs to the total environmental costs for resistant cement was (11.32%) and for ordinary cement it was (10.2%), and the percentage of prevention costs to the total environmental costs for resistant cement was (7.31%) and for ordinary cement it was (%) 8.60), and a high percentage of non-productive material costs when compared to other types of environmental costs.

3-4 Implementation of the strategy of environmental efficiency and protection of the environment from pollution by using environmental costs based on activities in the Karbala Cement Factory:

In order to implement the strategy of environmental efficiency by using environmental costs based on activities in the Karbala Cement Factory, to achieve a certain level of economic results with the least undesirable environmental impacts, it is necessary to reduce the environmental damage associated with the production of each product during its life cycle and reduce the environmental impacts of the products of the economic unit. Consequently, environmental costs must be reduced and the company's profitability must be increased through the optimal use of economic resources, which are linked to plans and policies and are related to operations or processors in the system.

In order to calculate the environmental efficiency of the research sample factory, the amount of production must be determined during the year 2022 amounting to (738500) tons for resistant cement and (102400) tons for ordinary cement, and the amount of dust and sediments must be determined before implementing the environmental efficiency strategy during the year 2022 amounting to (22500) tons for resistant cement and (12600) tons for ordinary cement. The environmental efficiency can be clarified before analyzing the environmental costs in the Karbala Cement Factory during the year 2022 through the following schedule:

Schedule (5): Environmental efficiency before analyzing the environmental costs in Karbala cement plant during the year 2022

Details	Resistant cement	Ordinary cement
Production quantity (tons)	738500	102400
÷ Quantity of dust and sediments (in tons)	22500	12600
= Environmental efficiency	32.82	8.13



Source: prepared by the researchers.

It is noted from schedule (5) that the environmental efficiency before analyzing the environmental costs in the Karbala cement plant for the resistant cement product was (32.82) and for the regular cement product was (8.13), as it is noted that the resistant cement product has higher environmental efficiency than the ordinary cement product.

When implementing the strategy of environmental efficiency in the Karbala Cement Factory, the amount of dust can be reduced from (10,200) tons to (8,600) tons for resistant cement, and from (4,200) tons to (2,800) tons for ordinary cement, and the amount of deposits can be reduced from (12,300) tons to (7,400) tons and from (8400) tons to (4200) tons for ordinary cement, indicating that the amount of dust and sediment will drop from 22500 tons to 16000 tons and from 12600 tons to 7000 tons for regular cement. The following schedule can be used to compare the amount of dust and sediment before and after the environmental efficiency strategy is implemented in the Karbala Cement Factory in 2022:

Schedule (6): The amount of dust and sediments before and after the implementation of the environmental efficiency strategy in Karbala Cement Factory during the year 2022

Details	Resistant cement	Ordinary cement
The amount of dust before implementing the environmental efficiency strategy	10200	4200
The amount of dust after implementing the environmental efficiency strategy	8600	2800
Sediment quantity prior to implementation of a cleaner environmental efficiency strategy	12300	8400
The amount of sedimentation after implementing the environmental efficiency strategy	7400	4200
The amount of dust and sediments before implementing the environmental efficiency strategy	22500	12600
The amount of dust and sedimentation after implementing the environmental efficiency strategy	16000	7000
The rate of reduction in the amount of dust and sedimentation after implementing the environmental efficiency strategy	28.89%	44.44%

Source: prepared by the researchers.

It is clear from schedule (6) that the rate of dust and sediment reduction following the application of the environmental efficiency approach for resistant cement was (28.89%) and for ordinary cement it was (44.44%), and this indicates the importance of analyzing environmental costs based on activities in making these improvements, and efficiency can Environmental before and after the implementation of the environmental efficiency strategy in Karbala Cement Factory during the year 2022 through the following schedule:

Schedule (7): Environmental efficiency before and after the implementation of the environmental efficiency strategy in Karbala Cement Factory during the year 2022



Details	Resistant cement	Ordinary cement
Production units (tons)	738500	102400
The amount of dust and sediments before implementing the environmental efficiency strategy (tons)	22500	12600
The amount of dust and sedimentation after implementing the environmental efficiency strategy (tons)	16000	7000
Environmental efficiency before implementing an environmental efficiency strategy	32.82	8.13
Environmental efficiency after implementing the environmental efficiency strategy	46.16	14.63

Source: prepared by the researchers.

It is noted from schedule (7) that the environmental efficiency in the Karbala cement plant during the year 2022 was before analyzing the environmental costs of the resistant cement product (32.82) and for the regular cement product (8.13), and the environmental efficiency after analyzing the environmental costs of the resistant cement product became (46.16) and for the product Ordinary cement (14.63), and this indicates that using the environmental efficiency method helps to lessen the impact on the environment (the quantity of trash and emissions), and the environmental effects can be reduced inside the factory and thus improve environmental performance and increase production capacity, as reducing environmental effects from the amount of waste and emissions leads to Improving environmental performance and protecting the environment from pollution.

It is clear from the foregoing that the analysis of environmental costs based on actions can support the environmental efficiency strategy's execution by providing the administration with indicators that help in implementing this strategy successfully and protecting the environment from pollution, as the consumption of raw materials, black oil, other petroleum materials, oils, grease and electrical energy used in The factory in large quantities requires the reduction of these main materials used through the application of the environmental efficiency strategy, and therefore it can be said that the analysis of environmental costs using the activity-based costing technique helps in implementing the strategy of environmental efficiency and protecting the environment from pollution, and thus the research hypothesis has been proven.

THE FOURTH TOPIC: CONCLUSIONS AND RECOMMENDATIONS

4-1 Conclusions:

The following findings have been drawn from the theoretical and applied research:

1. There is a possibility of analyzing environmental costs based on activities and providing the necessary information to improve environmental performance. These costs can be divided into non-productive environmental costs, sediment removal costs, pollution control costs, and prevention costs.
2. By dividing the environmental costs on the basis of activities, it was discovered that the company is primarily affected by non-productive environmental costs, and there is a connection between environmental costs based on activities and the environmental efficiency plan.
3. The Karbala Cement Factory has negative internal and external environmental effects, and the impacts of dust and flying dust on factory workers serve as a representation of the interior repercussions, while the external effects include negative effects on the residential community because the work site is in an agricultural area.
4. The Karbala Cement Factory did not follow any technology used to reduce or reduce environmental costs, as well as not following any method for separating environmental costs, which made it difficult to account for these costs.
5. Analyzing environmental costs is a representation of the steps involved in analyzing environmental costs based on activities identifying activities, allocating costs to activity cost centers, determining cost vectors for activities, and charging activity costs to products.



6. The environmental efficiency strategy's use aids in meeting environmental standards through the use of natural resources that are environmentally friendly, that is, it is a link to improving the product and reducing environmental impacts by using good resources.

4-2 Recommendations:

The following is a list of the most crucial suggestions based on the research's findings:

1. Management provides information on activity-based environmental cost analysis through cost measurement and monitoring.
2. Reducing the environmental impact of the Kufa Cement Plant, which negatively affects workers and the surrounding community, by purchasing modern dust collectors and filters, providing devices to measure harmful gas emissions, and training qualified personnel to measure and monitor these emissions.
3. Due to the high environmental costs at the Karbala Cement Plant, it is essential to provide equipment with lower emissions and energy consumption, achieve higher production efficiency, and install modern machinery and equipment in the plant's departments to minimize their environmental impact.
4. Implementing an environmental efficiency strategy at the Karbala Cement Plant is crucial, because it increases the rate of environmental efficiency, enhances environmental performance, and lowers waste in the plant to assist prevent pollution of the environment.
5. Implementing an environmental efficiency strategy that contributes to increased production volumes by reducing dust and sediment from raw materials and increasing overall output. Efficiency at the plant can be improved by replacing environmentally impactful materials with less impactful alternatives, or by modifying production processes that generate emissions or pollutants.
6. To implement an environmental efficiency strategy and protect the environment from pollution at the Karbala Cement Plant, the plant should reduce environmental costs by eliminating materials that do not add value to the product, providing support and incentives to engineers and specialized workers to adopt a cleaner production performance strategy, and introducing environmental modifications to the plant's product and implementing a cleaner production performance strategy by reducing pollutants and waste generated from its production processes..

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