

Green Innovation within Materials Flow Cost: Opportunities and Challenges

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Abstract: The paper tries to identify the opportunities and challenges of material flow cost accounting via the green innovation, the green innovation is crucial for the development of manufacturing operations as it supports the basic needs of the costumers including production, suppliers, workers. Lighting the problem of traditional cost systems that unable to provide sufficient data for management include waste and loss during production processes for focusing on the value of raw materials, energy and water generated during production processes .Thus reflected on the lack of production efficiency and lower product quality. The analytical quantitative approach was adopted to employ the material and energy flow cost accounting technique to identify opportunities for improvement in the production process of the produced green cement. The research reached several conclusions, the most important of which are sing the material flow cost accounting technique and green innovation, the variable costs decreased and at the same time the production efficiency increased by achieving less inputs than the outputs, as well as achieving technological change by changing the type of fuel in the furnaces.

1 INTRODUCTION

Recently, interest in environmental issues and their problems has increased clearly, as a result of many motives and pressures, including the shortage of available resources and energy and the high rates of environmental pollution, which caused many economic problems, including the high costs resulting from waste and loss of raw materials and energy resources, and the decrease in the productivity of natural systems due to Pollution, and the emergence of costs necessary to address environmental impacts, which necessitated the need to assist the administration in developing appropriate solutions to solve these problems(Baumer-Cardoso et al., 2020; Huang et al., 2019; Syarif & Novita, 2019). By resorting to material flow cost accounting, we can obtain a clear detail about the flow of materials at each stage of production and determine the amount of material and energy losses and their locations, and thus this data has an important role in assisting managers in making decisions that help in managing costs and reducing them appropriately to reach to better competitive levels(Huang et al., 2016). It also works to determine the flows of materials and energy through the value creation

system during a certain period of time and evaluate the potential of cleaner production at the unit level and the initial estimate of the costs of waste generation(Wahyuni, 2009). The main idea of material flow cost accounting is based on tracking material flows and energy use and is measured in terms of quantitative and financial units(ISO14051, 2011). Waste is seen as a type of product whose cost must be calculated, as is the case with good products, which helps economic units to determine the value that cannot be obtained as a result of wastage(Kokubu & Nakajima, 2004).

Green innovation can be described as improving productivity by economic units and making their production green, which contributes to continuous improvement and helps protect the environment and achieve sustainability(Abdullah et al., 2016). The green product is a green strategy that focuses on the impact of production on the environment, and emphasizes the elimination of environmental waste related to the unnecessary use of water, energy and greenhouse effects, without affecting the costs and costs of the product with the aim of protecting the environment and society(Farias et al., 2019). Innovation is a product that uses environmentally friendly materials that can self-degrade while

following their life cycle stages to ensure that they remain within an environmental commitment, which includes no use of harmful substances, use of minimal materials and energy, and recyclable packaging (Baumer-Cardoso et al., 2020). The benefit of green innovation emerges through attention to reducing pollution, improving resource productivity, increasing the efficiency of energy and materials use, improving environmental performance, as well as reducing the costs of produced materials (Huang et al., 2016). Green innovation also contributes to the conservation of resources by recycling them and that the resources have a lower environmental impact at all stages of the product life cycle (Biswas & Roy, 2016).

The green innovation is one of technologies that are involved in energy saving, pollution prevention, waste recycling, and green product design, which uses environmentally friendly materials that can self-degrade. The traditional cost systems cannot provide sufficient data for management related to waste and loss during the operational activities and unable to show the value of raw materials, energy and water. The key to move from opportunities of integrating a green innovation with materials flow cost for improvement production process by generate a green products, trying to reduce the environmental emissions, and optimal using of resources.

Green innovation contributes significant benefits to the environmental performance and competitive advantage. This paper argues to show the opportunities of integrating green innovation with materials flow cost are for improving the production process by providing green products, trying to reduce the environmental emissions, and optimal using of resources. the application of material flow cost in light of green innovation has important for industry, considering that manufactural companies still depend on traditional methods of production, which cause dangerous wastes on the environment. By monitoring production since the entry of raw materials to the stage of obtaining the ready-to-use product, the green product for the purpose of enhancing the competitiveness of the company. As well as trying to control waste of materials through the method of internal recycling of factors. The paper has divided three sections, introduction is first one. The second section is materials and methods. Conclusions is last section.

2 MATERIALS AND METHODS

2.1 The Sample

The paper has conducted in the national company of cement industry, and data on 2020 used to conduct the results.

2.2 The Procedures

Four procedures have been taken to develop materials flow cost accounting through the green innovation. The stages of cement industry (raw materials mills, rotary kilns, cement mills, and packaging), these will classify based on methodology of materials flow cost accounting using procedures (Plan-Do-Check-Act) (ISO14051, 2011) as follows:

Plan: the first process includes several acts that clarified according to (Kokubu & Nakajima, 2004; Syarif & Novita, 2019): identify the required expertise, the expertise of engineers and workers in the production department and in the management and control of production planning, in order to collect data on the production quantities needed for analysis.

Do: the second step has several procedures that can be clarified according to (Syarif & Novita, 2019; Sygulla et al., 2014): Quantitative measurement of flows: The inputs and outputs of each center has measured, the resources received from a previous job center, and the outputs are the two items good and spoilage produced units.

Check: according of this step (Dekamin & Barmaki, 2019) Summarizing the data and analyzing the results: preparing a scheme that combines the costs of good and wasted product in operations called "Cost Flow Matrix". The results are according to the material flow cost accounting, which calculated the total manufacturing costs amounted to (50715031643) dinars, and these costs are distributed between the good product and the defective or lost product, where the costs of each of the costs of the good product = 22438916428 dinars, and the costs of the defective or lost product = 28276115215 dinars.

Act: This is an important step because it has impact on the all activity of company as a result of transparency in the flows of materials and energy (Kokubu & Nakajima, 2004). The results is

improve financial and environmental performance which identified and evaluated before starting a cycle again. Moreover, replacing better quality materials, improving processes, modifying production lines or products, and development activities related to material and energy efficiency. For supporting cost-benefit analysis of the proposed methods in the cement industry that consumes a lot of natural resources, electric power, fuel and water.

In this paper, cement industry can create a new item called “Green Cement” from the process of internal

recycling of all cement kiln dust, which is collected from the air leaving the rotary kilns by depositing it by electrostatic dust precipitators to the stage of cement mills, and from here it can be We consider this product to be environmentally friendly and for the laboratory at the same time, as it will achieve financial savings for the laboratory (the study sample) by converting the production pattern from resistant cement to the production of green cement, showed in tables(1 and 2).

Table 1: The flow cost of job centers.

Input			Output				
MFCA elements	Quantity	cost	bagged cement	wastage losses			
	(Ton)	(Dinar)	product 477474 (Ton)	final cement wasted 7447 ton 27574 bags wasted	Recycled cement 90110Ton	Power final cement	
first stock	9154	15055444	-	-	-	-	
Quantity of cement received	700795	99997951949	99705495914	1579995099	-	-	
new material (bag)	1577450	9195094144	9141119444	-	5590144	-	
other stock	145	15055444	-	-	-	-	
User of material	-	91459901049	-	-	-	-	
Power	Electricity	9901901	0191111	5515119	-	1104	9599971
	Oils and greases	995145	19947971	19947971	-	-	-
system	-	5145175509	5911049411	50955794	79595015	-	
waste management	-	195159	-	195159	-	-	
Total		59195995777	99051199091	1041151999	77151955	9599971	

Table (2) presented the total cost of the green cement product reached about (28181559041) dinars with eliminating waste of kiln dust by recycling, which amounted to (50716547821) dinars. The production of 744,723 tons of green cement requires (500,750) tons of clinker instead of (649754) tons of clinker in the production of resistant cement, and this led to a decrease in the need for raw materials (putty) entering the rotary kiln.

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The cost of producing line was (50716547821 dinars) according to the material flow cost accounting, the cost per ton (68100 dinars/ton).While the cost of producing green cement-CKD type is (28181559041 dinars), according to the innovation of the green product.

Table 2: The follow Costs within green product innovation.

Input		Output green cement product		
cost elements	Quantity (Ton)	cost (Dinar)	Quantity (Ton)	cost (Dinar)
first stock	9154	15055444		
Quantity of green cement received	700795	90195551054	-	-
sachet packaging materials	1501014	9141119444	-	-
other stock	145	15055444	-	-
User of material	-	99155955054	077070	91491579941
Power electricity	5728421 Kwh	0951459	-	-
	133200 liter	99455515	-	-
System	-	9979491990	-	-
total cost of bagged and free green cement		91919551409	077070	91491579941

3 CONCLUSIONS

The study aimed to identify the application of material flow cost accounting in light of green product innovation. For the purpose of producing green cement in the national company of Cement industry. Depending on quantitative income, reached the need to adopt modern technologies such as accounting for material flow costs, green product innovation and other modern techniques to address the sharp rise in costs experienced for the companies by increasing efficiency in resource exploitation and improving the decision-making process for continuous improvement, thus improving production and environmental performance. At the same time, which achieves economic benefits that affect the financial position of the plant while achieving environmental benefits. The study also urges the need to move towards green innovation approach in all products and processes in the factory that will enhance the national product and not rely on imported foreign products, as well as to be able to apply modern systems and methods that remain in the face of intense competition from local and imported products. Which filled the markets, he had to set up training courses for all employees and workers, all according to specialization, because high skills are reflected on performance at work.

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