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Green Marketing in Sustainable Business: Utilizing Fly Ash as a Cement Substitute to Reduce CO₂ Emissions in the Mortar Industry

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ABSTRACT

Green marketing has become increasingly important in efforts to achieve sustainable business, especially in the mortar industry. The use of fly ash as a cement substitute has emerged as a technological innovation aimed at reducing CO₂ emissions in mortar production. This research explores the close relationship between green marketing and the use of fly ash in this industry, as well as its impact on business sustainability. Through analysis of green marketing strategies, the use of fly ash in mortar composition, and the associated environmental impacts, this research aims to provide in-depth insight into how sustainable business practices and technological innovation can collaborate in creating environmentally friendly products. By focusing on this research, companies can advance their efforts to reduce CO₂ emissions while strengthening their corporate image as an entity that cares about the environment and is committed to sustainability. This research promotes efforts to replace conventional practices with more sustainable and environmental approaches, leading to broader benefits for our planet and society as a whole.

1. Introduction

Climate change caused by global warming is a problem in the world today because various countries have felt the impact of global warming. The United Nations (UN) revealed a report on weather changes and global warming, namely that 2019 was the hottest year in the last five years. One of the causes is the increase in carbon dioxide (CO₂) in 2018 (CNN Indonesia, 2019). According to scientists at the Mauna Loa Atmospheric Baseline Observatory, United States, carbon dioxide continued to increase rapidly in 2019 to 414.7 parts per million (ppm) and is expected to increase rapidly every year (NOAA, 2019). Disclosure of carbon emissions cannot be separated from the company's environmental performance.

Environmental performance is the company's contribution to efforts to preserve the environment because company operations are a factor that contributes to environmental damage, one of which is from chemicals and emissions contained in raw materials and equipment (Anggraeni, 2015). Therefore, companies need to improve environmental performance and disclose environmental information. According to Clarkson et al. (2008), companies with good environmental performance tend to have active strategies in dealing with environmental problems. Green marketing strategies in sustainable business are an increasingly important approach in the current era, where concern for the environment and consumer awareness of environmental issues is increasing. In an



effort to achieve economic growth balanced with environmental conservation, many companies are focusing on environmentally friendly marketing practices. Through implementing green marketing strategies, companies can not only meet the demands of environmental ethics but also create a competitive advantage by attracting customers who care more about environmentally friendly products and services. This approach involves all aspects of business, from product design to consumer communications, with the goal of creating sustainable relationships and a positive impact on the planet.

Fly ash material as a mortar-forming material is based on the properties of this material, which are similar to the properties of cement. The similarity of these properties can be seen from two main properties, namely physical and chemical properties. Physically, fly ash material is similar to cement in terms of the fineness of the grains. According to ACI Committee 226, fly ash has fairly fine grains, which pass through the No. 2 sieve. 325 (45 milli microns) 5-27% with a specific gravity between 2.15-2.6 and blackish gray in color. The chemical properties of fly ash are in the form of silica and alumina, with a presentation of up to 80%. The similarity of these properties makes fly ash a substitute material to reduce the amount of cement as a constituent material for high-quality mortar. The use of fly ash as a mortar-forming material has a positive impact from an environmental perspective. Fly ash is a very fine residue from burning coal. The fineness of the fly ash grains has the potential for air pollution. Apart from that, fly ash handling is currently limited to landfilling on empty land. Fly ash solid waste, if not handled properly, will cause environmental pollution, both water, air and soil. Optimizing the use of fly ash waste has the opportunity to be developed for use with the issuance of Republic of Indonesia Government Regulation Number 22 of 2021 which classifies fly ash as Non-B3 Waste. One way to handle fly ash solid waste is to convert it into an adsorbent because fly ash is absorbent in the form of a carbon compound, which has high porosity and a specific

surface area and is very good for absorbing gases in the form of VOCs, NO_x and SO₂ after modification. (Ge et al., 2018) The aim of this research is to analyze the impact of using fly ash as a cement substitute in the mortar industry on corporate green marketing practices and business sustainability, as well as identify effective marketing strategies to reduce CO₂ emissions and promote sustainable products in this industry.

2. Literature Review

Understanding green marketing and green products

According to Chen (2010), Green marketing is a company management strategy to market its products while maintaining environmental sustainability, while green advertising is used as a medium to promote environmentally friendly products. Green advertising includes product characteristics and features, product manufacturing processes, and policies. Green Products are products that are designed or created to have the least bad/negative impact on the environment. Meanwhile, according to Feedough, a green product is a product that considers sustainable factors that minimize negative/bad impacts on the environment throughout the product's life cycle until the product can no longer be used. Products that apply Green Product principles are usually made from recycled materials that can be reused or what are usually called biodegradable and do not contain toxins or other dangerous materials. Apart from not containing toxic or hazardous materials, green products are also made from environmentally friendly renewable resources.

Currently, companies are increasingly implementing or replacing raw materials for their products (green products) in order to attract consumer interest amidst the increasing issue of global warming. With these efforts, companies will be able to influence consumers to buy products and have awareness to buy products that pay attention to the environment/environmentally friendly (Okada, 2010; Saxena, 2012). In general, consumer awareness



consists of consumer perceptions and consumer reactions. Consumer awareness regarding green products is not only a matter of understanding but also a matter of willingness and ability to buy and, even at a certain level, promote environmentally friendly products. According to Wu & Chen (2014), buying interest is also influenced by consumer awareness of the use of green products. Apart from increasing buying interest, consumer awareness of buying green products can also help preserve the environment (Okada, 2010).

Syypa (2006) believes that Green Consumers are consumers who care about environmental problems and always buy environmentally friendly products. Environmentally friendly consumers are a specific market segment, which can also be called environmentally friendly customers. These environmentally friendly customers will still buy environmentally friendly products even though the price is more expensive. Therefore, at one point, companies will realize that environmental awareness and movements through eco-labeling or environmentally friendly products will not be abandoned by society, which will increase profitability. Green Product issues relate to the development, production, and use of products that are more environmentally friendly and sustainable. Reducing CO₂ emissions is one aspect of the green product issue. Reducing CO₂ emissions is closely related to Green Products because CO₂ gas is one of the main causes of global warming and climate change.

Fly ash

Fly ash is coal ash, which is part of the residue from burning coal in the form of fine, amorphous particles. According to Setiwati (2018), fly ash is coal ash in the form of fine, amorphous particles. This ash is an inorganic material formed from changes in mineral matter due to the combustion process. The process of burning coal in a steam generating unit (boiler) will form two types of ash, namely fly ash and bottom ash.

The composition of coal ash consists of 10-20% bottom ash and 80-90% fly ash. Fly ash is captured with an electric precipitator before being thrown into the air through a chimney. In several studies on the effect of using fly ash in mortar, according to Naik et al. (1991), fly ash as a cement substitute has a positive impact on the durability and workability of mortar. Meanwhile, Jatake et al. (2013) stated that the use of fly ash could increase the workability of mortar, while the speed of strength development is influenced by the water-cement factor (W/C ratio) and the percentage of fly ash in the mortar mixture. Apart from that, according to Nath et al. (2013), fly ash can reduce drying shrinkage in the mortar of the same class if the ratio of water and binder is adjusted. Fly ash can be used as a cement replacement material to reduce CO₂ emissions originating from cement production so that it can contribute to supporting the creation of sustainable development. According to research by Nugraha (2007), waste products from the PLTU reach 1 million tons per year. Coal burning is mostly used in steam power plants. Fly ash is a material that comes from unused coal burning residue. Fly ash has a high cement content and has pozzolanic properties. According to Nugraha (2007), silicate dioxide (SiO₂), aluminum (Al₂O₃), iron (Fe₂O₃), and calcium (CaO), as well as magnesium, potassium, sodium, titanium, and sulfur in smaller amounts are the contents contained in fly ash. Fly ash will harden with time. One of the important properties of fly ash is self-hardening, and this property resembles the properties of cement. Economically, the use of additional materials to partially replace cement as a mortar or mortar mixture allows for cost reduction by reducing the use of cement. Technically, this material can function as a filler in the mixture and improve workability. The use of this material also has a positive impact on the ecological sector because it has the potential to reduce air pollution and water pollution caused by the accumulation of large amounts of this material. Burning lignite and sub-bituminous coal produces fly



ash with more calcium and magnesium oxide than bituminous types. The main components of coal fly ash are silica (SiO₂), alumina (Al₂O₃), iron oxide (Fe₂O₃), calcium (CaO); and trace amounts of magnesium, potassium, sodium, titanium, and sulfur. The chemical properties of fly ash are influenced by the type of coal burned, storage techniques, and handling.

3. Methods

The research is a qualitative approach that is used to find out or describe the reality of the events being studied so as to make it easier to obtain objective data. Sugiyono (2015) states that qualitative research methods are used by researchers in natural object conditions. According to Moleong (2009), qualitative research is "research that intends to understand phenomena about what is experienced by research subjects, for example, behavior, perceptions, motivations, actions, etc., holistically, and by means of descriptions in the form of words and language, in a special natural context and by utilizing various natural methods". The criteria determined by researchers as research subjects are those who are involved in the activities being researched and know and understand information related to research. Based on this, the

subjects in this study were selected using the following criteria: employees, employees with supervisor level and above, and ready to be interviewed. In this research, the employees of the Mortar company in Bekasi. The two employees selected were at supervisor level and above and had a background in working at a mortar company. based on the consideration that qualitative research is more concerned with large amounts of information than the large number of informants. Therefore, the determination of research subjects was carried out using purposive techniques or in accordance with the objectives or criteria of the research population.

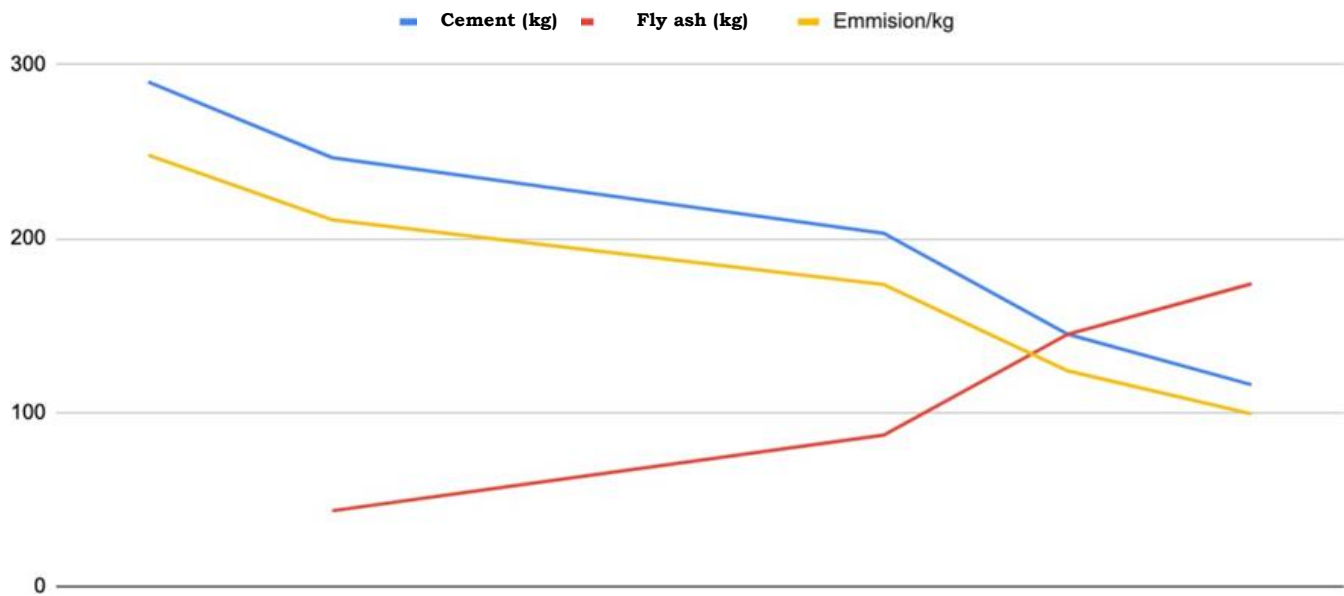
This research uses the triangulation method as described by Moleong (2004). The triangulation method is carried out by comparing information or data in different ways. Researchers use different techniques to obtain data from the same source. Researchers can use observation, in-depth interviews, and documentation. Through various perspectives, it is hoped that results will be obtained that are close to the truth. Therefore, triangulation at this stage is carried out if the truth of the data or information obtained from research subjects or informants is doubtful.

4. Results and Discussion

Table 1. Mortar work mix formula.

Component	NFA	FA 15%	FA 20%	FA 25%	FA 30%	FA 50%	FA 60%
Cement (kg)	290.0	246.5	232.0	217.5	203.0	145.0	116.0
Fine sand (kg)	350.0	350.0	350.0	350.0	350.0	350.0	350.0
Medium sand (kg)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fly ash (kg)	-	43.5	58.0	72.5	87.0	145.0	174.0
Coarse aggregate (kg)	260.0	260.0	260.0	260.0	260.0	260.0	260.0
Additives (kg)	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Emissions/kg	247.95	210.76	198.36	185.96	173.57	123.98	99.18
Percentage	100%	85%	80%	75%	70%	50%	40%





Source: Data processed by researchers.

Figure 1. Mortar work mix formula.

Fly ash can be used as a partial cement replacement based on the weight of the cement or as an additive to the concrete mix. Utilizing fly ash as a mixed cement component can save a lot of energy and costs in making cement. Replacing cement using fly ash can reach 75% of the cement weight, but there are strict standards that regulate its use, such as the American Society for Testing Materials ASTM C 618 and European Standard EN 450-1. A new cement alternative in the field of building materials and construction is geopolymers concrete with fly ash. This concrete mixture produces concrete with high compressive strength, low creep, good acid resistance, and low shrinkage. Usually, fly ash is used in mixed cement to produce in situ concrete mixtures, but fly

ash can also be used in high-strength precast and prestressed concrete. Having slow strength development at an early age, the use of fly ash in high-strength precast and prestressed concrete is still limited. Somehow, current research has validated that superplasticized fly ash concrete with a low water-to-cement ratio can be adapted to meet very early life strength as well as other requirements for precast or prestressed concrete products.

Here are ways companies in the mortar industry can promote their products that use fly ash as an environmentally friendly solution, as well as the impact on consumer perception and the sustainability of their business in tabular form:



Table 2. The company's way to promote its products that use fly ash.

Green marketing strategy	Description	Impact on consumer perception	Impact on business sustainability
Customer education	Educate customers about the use of fly ash in mortar, including environmental benefits.	Increase consumer understanding of sustainable products.	Creating a larger market for sustainable products.
Environmental certification	Obtain environmental certification or green label to demonstrate the sustainable quality of the product.	Increase consumer confidence and convince them of sustainability claims.	Differentiate products from competitors and attract customers who care about the environment.
Promotion of sustainability	Promote mortar with fly ash as a sustainable and environmentally friendly choice.	Encourage consumers to choose products that contribute to environmental protection.	Increasing sustainable product sales.
Transparency	Provide clear information about the percentage of fly ash in the product and the source of the fly ash used.	Increase consumer trust by providing transparent information.	Create strong relationships with customers who value transparency.
Reduction of environmental impact	Promote how the use of fly ash can reduce the use of natural resources and carbon emissions.	Reinforces the perception that this product helps protect the environment.	Meet market demands for products that contribute to environmental protection.
Success stories and case studies	Share success stories and case studies of using mortar with fly ash in sustainable construction projects.	Illustrate the positive impact of the product on a real project.	Improve the product's image as an effective and environmentally friendly solution.
Partnerships with environmental organizations	Establish partnerships with environmental NGOs or sustainability organizations.	Increase the legitimacy of Companies and products in terms of sustainability.	Improve corporate image and support sustainability initiatives.
Impact measurement and reporting	Always measure the positive impact of products with fly ash on the environment and create sustainability reports.	Demonstrate a long-term commitment to sustainability.	Increase customer trust and sustainability investment.

5. Conclusion

The promotion of products with fly ash as an environmentally friendly solution can have a positive impact on consumer perception and business sustainability. Consumers who care about the environment are more likely to choose these products, and companies can differentiate themselves from competitors by focusing on sustainability. In the long term, this can lead to increased sales, stronger consumer confidence, and greater investment support for business sustainability.

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