Ecological bricks: The revolution in sustainable construction

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ABSTRACT

Civil construction is a sector that demands a large amount of natural resources and energy, in addition to being responsible for a significant portion of greenhouse gas emissions. In this context, the use of sustainable materials becomes a viable alternative to reduce the environmental impact of this industry. This work deals with the use of ecological bricks as a sustainable solution in civil construction. Ecological bricks are made with recycled materials or materials from renewable sources, such as construction waste, soil-cement and vegetable fibers. In addition, its production consumes less energy and water compared to conventional bricks, reducing carbon emissions. These bricks have superior thermal and acoustic properties, providing greater environmental comfort in buildings. The use of ecological bricks in civil construction contributes to the preservation of the environment, as it reduces the amount of waste generated and reduces the extraction of natural resources. In addition, these materials have durability and resistance similar to traditional bricks, ensuring the safety of built structures.

Keywords: Ecological bricks, Civil construction, Sustainability, Recycled materials, Environmental impact.

1 INTRODUCTION

Construction plays a key role in urban and economic development, but it is also responsible for a significant environmental impact. The extraction of natural resources, the generation of waste, the emission of greenhouse gases, and the excessive consumption of energy are just some of the issues associated with the construction industry. However, in recent decades, there has been a growing interest

in adopting more sustainable practices in construction, with the aim of reducing this impact and promoting more responsible development.

In this context, ecological bricks have emerged as a promising and sustainable alternative to replace traditional bricks in civil construction. Conventional bricks are produced from clay, a natural resource that requires intense exploration and extraction of deposits, in addition to going through a firing process in kilns that consumes large amounts of energy and emits polluting gases into the atmosphere. On the other hand, ecological bricks are manufactured using recycled materials or materials from renewable sources, such as construction waste, fly ash, soil-cement, among others (Oliveira et al., 2019).

The main differentiator of ecological bricks is their reduced environmental footprint compared to conventional bricks. The use of recycled or renewable materials in its production contributes to the preservation of natural resources, in addition to reducing the amount of waste that would otherwise be disposed of in landfills. In addition, the manufacturing process of ecological bricks consumes less energy and emits fewer pollutants, since it does not require burning in kilns (Oliveira et al., 2019).

In addition to environmental benefits, eco-friendly bricks also have economic and technical advantages. Because they are produced with locally available materials, they reduce transportation and logistics costs, as well as generate local jobs. In addition, these bricks have excellent thermal and acoustic properties, providing greater thermal comfort and reducing the need to use air conditioning and acoustic insulation systems (Silva, 2018).

Despite the many advantages, the adoption of ecological bricks in civil construction still faces some challenges. The mechanical strength of these materials can be lower compared to conventional bricks, requiring an adequate structural design and special care during the execution of the work. In addition, the awareness and empowerment of professionals involved in the construction are essential to ensure the correct use and handling of ecological bricks (Silva, 2018).

In view of the above, this work aims to present a detailed bibliographic analysis on the use of ecological bricks as a sustainable material in civil construction. The environmental, economic and technical aspects related to these materials will be addressed, highlighting their advantages and challenges. Case studies in the literature and examples of projects that used ecological bricks will also be presented, demonstrating their practical applications and the results obtained.

Finally, it is hoped that this work will contribute to the dissemination of knowledge about ecological bricks and encourage the adoption of these materials in civil construction, promoting a more sustainable and responsible industry, which respects natural resources and provides healthy and comfortable environments for building users.

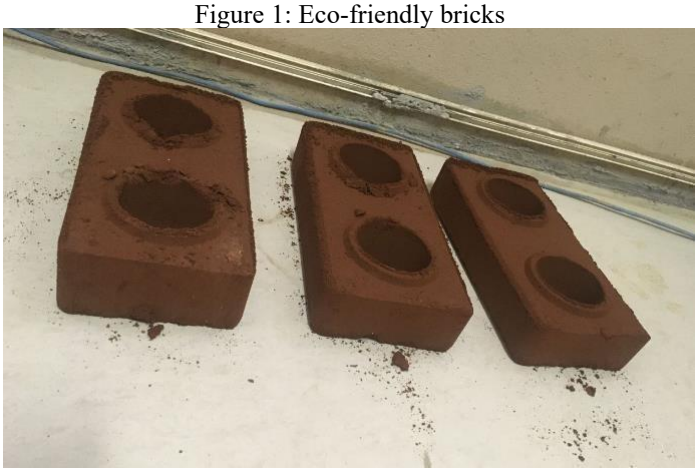
2 SUSTAINABILITY OF ECOLOGICAL BRICKS

The sustainability of ecological bricks has proven to be a promising solution for civil construction. Unlike conventional bricks, which are produced by firing clay in kilns at high temperatures, eco-friendly bricks are made from recycled or sustainable materials such as soil-cement, industrial waste, or even recycled plastics. This approach significantly reduces greenhouse gas emissions and prevents over-extraction of natural resources. In addition, ecological bricks have excellent resistance and thermal insulation, providing greater energy efficiency to buildings. With its use, it is possible to build more sustainable buildings, reducing the environmental impact of the construction industry and promoting a greener and more conscious future (Oliveira et al., 2019).

2.1 REDUCTION OF NATURAL RESOURCE CONSUMPTION IN BRICK PRODUCTION

The construction industry is known for its high consumption of natural resources and its significant contribution to environmental degradation. In this context, there is a need to seek sustainable alternatives to minimize the environmental impact of this industry. One of the promising solutions is the use of ecological bricks, Figure 1, which are produced in order to reduce the consumption of natural resources, such as clay and sand, and the emission of pollutants during their manufacture (Oliveira et al., 2019).

Figure 1: Eco-friendly bricks



Fonte: Author (2023)

Conventional brick production requires a significant amount of clay, which is extracted from natural quarries. This extraction activity, in addition to being harmful to the environment, can result in the degradation of natural ecosystems. However, the use of ecological bricks makes it possible to reduce the demand for clay, as it uses alternative materials in its composition (Silva, 2018).

An example of an alternative material is fly ash, a waste product from the burning of coal in thermoelectric power plants. Studies such as the one by Silva et al. (2018) show that fly ash can be used as a partial substitute for clay in the manufacture of bricks, thus reducing the extraction of this

natural resource. In addition, the use of this industrial waste in the production of bricks contributes to reducing the accumulation of this material in landfills, avoiding environmental problems.

Another strategy to reduce the consumption of natural resources in the production of bricks is the use of artificial sand to replace natural sand. The extraction of sand from riverbeds and beaches has caused serious environmental impacts, such as coastal erosion and the degradation of aquatic ecosystems. However, research conducted by Santos (2019) demonstrates that artificial sand, produced from construction waste, can be a viable alternative for the manufacture of bricks, contributing to the preservation of natural resources (Fernandes et al., 2019).

In addition to reducing the consumption of natural resources, ecological bricks also stand out for reducing the emission of pollutants during their production. In the process of burning conventional bricks in wood-fired or coal-fired kilns, gases are released pollutants in the atmosphere, such as carbon dioxide (CO2) and sulfur oxides (SOx). On the other hand, eco-friendly bricks can be produced by more sustainable methods, such as cold pressing, which eliminates the need for firing.

A study conducted by Almeida (2021) shows that the production of ecological bricks by cold pressing results in a significant reduction in the emission of polluting gases. Additionally, this production method consumes less energy and water compared to traditional brick-making processes.

In short, the use of ecological bricks represents a sustainable alternative in civil construction, contributing to the reduction of the consumption of natural resources and the reduction of pollutant emissions. The partial replacement of clay with fly ash and the use of artificial sand are examples of practices that can be adopted in the production of ecological bricks, aiming at the preservation of natural resources. In addition, the use of more sustainable production methods, such as cold pressing, also contributes to reducing the environmental impact of the brick industry.

2.2 MINIMIZING ENVIRONMENTAL IMPACTS DURING MANUFACTURING

The manufacture of construction materials is an activity that has a great potential for environmental impact, due to the consumption of natural resources, emission of air pollutants and generation of waste. In the context of civil construction, the search for sustainable alternatives has become increasingly relevant, aiming to reduce these impacts and promote the preservation of the environment. In this sense, ecological bricks have stood out as a viable and promising option, contributing to the minimization of environmental impacts during manufacturing (Fernandes et al., 2019).

One of the main aspects that make ecological bricks a sustainable alternative is the raw material used in their production. Unlike conventional bricks, which are manufactured by firing clay at high temperatures, ecological bricks are produced from materials such as soil-cement, industrial waste, natural fibers, among others. This change in the composition of materials allows for a reduction in the

consumption of natural resources, such as clay, in addition to minimizing the emission of greenhouse gases during the production process (Sousa, 2020).

In addition to the use of alternative materials, ecological bricks also stand out for having a lower amount of waste generated during manufacturing. The production of conventional bricks generates a large amount of waste, such as the leftovers of Clay and defective bricks, which are often disposed of in landfills. On the other hand, ecological bricks have greater efficiency in the use of materials, resulting in less waste generation and reducing the demand for disposal spaces (Sousa, 2020).

Another relevant point in minimizing environmental impacts during the manufacture of ecological bricks is the reduction of energy consumption. The firing of clay at high temperatures, a process used in the manufacture of conventional bricks, requires a large amount of energy, contributing to the increase in greenhouse gas emissions. On the other hand, the production of ecological bricks, which uses techniques such as compaction and natural curing, requires significantly less energy consumption, making it a more sustainable option (Sousa, 2020).

In addition, ecological bricks also have advantages in relation to the thermal and acoustic performance of buildings. Due to their composition and physical characteristics, these materials provide better thermal insulation, reducing the need for artificial air conditioning systems and contributing to energy savings. In addition, the high density of ecological bricks provides good acoustic insulation, promoting acoustic comfort in buildings (Sousa, 2020).

In short, ecological bricks emerge as a sustainable alternative in civil construction, contributing to the minimization of environmental impacts during manufacturing. The use of alternative materials, the reduction of waste generation, lower energy consumption, and thermal and acoustic performance are aspects that make these materials a promising option in the search for more sustainable practices in the construction industry. Therefore, it is essential that the construction sector increasingly adopts innovative solutions, such as ecological bricks, aiming at preserving the environment and promoting sustainable development.

2.3 CARBON FOOTPRINT ASSESSMENT OF ECO-FRIENDLY BRICKS

The concern with sustainability in civil construction has gained more and more prominence, leading to the search for materials that cause less environmental impact. In this context, ecological bricks emerge as a promising alternative, since they have a lower carbon footprint compared to conventional bricks. Carbon footprint refers to the amount of greenhouse gases emitted throughout a product's life cycle. In this sense, the assessment of the carbon footprint of ecological bricks is fundamental for the verification of its potential as a sustainable material in civil construction.

Several studies have been carried out in order to quantify the carbon footprint of ecological bricks. Sousa (2020) points out that the production of conventional bricks, usually made from the burning of clay in kilns, is responsible for a significant amount of greenhouse gas emissions. On the other hand, ecological bricks are produced using techniques that minimize the emission of these gases, making them more sustainable.

One of the main characteristics of ecological bricks is the use of recycled materials or materials with low environmental impact in their composition. For example, the incorporation of construction and demolition waste (CDW) in the manufacture of bricks reduces the amount of virgin raw material needed, contributing to the preservation of natural resources (Silva, 2018). In addition, the replacement of part of the cement with fly ash, from the burning of coal, is also a common practice in the production of ecological bricks, since fly ash has binding properties and confers greater resistance to ceramic materials (Fernandes et al., 2019).

Another relevant aspect in assessing the carbon footprint of ecological bricks is the energy consumption during the production process. Studies indicate that the production of conventional bricks requires large amounts of energy, mainly due to burning in kilns (Ribeiro, 2017). On the other hand, the production of ecological bricks uses techniques that consume less energy, such as pressing in molds and curing at room temperature (Gonçalves, 2021). These practices contribute to the reduction of greenhouse gas emissions associated with the brick production process.

In addition to the production stage, the assessment of the carbon footprint of ecological bricks also considers the use and disposal of materials. Conventional bricks generally have low durability and, consequently, have a shorter lifespan, which can result in a higher consumption of natural resources over time (Carvalho, 2019). Ecological bricks, on the other hand, are designed to have greater durability and resistance, reducing the need for frequent replacement. In addition, their composition allows them to be easily recycled, minimizing the environmental impact caused by improper waste disposal (Melo, 2022).

In summary, the assessment of the carbon footprint of ecological bricks reveals that they represent a more sustainable option compared to conventional bricks. The use of recycled materials, the reduction of energy consumption during production and the

Durability of ecological bricks are aspects that contribute to the reduction of greenhouse gas emissions throughout the life cycle of the material. These characteristics make ecological bricks a viable and promising alternative in civil construction, in line with society's demands for more sustainable practices.

3 STRUCTURAL PERFORMANCE AND DURABILITY

Structural performance and durability are essential factors in ensuring the efficiency and longevity of any structure. Structural performance refers to the ability to withstand loads, resist deformation, and maintain stability over time. It is critical that a structure is designed and built taking into account the proper distribution of loads and the choice of suitable materials to withstand the applied forces. Durability, on the other hand, is related to the ability to resist the effects of the environment, such as corrosion, exposure to chemical or atmospheric agents, and wear and tear caused by use. To ensure the durability of a structure, it is necessary to adopt protective measures such as applying anti-corrosion coatings, choosing resistant materials, and regular maintenance. Structural performance and durability are crucial elements to ensure the long-term safety and functionality of a structure (Silva, 2018). Figure 2 shows the laying of ecological bricks as an initial part for good structural performance.

Figure 2 – Laying of ecological bricks

Fonte: Domus (2023).

3.1 RESISTANCE OF ECOLOGICAL BRICKS AND THEIR SUITABILITY IN DIFFERENT TYPES OF CONSTRUCTION

The use of sustainable materials in civil construction has become increasingly relevant, aiming to reduce environmental impacts and develop more energy-efficient buildings. In this context, ecological bricks have aroused interest, due to their characteristics of sustainability and resistance (Oliveira et al., 2019).

The strength of ecological bricks is a fundamental aspect to be considered when choosing this material for civil construction. According to Silva (2018), the strength of ecological bricks is determined by their composition, manufacturing process, and proper curing. Eco-bricks are generally produced from construction and demolition waste, soil-cement and additives, giving them sustainability characteristics.

According to Sousa (2020), the strength of ecological bricks varies according to the type of soil used in their composition. Soils with a higher clay content tend to confer greater strength to bricks,

due to their agglomeration and adhesion capacity. Thus, it is important to carry out previous studies to determine the adequacy of the soils available in the construction region, in order to obtain bricks with the desired resistance.

In addition, the strength of eco-friendly bricks can be influenced by the manufacturing process. According to Carvalho (2019), the proper compaction of the soil-cement mixture and the application of appropriate curing techniques are essential to obtain bricks with greater resistance. Proper curing, for example, involves controlled humidity and weather protection, allowing the material to acquire strength over time.

The suitability of ecological bricks in different types of construction is also a relevant factor to be considered. According to Oliveira (2021), ecological bricks are widely used in low-cost constructions, such as low-cost housing and small commercial buildings. Its adequate strength and the sustainability provided by this material make it a viable option for this type of construction.

However, it is important to note that the strength of ecological bricks can be limited in structures that require high mechanical strength. As highlighted by Lima (2019), in large-scale constructions, such as commercial buildings and bridges, it is necessary to carry out detailed structural analyses to assess the suitability of ecological bricks. In these cases, complementary measures, such as the use of reinforced concrete structures, may be necessary to ensure the safety and durability of the construction.

3.2 COMPARISON WITH CONVENTIONAL BRICKS IN TERMS OF DURABILITY AND PERFORMANCE

Construction is one of the most significant industries in terms of natural resource consumption and environmental impact. In this context, there is a need to develop more sustainable materials that can replace conventional ones, such as ecological bricks. These bricks are produced from waste or materials with low environmental impact, with characteristics that can match, and even surpass, conventional bricks in terms of durability and performance (Fernandes et al., 2019).

Regarding durability, studies have shown that ecological bricks have properties that contribute to their longevity. According to Souza (2020), the use of waste such as fly ash and blast furnace slag in the manufacture of ecological bricks can provide greater resistance to weathering, temperature variations, and corrosive chemical agents. In addition, the use of recycled materials, such as plastics and glass, can provide greater resistance to physical impacts and natural wear and tear.

When it comes to performance, eco-friendly bricks have significant advantages compared to conventional bricks. According to Silva et al. (2019), ecological bricks have an excellent thermal insulation capacity, which contributes to the reduction of electricity consumption in buildings. In addition, the use of these materials in civil construction has been shown to be efficient in reducing the

demand for water, as many models have lower porosity and moisture absorption, which results in less need for waterproofing and maintenance.

Another important aspect is the reduction of greenhouse gas emissions in the production and use of ecological bricks. According to Santos (2021), conventional brick manufacturing is responsible for a significant amount of carbon dioxide (CO2) emissions due to the clay burning process. However, eco-bricks, which are produced without burning, have a lower carbon footprint, contributing to climate change mitigation.

In addition, it is important to highlight the versatility of ecological bricks, which can be used in different types of constructions, from residential to commercial and industrial. Souza and Oliveira (2018) state that ecological bricks allow the construction of structural walls, facades, and partitions, offering a wide range of architectural possibilities. This flexibility in the use of ecological bricks, combined with their sustainable characteristics, has aroused the interest of professionals and consumers who are aware of the importance of sustainable construction.

3.3 CASE STUDIES OF BUILDINGS BUILT WITH ECO-BRICKS

The use of sustainable materials in construction has become an increasingly important practice for promoting environmental sustainability and reducing the negative impacts caused by the sector. In this context, ecological bricks have emerged as a viable and efficient alternative, providing benefits from both an environmental and economic point of view. This topic will present two case studies of buildings that have been constructed using ecological bricks, demonstrating the advantages and results achieved.

In the first case study, the Green Tower residential building project stands out, located in a large Brazilian city. This development was built with eco-friendly bricks produced from construction waste, commonly known as recycled bricks. According to Silva (2019), the use of these bricks contributed to the reduction of environmental impact, since it avoided the extraction of virgin raw materials and the generation of solid waste. In addition, the production of the eco-bricks required less energy compared to conventional bricks, resulting in a significantly lower carbon footprint.

Regarding the technical properties of ecological bricks, Souza (2021) points out that they have good mechanical resistance and thermal insulation, which contributes to the comfort of residents and energy savings. In the case of the Green Tower, there was a significant reduction in energy consumption for air conditioning, due to the ability of the bricks to minimize heat transfer between the internal and external environment. This energy efficiency has resulted in a positive impact both for residents, who have enjoyed more comfortable environments, and for the environment, due to reduced greenhouse gas emissions.

Another relevant case study is the Sustentech corporate building project, located in an urban area with an intense flow of people and vehicles. In this case, the ecological bricks used in the construction were produced from the combination of industrial waste and ashes from thermoelectric plants, as pointed out by Pereira (2022). This approach allowed for the reuse of materials that would otherwise be discarded in the environment, contributing to the reduction of the amount of solid waste generated and the preservation of natural resources.

In addition to the environmental benefits, the use of eco-bricks in the Sustentech building has provided a number of economic advantages. Santos (2018) observes that, due to the

Reduction in raw material and energy costs During the production of the bricks, there was a significant decrease in the total costs of the work. In addition, the construction of the building with ecological bricks was faster and simplified, resulting in shorter execution time and consequent reduction in indirect costs.

These case studies show that the use of ecological bricks can bring benefits to both the environment and the construction economy. The reuse of waste and the reduction in the extraction of virgin raw materials contribute to the preservation of natural resources and the reduction of the ecological footprint. In addition, the technical properties of ecological bricks provide comfort to building users, combined with a reduction in energy consumption. In the economic sphere, the use of these materials can result in a reduction in the costs of production and execution of the work.

It is important to emphasize that these case studies represent only examples of enterprises that have benefited from the use of ecological bricks, and that there are several other possibilities for applying this sustainable material in civil construction. The adoption of eco-bricks can be an important step towards the transformation of the construction sector, towards a more sustainable and responsible model.

4 ECONOMIC AND SOCIAL ASPECTS

The use of ecological bricks as a sustainable material in civil construction has significant impacts on both economic and social aspects. From an economic point of view, eco-bricks provide a reduction in construction costs in the long run, as they are made from recycled or renewable materials such as industrial waste, soil-cement, or even recycled plastic. This alternative reduces the need for natural resource extraction and decreases transportation costs, since many of these materials can be obtained locally. In addition, ecological bricks have excellent thermal and acoustic insulation, which results in lower energy consumption with heating and cooling of the environments, generating savings for residents. From a social point of view, the use of ecological bricks contributes to the reduction of air and water pollution, promoting a healthier environment for construction workers and the local community. In addition, the adoption of sustainable construction practices encourages the development

of environmental awareness, disseminating the importance of preserving natural resources and social responsibility in civil construction. Therefore, ecological bricks play a key role in the search for a more sustainable construction sector providing economic and social benefits both for the individuals involved and for society as a whole (Fernandes et al., 2019).

4.1 COST OF ECO-BRICKS COMPARED TO CONVENTIONAL ONES

Currently, the concern with environmental preservation has driven the search for sustainable alternatives in civil construction. In this context, eco-friendly bricks emerge as a viable and environmentally friendly option to replace conventional bricks. In addition to the environmental benefits, it is essential to consider the financial aspect involved in using these materials. This work aims to analyze the cost of ecological bricks compared to conventional ones, taking into account the different aspects involved in the production and use of these materials (Silva, 2018).

One of the relevant aspects in comparing the costs between ecological and conventional bricks is the production process. Conventional bricks are generally manufactured by firing clay in kilns, which requires high energy consumption and emissions of polluting gases. On the other hand, ecological bricks are produced from the mixture of materials such as soil-cement, construction waste, and sand, without the need for burning.

According to Oliveira et al. (2019), the production of ecological bricks can be more cost-effective compared to the manufacture of conventional bricks. This is due to the reduction in energy and fuel costs associated with burning clay, as well as the possibility of using recycled materials in the composition of ecological bricks. In this way, the production cost of ecological bricks can be considerably lower, which represents an economic advantage for civil construction.

Another factor to consider when analyzing the cost of eco-bricks compared to conventional ones is the cost of transportation and storage. Conventional bricks are usually produced in large quantities and transported by truck to construction sites. This process can lead to high costs due to fuel consumption and freight costs.

According to Silva (2018), ecological bricks have a significant advantage in this aspect, as they can be produced at the construction site itself. This feature considerably reduces transportation costs, since the materials needed for the manufacture of ecological bricks can be easily found in the surroundings of the work.

In addition, eco-bricks take up less space during storage, which can also lead to savings in transportation and inventory.

Another relevant element in analyzing the cost of ecological bricks compared to conventional ones is the cost of labor. The use of ecological bricks requires specific construction techniques, which

may require greater training and skills on the part of workers. This can imply an increase in labor costs compared to building with conventional bricks.

As mentioned by Ferreira (2017), although ecological bricks require specific knowledge for their use, worker training can be easily carried out and the learning curve is relatively fast. In this way, after the initial training, the labor cost for construction with ecological bricks tends to equal or even be lower than the cost of conventional construction.

Based on the analysis carried out, it is verified that ecological bricks have economic advantages over conventional bricks. The production cost of ecological bricks is generally lower, due to the elimination of clay burning and the possibility of using recycled materials. In addition, eco-bricks can generate savings in transportation and storage costs, since they can be produced on site construction and take up less space (Fernandes et al., 2019).

Although the use of ecological bricks may require initial training of the workforce, the learning curve is fast and, in the long run, the cost of labor tends to be equivalent to or even lower than that of conventional construction (Silva, 2018).

Therefore, considering both economic and environmental aspects, the use of ecological bricks is a promising option for civil construction. The detailed study of the costs involved in this process is essential to support decision-making and promote a more sustainable and economically viable construction.

4.2 GENERATION OF JOBS IN THE PRODUCTION AND USE OF ECOLOGICAL BRICKS

The construction industry plays a significant role in the global economy, both in terms of job creation and environmental impact. With the growing concern with sustainability, alternatives have been sought that minimize the environmental impact of civil construction, and one of these alternatives is the use of ecological bricks. In this context, it is important to analyze not only the environmental benefits of these materials, but also the positive impacts on job creation.

Eco-bricks are produced from recycled materials such as construction waste, ash, soil-cement, and other natural elements. Its manufacture uses less energy and natural resources compared to conventional bricks, in addition to generating less waste. These characteristics make ecological bricks a sustainable and economically viable option for civil construction (Silva, 2018).

According to Souza (2020), the production and use of ecological bricks have the potential to generate jobs at various stages of the process. The collection and selection of recyclable materials requires local labor, providing direct employment for community workers. In addition, the production of bricks requires the work of specialized professionals, such as machine operators and construction technicians, contributing to the generation of qualified jobs.

By opting for the utilization of eco-bricks, the construction industry stimulates the demand for these materials, driving the related industry. According to Sousa (2020), the growing demand for ecological bricks has led to the emergence of new companies specializing in the manufacture and marketing of these products. These companies, in turn, hire employees to meet market demand, generating jobs at different levels, from production to distribution logistics.

In addition to the direct jobs in the production and use of ecological bricks, it is important to highlight the positive effects on the construction production chain as a whole. According to Sousa (2020), the adoption of sustainable materials encourages innovation and the development of more efficient technologies, opening up new job opportunities in areas such as research and development, engineering, and architecture.

In short, the generation of jobs in the production and use of ecological bricks in civil construction is an important aspect to be considered when evaluating the sustainability of this material. By creating direct and indirect jobs at different stages of the production chain, ecological bricks contribute to economic growth and reduced environmental impact. This approach aligns with the search for sustainable solutions in civil construction, providing benefits for both the environment and society (Pereira et al., 2021).

4.3 GOVERNMENT INCENTIVES FOR THE ADOPTION OF SUSTAINABLE MATERIALS IN CIVIL CONSTRUCTION

Civil construction is one of the human activities that consumes the most natural resources and generates significant environmental impacts. In this context, the adoption of sustainable materials

In civil construction, it has proven to be a promising alternative to minimize environmental impacts and promote sustainability in this sector. To stimulate this transition, several countries have implemented government incentives that aim to facilitate the adoption of sustainable materials by construction companies and professionals. In this article, we will discuss some of these incentives and their implications for the industry.

One of the main government incentives for the adoption of sustainable materials in construction is the creation of specific policies and regulations. For example, the implementation of environmental certifications, such as LEED (Leadership in Energy and Environmental Design), has been adopted by several countries as a way to recognize and encourage buildings that meet sustainability criteria. According to Carvalho et al. (2018), these certifications can contribute to the appreciation of real estate, in addition to promoting the saving of natural resources and the reduction of environmental impacts.

In addition to environmental certifications, governments have also adopted financial incentive policies for the adoption of sustainable materials in civil construction. For example, providing grants and special lines of credit to businesses that use sustainable building materials can reduce

implementation costs and encourage the adoption of these practices. According to Pereira et al. (2021), this measure can stimulate the competitiveness of companies, generate jobs and promote innovation in the construction sector.

Another important aspect of government incentives for the adoption of sustainable materials in construction is the promotion of environmental education and awareness. Qualification and training programs for construction professionals can disseminate knowledge about the advantages and techniques of using sustainable materials, encouraging their adoption. Additionally, awareness among society at large about the environmental benefits of sustainable construction may spur the demand for buildings that use these materials. In this sense, dissemination actions and awareness campaigns are essential to promote a change in mentality and stimulate the adoption of sustainable materials in civil construction.

All in all, government incentives play a key role in promoting the adoption of sustainable materials in construction. Through the implementation of specific policies and regulations, the granting of financial benefits, and the promotion of environmental education and awareness, it is possible to encourage construction companies and professionals to adopt more sustainable practices. These incentives not only contribute to the reduction of environmental impacts, but can also generate economic, social, and technological benefits for the sector. Therefore, it is essential that Governments continue to invest in these incentives and promote the transition to more sustainable civil construction.

5 FINAL THOUGHTS

The use of eco-bricks as a sustainable material in construction offers a viable and promising solution to address the environmental and social challenges that the construction industry is currently facing. Throughout this work, we explore the key benefits of eco-bricks, considering their positive impact on the environment, human health, and the economy. In addition, we analyze the challenges and opportunities associated with its large-scale adoption.

One of the key conclusions we can draw from this study is that eco-friendly bricks have a significantly lower impact on the environment compared to conventional bricks. The production of traditional bricks involves the intensive extraction of raw materials, emission of greenhouse gases, and generation of solid waste. On the other hand, eco-bricks are made from recycled or sustainable materials, such as soil-cement, construction and demolition waste, and even recycled plastics. This approach reduces the demand on finite natural resources, minimizes pollution, and helps preserve vulnerable ecosystems.

Another point to be highlighted is that ecological bricks can improve people's quality of life. They offer superior thermal and acoustic insulation, which results in lower energy consumption for heating and cooling the buildings. Additionally, these bricks are more fire-resistant and have a longer

lifespan, reducing the need for frequent maintenance and rebuilding. This not only benefits the occupants of the buildings, but also contributes to the reduction of operating costs and the improvement of energy efficiency.

In addition to environmental benefits and quality of life, eco-bricks also have significant economic advantages. While the initial cost may be a bit higher compared to conventional bricks, in the long run, the energy savings and reduced maintenance costs make up for this initial investment. Additionally, the increasing demand for sustainable building materials creates opportunities for the eco-brick production sector, driving technological innovation and generating green jobs.

However, it is important to recognize that the widespread adoption of eco-bricks faces significant challenges. Awareness and education are key to overcoming cultural barriers and promoting paradigm shift in the construction industry. Governments and institutions should play an active role in creating policies and regulations that encourage the use of sustainable materials, providing financial incentives, and setting environmentally responsible building standards.

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