

# NEED OF SUSTAINABLE DEVELOPMENT FOR CONSTRUCTION

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**Abstract:** *In recent decades, we have been faced global environmental challenges including climate change, pollution and environmental degradation due to human activities on a global scale in different fields such as industry, energy, transport, construction etc. Thus, in order to protect environment, it is necessary to integrate all projects into an approach of sustainable development in all fields. The aim of this paper is to present the influence of construction sector on environment and the use of eco-materials for construction in future, which positively contributes to sustainable development in construction area.*

**Keyword:** Sustainable development, eco – material, environment.

## 1. SUSTAINABLE DEVELOPMENT

In the report of the World Commission on Environment and Development: Our Common Future [7], Mrs Brundtland – the report’s author gave the most widespread definition of sustainable development: “*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*”. The sustainable development was described as enhancing quality of human life for present and future generations with a healthy environment and improved social, economic and environmental conditions.

United Nations held many conferences in order to give the action programs for sustainable development. The first conference of United Nations on environment and development in Rio de Janeiro in June 1992 adopted the program of action in sustainable development with the principle declaration: “*Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature*”, called “Rio Declaration” [32]. The Earth Summit 2002 discussed about and proposed effective program of action for sustainable development,

especially the one of the largest conference in history of United Nations took place in Rio de Janeiro, Brazil in June 2012 proposed the institutional framework for sustainable development [33]. On the other hand, the Kyoto Protocol [21] was adopted in Kyoto, Japan in December 1997 and entered into force in February 2005 to limit or reduce emission of greenhouse gases (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride) and two groups of gases (hydrofluorocarbons and perfluorocarbons).

In conclusion, the sustainable development over the world is extremely necessary to protect and enhance environment. The United Nations, the international community and each country need to propose long-term environmental strategies, which take account of the interrelationships among people, resources, environment, and development. Thus, each area also needs to study to integrate the projects into an approach of sustainable development.

## 2. INFLUENCE OF CONSTRUCTION ON ENVIRONMENT

The report of “Our Common Future” [7] showed threatens and challenges for all fields, which are population and human resources, food security, species and ecosystem, the choice of energy for environment and development,

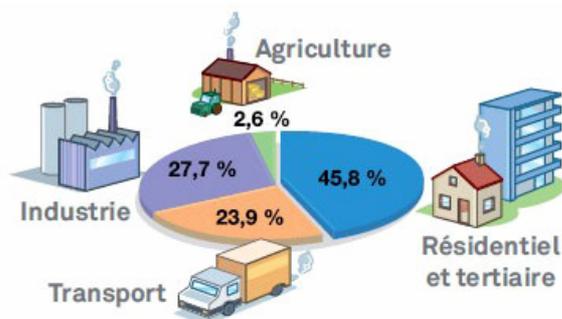
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industry, and urbanization in developing countries.

We know that the construction sector has an impact on many other industries because of the use of various kinds of materials which are produced in various categories of industry, thus this sector has major impacts not only on economic and social life, but also on the natural and built environment. This area is one of the key consumers in nation's total energy and cause a significant amount of greenhouse gas emissions, mainly CO<sub>2</sub>, altering our planet's climate. All the activities from production of building materials, construction, building operations, and decommissioning, directly or indirectly affect the environment.

In regard to energy consumption, previous studies showed that construction sector is responsible for a large share of the world's total energy consumption, it was estimated that buildings account for 30 - 50% of the worldwide energy use [5], [9], [12] and [34]. The fig.1 is an example, which shows the energy consumption of construction sector in comparison with other sectors in France in 2011.



*Fig.1 Energy consumption by sector in France [12]*

Concerning greenhouse gas emissions, carbon dioxide (CO<sub>2</sub>) is one of principal greenhouse gases being responsible for global warming, it was estimated that CO<sub>2</sub> contributes about 50% to greenhouse gases [13]. The Environmental Protection Agency of United State [16] showed that greenhouse gas

emissions in construction sector appear to come mostly from energy use. Price et al [27] also indicated that construction sector is the second largest global CO<sub>2</sub> emitter after industry, representing approximately 33% of the total, in which around 36% in Europe [6] and 39% in United State [35].

In building operations, the production and delivery processes of building materials include discovering raw materials in nature as well as extracting, manufacturing, packaging, and transportation to a building site. These processes can consume much large energy and emit large CO<sub>2</sub> amount, consequently cause the much important damage for environment. Nowadays, cement concrete is the most widespread building material because of excellent mechanical and durability properties, geometrical adaptability, its high level of fire resistance, and decrease of unwanted noise. Portland cement is the key ingredient in cement concrete, it is known that the production of each ton of Portland cement releases almost one ton of carbon dioxide into the atmosphere. Worldwide, the cement industry alone is estimated to be responsible for about 7% of all CO<sub>2</sub> generated [22]; in Western European, it is approximately 8-12% of total CO<sub>2</sub> emission [20]. Furthermore, production and exploitation processes of other building materials such as steel, aggregates, plaster etc. also significantly impact environment.

In conclusion, it is clear that construction sector has major impact on environment due to consume a large amount worldwide energy and cause a significant amount of greenhouse gas emissions, which considerably contributes alter our planet's climate. Thus, it is necessary to reduce greenhouse gases emission into the atmosphere in order to control adverse environmental impacts. Therefore, selection of materials and technologies for the building

construction should satisfy the felt needs of the user as well as the development needs of the society, without causing any adverse impact on environment.

### **3. PERSPECTIVE BUILDING MATERIALS FOR FUTURE**

The previous paragraphs showed that it is necessary to choose the materials that can contribute to considerably limit the negative impact on environment, this means the use of materials with low embodied energy and toxicity. Escadeillas [17] also indicated that it should choose eco-materials, or research and develop new materials whose manufacturing and implementation would generate less gas emissions while keeping and improving as much as possible the performances (mechanical, thermal and durable properties ...). Thus the use of a low CO<sub>2</sub> binder including plant aggregates could be a solution for the development of innovative and low impact building materials in the future.

#### **3.1. Low CO<sub>2</sub> binders**

In cement manufacture field, European Commission [18] point out that the use of renewable energy sources and improving technologies could reduce the emissions of CO<sub>2</sub>. In an other study, Benhelal et al [3] showed that global strategies should be considered in cement industry which are energy saving approach, carbon separation and storage approaches.

Many studies have mentioned the reduction of energy consumption and CO<sub>2</sub> emission in cement production (around 1 ton CO<sub>2</sub> per 1 ton cement in traditional cement production). For the replacement of clinker, Martín-Sedeño et al [24] indicated that the use of belite sulfoaluminate clinker reduced 35% CO<sub>2</sub> emission and energy consumption in cement production in comparison with ordinary Portland cements because this clinker production needed less calcite and calcinations

temperature than the clinker production of ordinary Portland cements did. Furthermore, the use of alternative low CO<sub>2</sub> cements such as pozzolan-based cements, calcium (sulfo)aluminate-based cements and calcium sulfate-based cements [19] and the improvement of the efficiency of cement use also contribute to reduce CO<sub>2</sub> emission [10].

For the technology of cement production, the novel technologies not only bring the remarkable environmental advantages, but also reduce the total cost of cement such as the technologies of pyro-processing [4], the calcium looping [11] and the NH<sub>3</sub> scrubbing [14].

In regard to other low CO<sub>2</sub> binders for the low strength structures, natural hydraulic lime (NHL) is considered as a more environmentally-friendly hydraulic binder, because its production needs lower energy than Portland cement do thanks to lower temperature of raw materials' calcinations, for example a product of Saint Astier emits totally around 650 kg CO<sub>2</sub> per ton of NHL5 [28]. On the other hand, flash metakaolin (MK) is also an eco-material because its production is not only rapid (within several tenths of a second) but also emits little CO<sub>2</sub> [1]. In previous studies, flash calcined metakaolin was used to replace partial cement in mortar and concrete. Magniont [23] illustrated that an alternative binder using 50% MK and 50% NHL5 can be used to produce concrete including hemp particles, a kind of plant aggregates. San Nicolas [29] showed the development of mechanical performances and durability of concrete using flash metakaolin up to 25% for substitution of CEMI cement. Trinh [31] indicated that MK can be effectively used in grout intended for soil nailing applications. His results demonstrated that the use up to 60% MK for replacement of cement in soil nailing is not only compatible with this application but also significantly reduces the CO<sub>2</sub> emission

during production of binders intended for injection grouting.

### **3.2.Plant aggregates**

Nowadays, there are many researches into plant concrete for insulation structures, a kind of materials used plant aggregates from vegetable resources (wood, straw, hemp, flax, ...) because these aggregates have not only good thermal and acoustic insulation but also low cost and low environmental impact (they contribute to significantly limit greenhouse gas emissions, [25]). Plant aggregates based concrete was studied with lime-based binders used in construction for roof insulation, filling of self bearing structure, realization of insulating screeds and decorative coats [8], [15], [25]. Hemp and sunflower stems were used as aggregates of plant concrete in previous studies with different binders such as lime [25], pozzolanic binder [23] & [26], and starch [30]. Arnaud [2] indicated that hemp shives is environment-friendly and economic material because hemp is an annual plant (around 4 months for harvesting) requiring no herbicides and no pesticides in growth.

In conclusion, low CO<sub>2</sub> binders and plant aggregates can be considered as eco-materials because of low consumption of energy and low emission of CO<sub>2</sub> from their production in comparison with conventional materials. Thus, it is necessary to study the use of these materials to replace the conventional materials for construction to consist with sustainable development in construction field.

### **4. CONCLUSIONS**

The building sector has negatively impacted environment and people health due to high consumption of energy as well as significant emission of CO<sub>2</sub> from material production and large consumption of non renewable raw materials. It is therefore necessary to develop new materials that not only satisfy the same technical criteria, but also have enhanced qualities in term of the environment, people health and comfort. Thus, it is necessary to develop and fabricate the eco-materials for construction, and thereby encourage construction professionals to use them.

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### **Tóm tắt**

## **SỰ CẦN THIẾT CỦA PHÁT TRIỂN BỀN VỮNG TRONG XÂY DỰNG**

*Trong những thập kỷ gần đây, chúng ta đã và đang đối mặt với những thử thách toàn cầu về môi trường, như sự biến đổi khí hậu, ô nhiễm và sự suy thoái môi trường do các hoạt động của con người trên phạm vi toàn cầu trong các lĩnh vực khác nhau như công nghiệp, năng lượng, giao thông, xây dựng, v.v... Vì vậy, việc kết hợp các dự án với sự tiếp cận về sự phát triển bền vững trong các lĩnh vực để bảo vệ môi trường là rất cần thiết. Bài báo này trình bày sự ảnh hưởng của lĩnh vực xây dựng đến môi trường và sự sử dụng vật liệu thân thiện trong ngành xây dựng trong tương lai, góp phần tích cực vào sự phát triển bền vững trong lĩnh vực xây dựng.*

**Từ khóa:** Sự phát triển bền vững, vật liệu sinh thái, môi trường.

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