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Concrete Technology and Sustainably Development from Past to Future

Rustam Hafizyar*[1], Mahmood Hunar Dheyaaldin[1],

[1]*Ph.D. Student, Dept. of Civil Engineering, Cyprus International University, Nicosia, Northern*

*Corresponding author/ E-mail address: rustamr323@gmail.com

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ABSTRACT. *A large number of concrete production today has a bad effect on environment resource and energy. Thus this issue of concrete technologies have an impact on the environment which is a critical problem in global warming. The current paper reviews the concrete technology and sustainable development from past to future and investigates sustainable concrete and material practice. Although while comparing these factors with the past, current and future prospective concrete sustainability development, this research found that the main cause of global warming is* CO_2 *emission during concrete and cement production. The solution of environment problem is not to replace the concrete by other substances and it can reduce the amount of cement with cementitious materials. The best approach for reducing the amount of* CO_2 *in environments is using Pozzolanic material and waste material, which both plays a vital role in the sustainable concrete structure.*

Keywords: Sustainability development, concrete technology, cement production, Pozzolanic material, recycling west material

1. INTRODUCTION

There is a concept that has come out as a reaction to some consternation and concerns regarding the impact of deteriorating global environment, although about expanding natural resource consumption on socio-economic developments, this concept is called sustainability or sustainable development [1]. Recently population, urbanization, industrialization, and globalization are increasing that society demands clean water, waste disposal clean air, safe transportation, and public, industrial, the residential building also natural sources for energy [2]. Throughout the 20th century, the Portland cement was developing as materials for modern infrastructural and today concrete industries are the major consumer of natural resources like sand, gravel, water, and crushed rock [3]. The Portland cement manufacturing that is used generally for modern concrete form although demands a lot of natural materials. Portland cement industries are under investigation now and with some agencies and public [3, 4]. Portland cement industries are playing a vital rule in infrastructure expansion and a large energy user and natural resources. Concrete industry must be reoriented from the adoption of eco-friend and much sustainable technology [4]. Increasing of infrastructural in the world can be balanced versus human life to be preserved hold environment on earth and used of natural sources unprofessionally can be increasing the magnitude of pollution. Thus increasing pollution is a concern which can’t longer continue to refuse the problem of pollution, also unlimited depletion of natural resources that must be found the solution to sustain environments. It is essential to find a satisfactory solution for environmental pollution and depletion of natural resources because it has threatened us standard life.

2 HIGHLIGHING THE PROBLEM

The problem was demographic pressure and technology which is an ecosystem under great pressure. To assist people and create a better condition for living and industries much more convert raw material to the consumer that should be leading faster [5]. In industrial activity is produced environment pollution but it is not a new problem. In Japan, North American, and Western Europe involved 20% of the world population [5]. Although 80% total energy in the world and resource consuming because of high standard living also 5 billion people developed has industrialization to following the best condition life [3, 4]. Based on Bueckert (1999) evaluated the population of the world that increased 5 billion since 1800 also in 1960 increase 3 billion people [6]. Growing of population demand natural resources and construction materials to build infrastructure like ports, water supply, house or shelter, sanitation, and transportation because of standard life [6].

3 PURPOSE OF STUDY

The current paper is a review on concrete technology and sustainable development from past to future and investigation of sustainable concrete and material practice. Although comparing these factors with past, current and future prospective concrete sustainability development.

4 SUSTAINABLE DEVELOPMENT DEFINITION

In 1992 Earth Summit at Rio de Janeiro was defined the sustainable development means an economic activity that is consistent by the ecosystem of the earth [7]. To find the best path to guarantee the sustainable development that can practice a barter system in the earth. The humans receive a few good things while at the same time they return a bit of the bad things. It is impossible to have lived like the golden rule but can try to have a goal for it in whole us economics and industrial undertakings [7]. Friendly environment and energy approach can be supporting the economic development and couldn't treat the natural source, international community created states, institutions, business, establishments and private organization or non-government organization so forth [6]. The environment factor can be increasing the greenhouse gas emission, global warming, and ozone layer that would be reduced biodiversity because of unbalancing production and consumption caused by unlimited production policy of industrial revolution while their impact was feeling on the local scale. There are three elements purpose for sustainable future, first one is socially and environmentally innovation, an efficient economy of resources that provide quality of life in the world development, the second is improving economic prosperity and quality of life in developing countries and resource are used in a healthy environment and protect reasonably in the worldwide [8]. Sustainability concept is basically a balance among social, economic, and environmental as shown in Figure 1 the Sustainable pillars were divided into three major part such as environmental issue, economic issue, and social issue.

Fig-1: Significant three pillars of sustainability [8]

4.1 Environment issue

Global environment concern on global warming, biodiversity, ozone layer, and recourses depletion. Resources depletion and biodiversity are showing in locally and regionally [8]. However biodiversity is linked with the global system, and resources utilized on global balance, it is essential to settle with them [9]. While these factors relate to the concrete industries and construction part. The product of construction material and construction operation straightly destroyed the environment and have a huge bad impact on environment status. For instance, the causes of steel and cement production are large volumes of CO_2 emission also construction activity spent a lot of fossil fuel [9]. These factors impact to global warming. Steel and cement production cause is increasing the large volumes of CO_2 emission and construction activity uses large amounts of fossil fuel. These activities contribute to global warming. As shown in Figure 2 schematically the environmental issue classifications like global, local, and built.

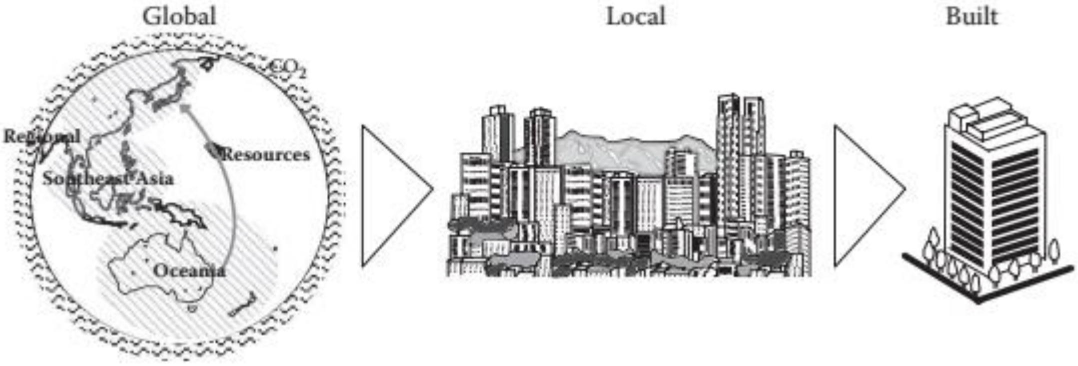

Fig- 2: Classifications of environmental issue [9]

The regional environment would be occurred air pollution, rain, acid, and water pollution. During manufacturing the raw material that used energy. These factors naturally happened and harmful substances. It can recover these substances but depends to cost and technology. The consequence of air pollution, rain, acid, and water pollution is bad impact on production activity in other region.

To specific place or city can be called local environment. The local environments were occurred soil pollution, land use west generation, noise, vibration, and dusty. These factors are being investigated within our daily lives. Soil pollution and west generation relate to using of concrete. Land use as well relate to construction sector [7-8].

To living and working on environment is called built environment and it is surrounding. Building is form to working on the environment and living. “Although a subject to indoor pollution caused by volatile organic compounds (VOCs), fungi, and radiation” [9].

4.1.1 Environment Prospective

Each ton of cement clinker demands around “7500 MJ total energy for production but slag demands only 700 to 1000 MJ/ton and FA around 150 to 400 MJ/ton and replacing 65% of cement with slag having 15% moisture content, for instance, will only require 0.5 tons of raw material and about 1500 - 1600 MJ of energy although every ton of cement replaced will thus save at least 6000 MJ of energy and each ton of cement releases 1.0 to 1.2 tons of CO_2, for every one ton reduction in clinker production, there is an almost equivalent reduction in CO_2 emissions” [10]. These factor can be directly impact on environment and economic factors.

4.2 Economic issues

Environment issue shows in industrial production and provided different services which are design to human life. In the economic activity would be used a lot of energy and resources [9]. In developing countries now have used a large number of energy and resources due to improve have the economy. However, developing countries have inadequate commodities that have led to developing productive activity and economic growing [10]. The economic activity can be provided infrastructure. In particular, this means construction of the road, building, railways, tunnels airports, ports, bridges, dams, and other structures as shown in Figure 3 which lead socioeconomic activity in each country.

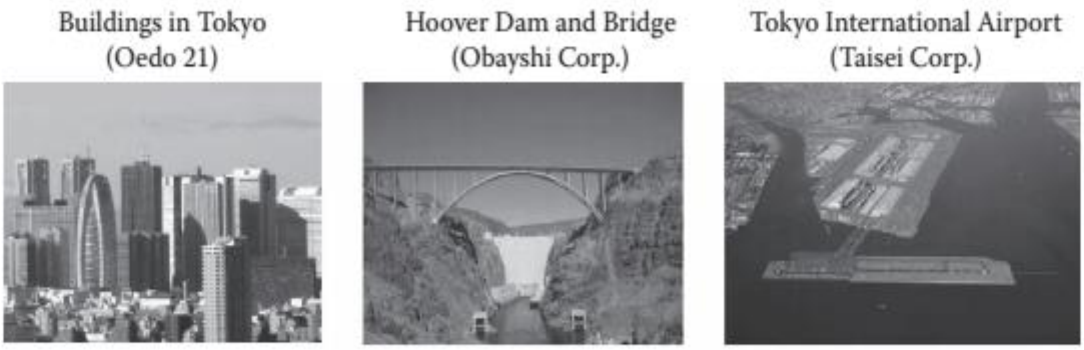

Fig-3: Economic activity of infrastructures in each country [9]

4.2.1 Concrete impacts on economic

The total amount of concrete cast every year "in the world is similar to a mountain with an area of 1 × 1 km, and a height comparable to that of Mt and this volume is more than twice that of all the other building materials together also over the last 10 to 15 years the center for the use of concrete has shifted from Europe and North America to Asia" [11]. Recently China is the largest consumer of concrete and producer of concrete in the world.

China is using more than "half of the cement in the world, or twice as much as Europe and the United States together and Cement was used 4.3 billion tones in 2014 in the world" [12]. In Figure 4 shown the global cement productions have increased in most industrial countries.

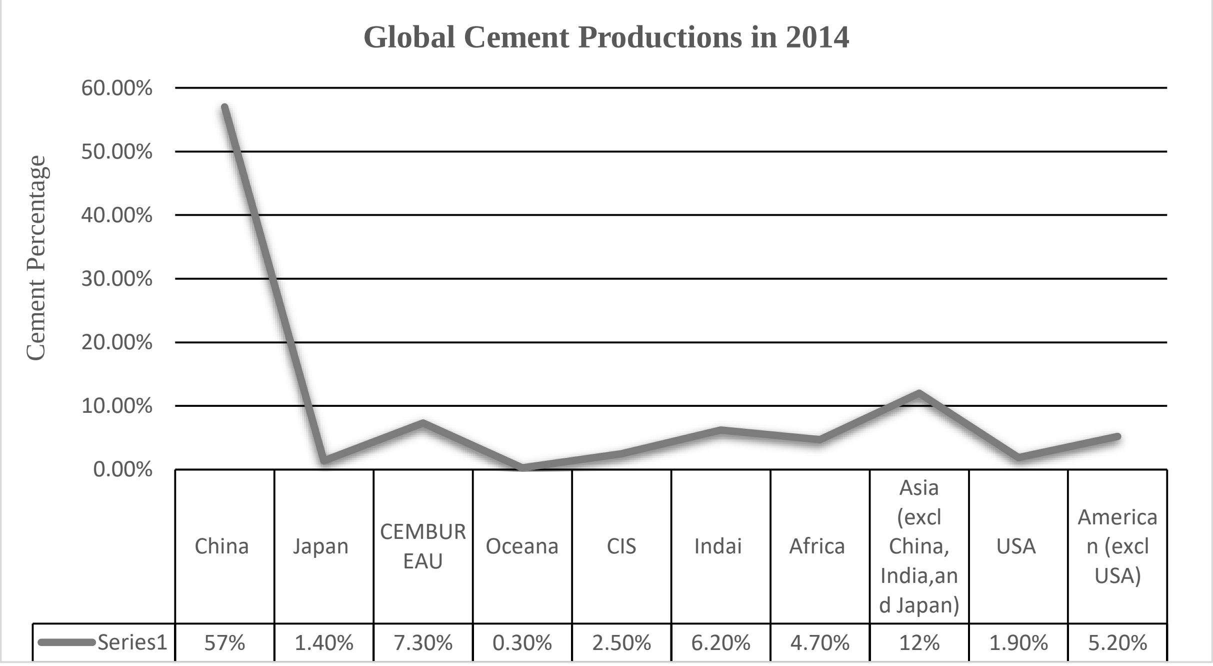

Fig-4: World Production Cement in 2014, by Region and Main Countries Percentage [12]

Cement production is much more contributor to greenhouse gas emissions. Therefore concrete industry substantially affects the ecology of our planet. In 2008, "India passed the United States as the second largest production and consumption country of cement and in 2010, India had a consumption of 216 billion tonnes, which is expected to grow to 425 billion tonnes in 2020 and 860 billion tonnes in 2030" [11]. Kulkarni (2011) revealed the India GDP was developed 9% in 2001 and 2010 because of concrete consumption as shown in Figure 5 [13]. In 1900 cement consumption was 10 million tonnes, in 1948 cement consumption was 100 million tonnes, in 1968 cement conception was 0.5 billion tonnes and 1989 cement consumption was 1 billion tonnes in around the world. The cost of cement and concrete are different from one country to another country as shown typical average prices in Figure 6. In 2011, the cost of per tonne cement in the United States was 110 USD and cost of concrete per m cubic was 130 USD [14]. In 2011, the cost of per tonne cement in the China was 53 USD and cost of concrete per m cubic was 65 USD [15]. In 2011, the cost of per tonne cement in Norway was 146 USD and cost of concrete per m cubic was 163 USD [15].

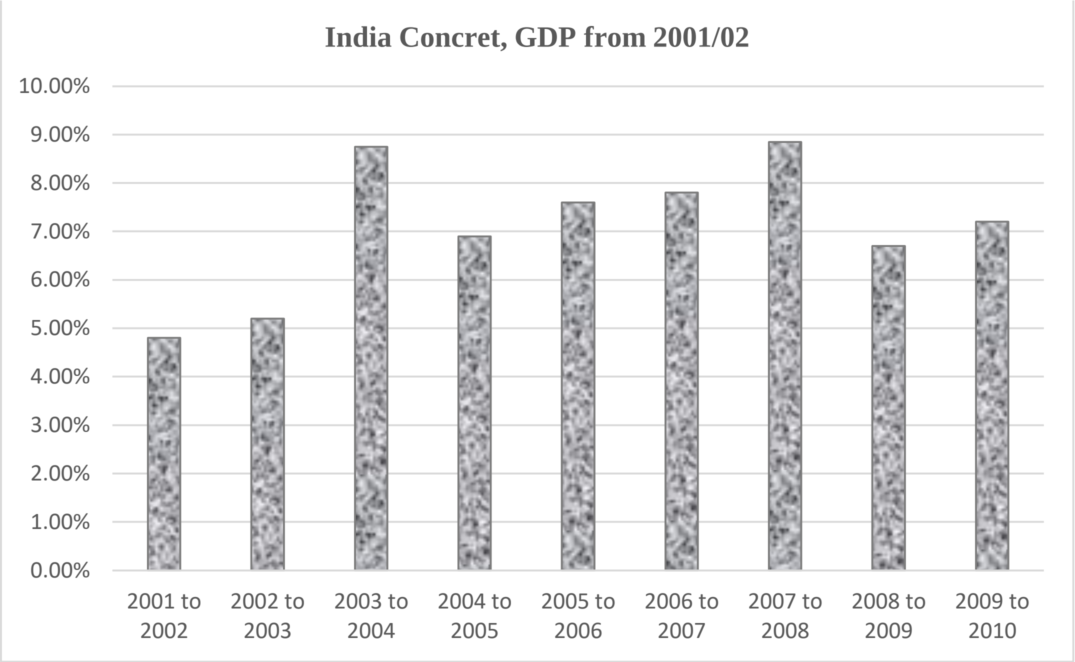

Fig-5: India, GDP growth from 2001 to 2010 based on concrete consumption [13]

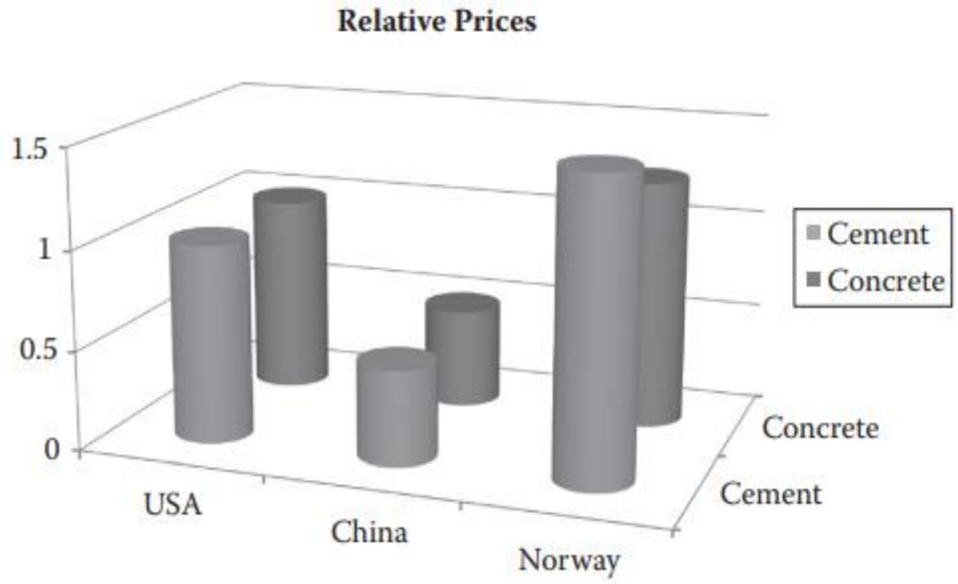

Fig-6: Relative prices from different countries [11]

China is the “largest consumer of concrete in the world and its price is obviously a major influence on the total economic impact in the world and the biggest economies in the world GDP 2010, according to the International Monetary Fund [10]. As shown in Figure 7 the GDP of concrete used in the world” [11].

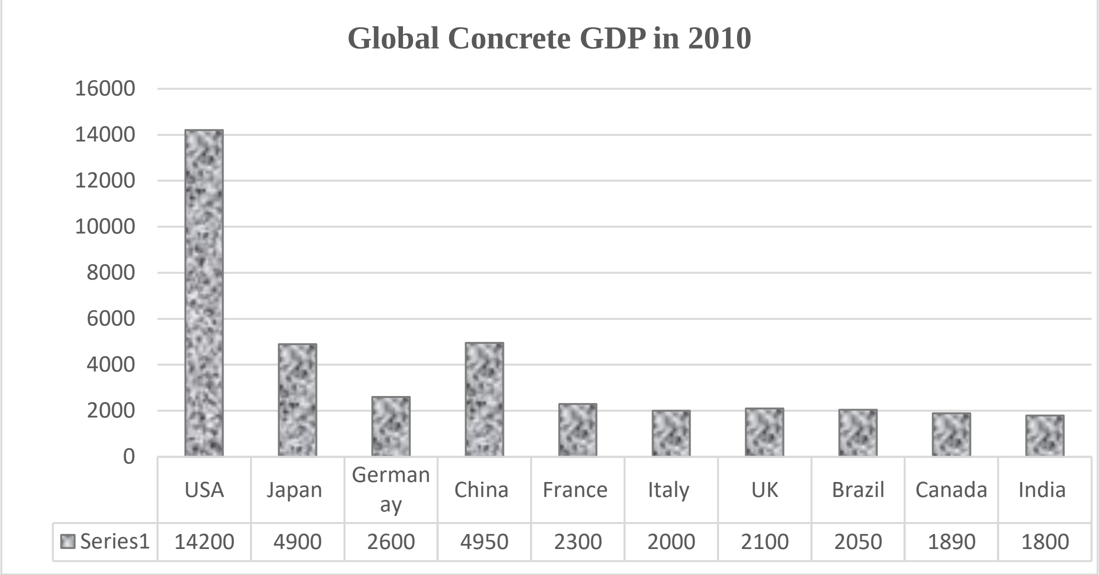

Fig-7: Concrete usage in development countries GDPs [11]

4.3 Social issues

Whole human activities include a specific social aspect of some kind. The economic and environmental issue includes a big number of social activity. Poor social systems are causing environmental problems that turn into social problems [9]. "Developing countries, whose economic growth is an absolute necessity, need to be actively involved in infrastructure development. Developing infrastructures provides a basis for economic expansion, but at the same time, it has greatly increased the environmental impact of economic development and our ultimate goal is to have a peaceful world with equal distribution of wealth, from a healthy global environment" [9].

5 CONCRETE TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT

The concrete is most widespread material and used widely in construction in the world. Concrete is comprehensiveness and provide infrastructural and directly run economic progress and stability of it, also need quality of life [14]. Concrete can be lightly organized and fabricated in whole category of any forms and structural system in the construction site or somewhere else. It is sample to prepare anywhere that is the advantage of concrete than other construction materials. In Figure 8 shown three major element can be support structure system of concrete technology and sustainability development.

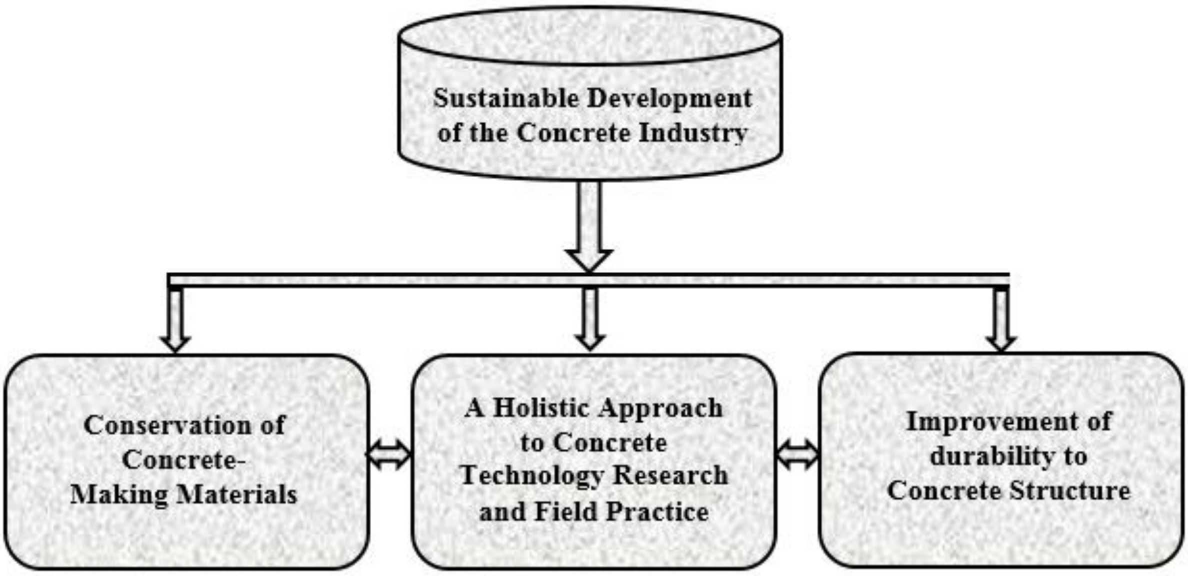

Fig-8: Foundations of an environment-friendly technology for sustainable development of the concrete industry [7]

5.1 Conservation of concrete making materials in past and present

Improvements in the concrete and cement industries with regards to sustainability can be achieved when moves are made by all parties involved to use present day advancements such as replacement of cement with Pozzolanic materials or waste materials and these can be properly incorporated in power plants and the metallurgic industry [15]. Concrete is the major part of construction material and widely used on it. The major part of concrete is three main ingredients which a Portland cement, aggregate, water, and admixtures based on specific performance criteria of concrete.

Since 1989 concrete industry was produced 560 million tons of coal ash but there are used only 25 million tons as Pozzolanic materials and totally 5% is available Fly ash [10]. Currently, production of coal ash is 650 million tons. Although the current production of fly ash is 450 million tones that it's most suitable for using as Pozzolanic. In the world every year spend a lot of fly ash by concrete industry and the rate of fly ash consumption in every year is 30 million tons, also other Pozzolanic material production such as iron blast-furnace slag and most suitable for concrete industry. Slag production 100 million tons/ year [13]. The application value of cement replacement is still low, thus in many countries can't be produced sustainable admixture like slag and so forth. Slag is processing into the granulated or cementitious form.

Mehta (1997) evaluated the magnitude of coal ash and iron blast Furance slag occurred and available on those countries that would be demand huge magnitude cement in the future [15]. (E.g. 200 million tons of coal ash in very year produced by China and India together and 250 million tons/year produced coal ash by European countries, mainly Russia, Poland, former Czechoslovakia, Romania, Germany, Spain, and the United). India, China, and Europe countries production 100 million tons/year of blast-furnace slag. To find a path to use all coal ash and Iron blast-furnace slag, either in shape of mixed Portland cement or as a mineral admixture in concrete. It should meet those project to demand cement without increase the present capacity Portland cement clinker production [15]. Cement and concrete industries try to improve his sustainable development and a fine way for the solution of the problem. Approximately 90% of slags and coal ashes are producing today, both of them have low value of application such as using in landfill and pavement or simple disposed.

5.2 Durability approach of concrete sustainability

Most of the industries producing the fly ash, silica fume and slag were replaced into the cement and reduces the amount of CO_2 emission and progress the properties of fresh and hardened concrete states [16, 17]. "apart from enhancing the rheological properties and controlling bleeding of fresh concrete, these materials greatly improve the durability of concrete through control of high thermal gradients, pore refinement, depletion of cement alkalis, resistance to chloride and sulphates penetration and continued microstructural development through long-term hydration and Pozzolanic reactions although concrete can provide, through chemical binding, a safe haven for many of the toxic elements present in industrial wastes; and there are strong indications that these mineral admixtures can also reduce the severity of concrete durability problems arising from Delayed Ettringite Formation and Thaumasite" [18].

5.3 Holistic approach design for sustainability development of concrete

The development of Concrete materials for durability, and composition SF, slag, FA or other different types of pozzolans materials as crucial and basic constituents of the concrete compositions are the first issues and a fundamental key advance towards accomplishing reasonable improvement of the Cement and Concrete Industry [18]. Therefore, it should be "flippant and facetious of us to believe that sustainable development in the construction industry can be achieved merely by utilizing siliceous industrial byproducts in concrete alone" [19]. It is essential to understand the concrete characteristic such as holistic design the materials to have good durable concrete structures. This method would incorporate the accompanying.

5.3.1 New concrete structure

Design of new concrete structure must durable and environmentally:

- Portland Cement must not be used alone in concrete
- The concrete must be designing with recycle material; FA, SF, LW, and so forth.
- Production of cement materials for DURABILITY and not for STRENGTH.

Design concrete structure for sustainability development:

- Design to minimize the site waste
- Waste material reduction and waste material disposal
- Design for the least harm to the environment
- Creative design, A closer investigation of configuration loads: Avoid over-design
- Determine the design specific life of concrete structures

Available Structures:

- Justify destruction
- Reconstruction, restoration
- Shield concrete from forceful situations
- Treatment concrete structure and creative new technology for concrete structure also prevent overload on concrete structures.

Management strategy for concrete structure:

- Concrete must be inspected, and repaired the defects of concrete structure
- Provide a maintenance approach for concrete structure.

6 POZZOLANIC MATERI TYPES FOR CONCRETE SUSTAINABLE DEVELOPMENT

6.1 Fly Ash or Pulverized-Fuel Ash (PFA)

PFA produced from fiery pulverized (finely ground) coal to power electric generation. The composition of PFA are “shales and clays (contents of silica, alumina and iron oxide) and other contents in coal, melt while in suspension, and then with rapid cooling, they are carried out by the flue gases and form into fine spherical particles” [20]. The Fly Ash particles are commonly circular fit as a fiddle and range in size from 0.5 µm to 100 µm. Fly ash is substantial Pozzolanic material that it has various advantages and evaluated with ordinary Portland cement. Fly Ash has a good lower heat of hydration that it has made famous cementitious materials for a mass concrete structure. Previous researches have investigated the utilization of fly ash as added substance concrete gives positive outcomes as far as mechanical and concoction properties [21, 22].

6.2 Silica Fume (SF)

SF is product from “silicon and ferrosilicon alloys from high purity quartz and coal in a submerged-arc electric furnace which it has a powder with particles having diameters 100 times smaller than those of anhydrous Portland cement particles and the most important influences in the use of silica fume as an admixture in cement-based materials are increases in tensile strength, compressive strength, compressive modulus, flexural modulus, and the tensile ductility, but decreases in the compressive ductility, it enhances the freeze-thaw durability, the vibration damping capacity, the abrasion resistance, the bond strength with steel rebar, the chemical attack resistance also the corrosion resistance of reinforcing steel” [20]. Addition, SF can be decreased the alkali-silica reaction, permeability, the drying shrinkage, coefficient of thermal expansion, creep rate, and dielectric constant. [21, 22].

6.3 Ground Granulated Blast furnace Slag (GGBFS)

GGBFS is acquired by extinguishing liquid “iron slag (produced by iron and steel particles) from a blast furnace in water or steam, to create a glassy, granular item that is then dried and ground into a fine powder also utilization of slag or slag cement typically enhances functionality and diminishes the water request because of the expansion in glue volume caused by the lower relative density of slag” [20].

6.4 Rice Husk Ash (RHA)

Nearly to 600 million tons of rice paddy are produced every year around the world. “On mean, 20% of RHA is produced, with an annual production of 120 million tons and rice husk is an outside cover of rice, that is produced (nearly 90% by mass) during de-husking of paddy rice also the Rice is wealthy in silica content, acquired by consuming rice husk to expel unpredictable natural carbon, for example, cellulose and lignin although it is evaluated RHA, one ton of rice yields 200kg of husk and about 40kg of powder” [20]. Based on Mehta, the amorphous silica powders with the high surface territory are more responsive than the crystalline type of silica. The fineness of ash will influence the reactivity of RHA in the lime, mortar [20, 21, 22, and 23].

6.5 Met kaolin (MK)

Met kaolin is “refined kaolin clay that is fired (calcite) under carefully controlled conditions to create an amorphous alumina silicate that is reactive in concrete and replacing Portland cement with 8% - 20% (by weight) met kaolin produces a concrete mix which exhibits favorable engineering properties, including: the filler effect, the acceleration of OPC hydration, and the Pozzolanic reaction” [20].

7 POZZOLANIC MATERIALS ADVANTAGE FOR CONCRETE SUSTAINABLE DEVELOPMENT

Recently construction industries widely used Pozzolanic materials in the concrete structure also for soil stabilization due to their technical strength, environment-friendly, and economic reasons [21, 22]. Supplementary cementitious materials are including GGBFS, FA, SF, RHA, MK, and POFA, to name a few. The use of Supplementary cementitious materials in concrete structure can mostly reduce the amount of cement and reduce CO_2 emission from the environment, which, thusly, can decrease construction costs, provide material suppliers, contractors, and engineers with substantial advantages [23]. Moreover, in spite of the problem in cement binary but the composition of cementitious supplementary can prompt numerous focal points, for example, enhanced concrete strength, durability of concrete, workability of concrete and so forth [24].

8 RECYCLED AGGREGATE TYPES FOR CONCRETE SUSTAINABLE DEVELOPMENT

Industrial waste a material has been used in the concrete production is a run through which could be dated back of few periods. Brito (2015) evaluated “The wide amount of cement mixtures formed with fly ash. Silica fume and granulated blast furnace slag and silica fume, all of which are wastes from industrial and the at the current time, applications had been still standing made to obtain new materials that could be appropriated in concrete production, and consequently give more sustainable construction manufacturers” [25].

8.1 Crushed marble recycled aggregate

Martins et al. (2014) and André et al. (2014) considered the mechanical and durability-related act and carry out, individually, concrete mixes with recycling coarse aggregate completed obtained as of industry of marble [26, 27]. The researcher made compare between the performances of this “concrete mixture with straight combinations of mixes made with limestone aggregates, basalt, and quartzite although compressive strength had been loss of 10% that was caused full replacement of coarse NA, in comparison to the concrete mixtures, with the exception for modulus of elasticity and conflict to abrasion(28% will losses up and 51% individually), commonly, the summary of recycled aggregate as of crushed marble just affected a slight decline in all properties” [25].

The researcher evaluated the mechanical and durability act and carry out, individually, by the way, the presence of the finer section of the marbles in crushed [28, 29]. The consequence result exposed compressive strength loss principle value between range 10 and 20 percent

8.2 Recycled aggregates ground rubber tyres

The researcher considered on durability and mechanical and -linked act and performance, individually, of mixes concrete structural to make by recycling ground rubber from used tyres. [30, 31]. “Concrete mixed with the ground rubber from used old tyres and formed concrete mixes through unused level 5, 10, and 15% with ground rubber tyres, with dissimilar sizes and shapes and the consumption of recycling tyres aggregate has been obtained through the procedure of cryogenic” [25]. The absorption of 15% percent of this material affected compressive strength loss values between range 46 and 52% percent Figure 8 the concrete compressive strength by increasing RA from managed rubber tyres. The consumption of recycled aggregate from tyres ground rubber in the concrete manufacture affected a substantial decline in the durability carry out [30]. On the other hand, it is present that the presence of this materials permitted producing concrete combinations mixes via the same water concentration with capillarity rates to these of the concrete referred in Figure 9 shown the water absorption rubber tyres by increasing

The researcher considered the behavior of mixes combination concrete, prepared with recycled ground rubber aggregate of used tyres, when existence exposed to fire and the results had been so clear [32, 33]. This material has been greatly subjected to the magnitude of recycled rubber aggregate, and higher replacement levels affected a poorer thermal.

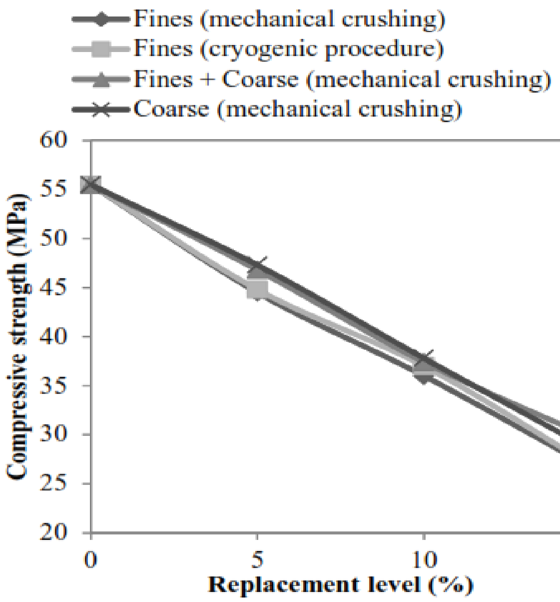

Fig-8: Concrete compressive strength by increasing RA from managed rubber tyres [29]

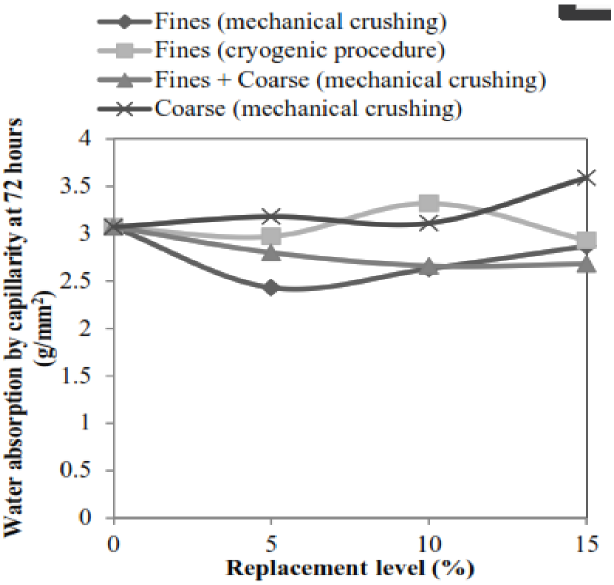

Fig-9: Water absorption rubber tyres by increasing RA [30]

8.3 Glass recycled aggregates

The researcher evaluated the durability and mechanical properties of concrete and mixed west glass with concrete [34, 35]. This west material can be decreasing compressive strength about 20 % while the consumption of recycled glass aggregate simply make happen a 10% decrease for the similar replacement level of 20% percent at that point the degree of this decline increased. This west glass has been permitted producing concrete combination mixes and effected on economic of concrete [31, 35].

8.4 Recycled aggregates from plastic waste

Babafemi (2018) evaluated “utilization of recycled waste plastics in concrete as a partial aggregate replacement has a clear effect on the properties of the material also this material is to be used in concrete in large quantities, it is important to know the relationship between the addition of recycled waste plastics and the engineering properties and in most cases, waste plastics have been used in concrete either as fine or coarse aggregate although utilization of this type of waste in concrete is beneficial from an environmental point of view, it's engineering (e.g., mechanical and thermal) properties are essentially different from natural aggregates” [36].

8.5 Other types of recycled aggregates

The researcher evaluated the "qualitative analysis on the comparative effects of incorporating more than a few types of non-conventional recycle aggregate, obtained from industrial wastes, on the mechanical and durability performance of concrete and some examples of these materials are, EVA (ethylene vinyl acetate), leather, iron, coal, oyster shells, powder stone sludge, palm tree husk and even synthetic sewer sludge aggregates. Commonly, the use of this materials as a replacement for conventional aggregates affected a considerable decline in the mechanical and durability-related act and performance, unless they have been used in very small quantities and/or as ultra-fine materials" [25].

9 APPROACH OF CONCRETE IN SUSTAINALBE BUILDINF AND SERVICE LIVE

Isaia and Gastaldini (2004) report that in their products it consumes 5.5GJ of energy and releases roughly 1ton of CO_2 per ton of clinker [39]. Japan has also acquired a wide range of concrete industry technologies to minimize potential effect and concentration on CO_2 emission control and recycling [40]. Those determinations helped to reduce CO2 emissions from manufacture of cement; unit- based CO_2 in Japan. Considering that 1ton of cement has about 70% of clinker, it is observed that a year are issued by the cement industry, about 1 billion tons of CO_2 into the atmosphere. Despite the numbers are not representative face global CO_2 emissions (representing on average 6% of the total issued, but of course cannot be overlooked), cement manufacturing for use in concrete had been reshaped to monitor sustainable global development.

There are basically two ways of reducing the amount of CO_2 in the atmosphere caused by cement production:

Reducing production quantity (limit production), and Replacement of the "pure cement" one or more mineral admixtures, most industrial by products typical case of fly ash and blast furnace slag, turning the product ecologically correct cements [36, 37, 38].

9.1 Properties improvement and service life of concrete in sustainability development

The environmental impact of the concrete structure has been reduction to minimum without gave in their performance is a major concern for sustainable development of concrete manufactured. Sustainability in concrete could be done by refining present observes, such as innovation nor improvement in concrete combination mix and invention design methods (Khokhar et al. 2010, Joseph and Tretsiakova-McNally 2010), the performance of concrete being improvement related on products in their life services [41, 42]. The durability and mechanical behavior of concrete have been the improvement in life services, and this performance ultimately reduce the amount of carbon dioxide CO_2 but increasing in service life's and the requirement of this material has been reduced in place of repairing. [38].

High and ultra-high strength of concrete and self-compacting concrete from use of innovation sorts in concrete correspondingly be increasable in the sustainable in concrete manufacture by giving the flexibility in design product by increasable material behavior (Joseph and Tretsiakova-McNally 2010) [42].

10 FUTURE PERSPECTIVE

The Cement Sustainability Initiative "(CSI) of the Business World Council for Sustainable Development (WBCSD) and IEA jointly conferred in 2009 a standard procedure regarding the contribution by the cement industry to reduce emissions of CO_2 by fifty percent in 2050" [7]. Four steps should be considered to reduce emissions for carbon according to the cement industry:

- Thermal and electric performance counting toward to placement of current "state-of-the-art technologies in plant in new cement and retrofit of energy efficiency equipment where economically viable" [7].
- Effective substitute for fuels, i.e. the use of fossil fuels with less carbon-intensive and more fuels (waste) and biomass fuels.
- Clinker Substitution, i.e., cementitious properties with materials.
- Carbon capture and storage known as CCS

Technology Roadmap "2009 IEA-WBCSD 2009 Cement: Carbon Emissions Decline up to 2050" [7]. The current and future sentiments of environmentally- friendly ecosystem uses that can accommodate a biological environment.

11 CONCLUSION

Concrete production plays a vital role in economic development both globally and locally. Due to the improvements in concrete sustainability that is essential to understand the impact of many issues in the concrete design phase, construction phase and life cycle of the concrete structure such as "durability" and the most significant issue is preserving the resource and energy in the ecosystem.

This study has summarized the evaluation of concrete technology and sustainable development from past to future and found the main cause of global warming which is CO_2 emission during the production of concrete and cement. Also this study found the best approach for reducing the amount of CO_2 in environments is Pozzolanic material and west material both as playing a vital role in sustainable concrete structure.

Although this study reviewed the concept of sustainable development in concrete industries which is using the amount of cementitious and Pozzolanic material instead OPC due to the conservation of concrete substances, durability design of the concrete structure, and holistic approach design for the concrete components. These are three important pillars of sustainable development.

Although this study reviewed the future prospects of concrete technology and sustainability development, recently most of international organizations are working on concrete sustainability development to reduce the amount of CO_2 emission by 50% until 2050. These organizations suggested four steps for reducing the amount of CO_2 emission based on the cement industries and concrete productions in all over the world which is the installation of new technology in old and new cement plant based on thermal and electric performances, The fossil fuel must be substituted of chemical and natural oil due to lessCO_2, intensive and more fuels (waste) and biomass fuels, clinker substitution, and Carbon capture and storage.

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REFERENCES

[1] Weaver P, Jansen L, Van Grootveld G, Van Spiegel E, Vergragt P. Sustainable technology development. Routledge; 2017 Sep 8.

[2] Mulder KF. Strategic competences for concrete action towards sustainability: An oxymoron? Engineering education for a sustainable future. Renew Sustain Energy Rev. 2016 Mar 25:1-6.

[3] Bjork, F. "Concrete Technology and Sustainable Development." CANMET/ACI International Symposium on Concrete Technology for Sustainable Development. 1999.

[4] Cheung, M., and S. Foo. "Technology Real Property Services Branch Public Works and Government Services Canada." Use of Fly Ash in Concrete: proposed PWGSC Guidelines, CAN MEET International Symposium on Concrete Technology for Sustainable Development. 1999.

[5] Bueckert, D., Canadian Press AThe World Braces for 6 Billion@, Vancouver Sun, September 24, 1999.

[6] Juenger MC. sustainable Low CO2 cement concrete. Routledge Handbook of Sustainable and Resilient Infrastructure. 2018 Dec 17:377.

[7] Gjorv O, Sakai K. Concrete technology for a sustainable development in the 21st century. CRC Press; 2014 Apr 21.

[8] Sim, Jongsung, Minkwan Ju, and Kihong Lee. "Thirty Years Researches on Development for Sustainable Concrete Technology." In MATEC Web of Conferences, vol. 138, p. 03008. EDP Sciences, 2017.

[9] Sakai K, Noguchi T. The sustainable use of concrete. CRC press; 2012 Jul 26.

[10] Swamy RN. Designing concrete and concrete structures for sustainable development. In Sustainable Development of the Cement and Concrete Industry. Proceedings of CANMET/ACI International Symposium, Ottawa, Canada 1998 Oct 21 (pp. 245-255).

[11]Jahren P, Sui T. Concrete and sustainability. CRC Press; 2013 Jul 16.

[12] Jonsung S, Lee KH. Sustainable Concrete Technology. Civil Engineering Dimension. 2015 Dec 18; 17(3):158-65.

[13] Kulkarni V.R. Concrete Sustainability: Current Status in India and Crucial Issues for the Future. Presented at Concrete Sustainability through Innovative Materials and Techniques, Roving National Seminars, Bangalore, and January 10–14, 2011.

[14] Mehta, P.K, AAdvancements in Concrete Technology@, Concrete International, June 1999, pp.69-76.

[15] Mehta, P.K., “Bringing the Concrete Industry into a New Era of Sustainable Development,” Proceedings of the Mario Collepardi Symposium on Advances in Concrete Technology, pp. 49–68, 1997.
[16] Malhotra VM, Mehta PK. Pozzolanic and Cementitious Materials, Gordon and Breach Publishers, SA, 1996, 191 pp. Coarse aggregate.;1225(1225):1225.
[17] Swamy RN. Design for durability and strength through the use of fly ash and slag in concrete. Special Publication. 1997 Aug 1; 171:1-72.
[18] Al-Mana AB, Haneef M, Maslehuddin M. Effect of cement replacement, content, and type on the durability performance of fly ash concrete in the Middle East. Cement, Concrete and Aggregates. 1986 Jan 1; 8(2):86-96.
[19] Swamy RN. Designing concrete and concrete structures for sustainable development. In Sustainable Development of the Cement and Concrete Industry. Proceedings of CANMET/ACI International Symposium, Ottawa, Canada 1998 Oct 21 (pp. 245-255).
[20] Mukherjee SP, Vesmawala G. Literature review on technical aspect of sustainable concrete. International Journal of Engineering Science Invention. 2013 Aug; 2(8):1-9.
[21] Altwair NM, Kabir S. Green concrete structures by replacing cement with pozzolanic materials to reduce greenhouse gas emissions for sustainable environment. InProceedings of 6th International Engineering and Construction Conference (IECC’6), Cairo, Egypt 2010 Jun 28 (pp. 28-30).
[22] Meyer C. The greening of the concrete industry. Cement and concrete composites. 2009 Sep 1; 31(8):601-5.
[23] Ismail MS, Waliuddin AM. Effect of rice husk ash on high strength concrete. Construction and building materials. 1996 Oct 1; 10(7):521-6.
[24] Owaid HM, Hamid RB, Taha MR. A review of sustainable supplementary cementitious materials as an alternative to all-Portland cement mortar and concrete. Australian Journal of Basic and Applied Sciences. 2012 Sep; 6(9):287-303.
[25] Brito J, Silva R. Use of waste materials in the production of concrete. InKey Engineering Materials 2015 (Vol. 634, pp. 85-96). Trans Tech Publications.
[26] Martins P, Brito JD, Rosa A, Pedro D. Mechanical performance of concrete with incorporation of coarse waste from the marble industry. Materials Research. 2014 Oct; 17(5):1093-101.
[27]André A, de Brito J, Rosa A, Pedro D. Durability performance of concrete incorporating coarse aggregates from marble industry waste. Journal of Cleaner Production. 2014 Feb 15; 65:389-96.
[28] D. Silva, F. Gameiro, J. de Brito, Mechanical properties of structural concrete containing fine aggregates from waste generated by the marble quarrying industry, J. Mater. Civ. Eng. dx.doi.org/1061/ (ASCE) MT.1943, (2014).
[29]Gameiro F, De Brito J, da Silva DC. Durability performance of structural concrete containing fine aggregates from waste generated by marble quarrying industry. Engineering Structures. 2014 Feb 1; 59:654-62.
[30] Valadares F, Bravo M, de Brito J. Concrete with used tire rubber aggregates: Mechanical performance. ACI Materials Journal-American Concrete Institute. 2012 May 1; 109(3):283.
[31] Bravo M, de Brito J. Concrete made with used tyre aggregate: durability-related performance. Journal of Cleaner Production. 2012 Apr 1; 25:42-50.
[32] Correia JR, Marques AM, Pereira CM, De Brito J. Fire reaction properties of concrete made with recycled rubber aggregate. Fire and Materials. 2012 Mar; 36(2):139-52.
[33] Marques AM, Correia JR, De Brito J. Post-fire residual mechanical properties of concrete made with recycled rubber aggregate. Fire Safety Journal. 2013 May 1; 58:49-57.
[34] Serpa D, de Brito J, Pontes J. Concrete made with recycled glass aggregates: Mechanical performance. ACI Mater. J. [accepted for publication]. 2015 Jan 1.
[35] de Castro S, de Brito J. Evaluation of the durability of concrete made with crushed glass aggregates. Journal of Cleaner Production. 2013 Feb 1; 41:7-14.
[36] Babafemi A, Šavija B, Paul S, Anggraini V. Engineering Properties of Concrete with Waste Recycled Plastic: A Review. Sustainability. 2018 Oct 25; 10(11):3875.
[37] Sakai K. Sustainability in fib Model Code 2010 and its future perspective. Structural Concrete. 2013 Dec; 14(4):301-8.
[38] Sobotka T, Skirbekk V, Philipov D. Economic recession and fertility in the developed world. Population and development review. 2011 Jun; 37(2):267-306.
[39] Henry M, Kato Y. Perspectives on sustainable practice and materials in the Japanese concrete industry. Journal of Materials in Civil Engineering. 2011 Sep 16; 24(3):275-88.
[40] Isaia G, Gastaldini A. Concreto “verde” com teores muito elevados de adições minerais: um estudo de sustentabilidade. InI Conferência Latino-Americana de Construção Sustentável X Encontro Nacional de Tecnologia do Ambiente construído, São Paulo, SP. Anais... CD-ROM 2004 Jul.
[41] Khokhar MI, Rozière E, Turcry P, Grondin F, Loukili A. Mix design of concrete with high content of mineral additions: Optimisation to improve early age strength. Cement and Concrete Composites. 2010 May 1; 32(5):377-85.
[42] Joseph P, Tretsiakova-McNally S. Sustainable non-metallic building materials. Sustainability. 2010 Feb; 2(2):400-27.