

A Review on Green Concrete Using Fly Ash

Paramjeet Kaur^[1]

Email: paramjeetkaur92@gmail.com

Prabhdeep Kaur^[2]

Email: prabh.kaur18@gmail.com

ABSTRACT: Purpose of this paper is to provide a concept of green concrete. As we know in all types of construction we mainly prefer concrete over all other building materials. We also know that in the production of concrete the main constituent is cement. For manufacture of cement, it requires a large amount of energy & also has very bad impact on environment. The “green” concrete is the concrete produced by utilizing alternative waste materials (such as fly ash) to reduce energy consumption, environmental impact. Thus, green concrete is an excellent substitute of cement as it is cheaper, because it uses waste products, saving energy consumption in the production. The most important thing about green concrete has greater strength and durability than concrete having only OPC.

KEY WORDS: *Green concrete, cement, cementitious materials, fly ash, Eco-Friendly, strength*

I. INTRODUCTION:

Concrete is the most commonly used man made material for the construction in India as well as in abroad. Its popularity lies in the simple fact that the cement used in it as a building material is commonly available, has high strength, durability, easy to handle. In short it is most consumed material in the world. It has the property of binding other material like coarse aggregate, sand. Once it is set it becomes like hard stone. The cement was discovered in 1824 by William Aspdin, but the cement now used is developed by Charles Johnson

Cement is produced by the proportioning of chalk lime & clay. After that grinding & mixing of raw materials done. Then in final step the raw materials are burned in the kiln at a temperature of 1400-1450 °C.

II. AIMS & OBJECTIVES OF USING GREEN CONCRETE:

The production of cement is not ecofriendly because many million tones of natural raw materials are mixed and grinded every year and it may leave a great impact on environment we know cement is manufactured from calcium carbonate which break into calcium & carbon-di-oxide. As a survey in 2004 which told that this carbon-di-oxide produced by cement production is responsible for green house gases (approximately 7% contribution). This survey also told that this contribution can be 100% by 2020 by the production of cement. Hence the quantity of carbon-di-oxide in the environment increase at a larger scale. Therefore we have to pay this popularity of cement at the cost of environment. As we know without environment we can not survive. Therefore we can not afford such a

big loss .So we can go for an alternative .which is termed as green concrete. By using green concrete we can maintain sustainable development Green concrete is nothing but it is an alternative for cement in which we use recycled or byproducts by some part in place of cement. The motto for this is to minimize the carbon content & to optimize the packing density of all the solid materials like cementitious materials & coarse aggregates. Both the addition of supplementary cementations materials and the optimization of packing density substantially reduce the absorptive and permeability of concrete, thereby improving the durability of the concrete structures. The material which have same physical & chemical properties that of cement is fly ash which is fine powder is a by product of industries & power plants producing electricity using coal as combustion material .therefore properties of ash varies as the quality of coal varies. But all the fly ash always contain silicon di oxide & caluim di oxide. In few years ago this fly ash is released in the atmosphere as a waste product or dumped into vacant places. But now approximate 40-50% of this fly ash is used as an alternative to cement.

| Country | Millions tons produced | Millions tons utilized | %age used |
|-----------|------------------------|------------------------|-----------|
| China | 91.1 | 13.8 | 15.1 |
| Denmark | 1.3 | 0.4 | 30.8 |
| Hong Kong | 0.63 | 0.59 | 93.7 |
| India | 57 | 2 | 3.5 |
| Japan | 4.7 | 2.8 | 59.6 |
| Russia | 42 | 4.3 | 6.9 |
| USA | 60 | 8.1 | 13.5 |

Table 1 Coal-Ash Production and Utilization (1995) [4]

III. CHEMICAL COMPOSTION OF FLY ASH:

The fly ash is collected from the power plants by electrostatic precipitators or by bags, because it solidifies when suspended in exhaust gases. As it Solidifies when suspended in exhaust gases. As it solidifies when in exhaust gases therefore it is generally in the spherical shape and its size generally varies from 4-300 μ. Fly ash generally contains material. SiO₂, Al₂O₃, Fe₂O₃ occasionally CaO are the main chemical components present in fly ashes.

| CHEMICAL PROPERTIES | |
|--------------------------------|--------|
| Compounds | %age |
| SiO ₂ | 45.98 |
| Al ₂ O ₃ | 23.55 |
| FE ₂ O ₃ | 4.91 |
| CaO | 18.67 |
| MgO | 1.54 |
| Na ₂ O ₃ | 0.24 |
| K ₂ O | 1.80 |
| SO ₃ | 1.47 |
| Loss of ignition | 2.31 |
| Cl- | 0.0053 |
| Free lime | 0.64 |

Table 2 Chemical Properties of fly ash[13]

IV .CLASSIFICATION OF FLY ASH:

1. **CLASS F:** This type of fly ash is generally produced by burning of anthracite & bituminous coal. It is pozzolanic in nature .in this the percentage of caluim oxide is very less approximately 20%.. It can produce cementitious products by

combing with OPC, quick lime and with the help of water

2. **CLASS C:** This type of fly ash is produced by burning lignite coal. This type of fly ash has both cementitious as well as pozzolanic properties. As compared to F type it has more percentage of calcium oxide (more than 20%).

| PHYSICAL PROPERTIES | CLASS C FLY ASH | CLASS F FLY ASH |
|---|-----------------|-----------------|
| Specific gravity | 2.73 | 2.31 |
| Soundness, autoclave expansion, % | 0.06 | 0.01 |
| Fineness, amount retained on #325 sieve, % | 16.6 | 18.45 |
| Strength activity index with Portland cement 1. at 7 days, % of Portland cement control 2. at 28 days, % of Portland cement control 3. Water requirement % of cement control | | |
| | 94 | 78.8 |
| | 96 | 80.8 |
| | 93 | 97.1 |

Table 3: Physical properties of fly ash [7]

Advantages of Adding Fly Ash:

1. Since by using fly ash in concrete, it reduces the carbon dioxide content. Therefore it reduces the greenhouse effect

2. Since it increases the durability & strength of concrete, therefore it increases the life time of structures
3. This mixture of fly ash & cement has good workability
4. As we have to dump this fly ash on landfills as it is a waste product of coal combustion
5. As for production of cement we have more & more concentration on natural resources. Therefore fly ash reduces this
6. More sustainable environment & concrete industry
7. By adding fly ash cost also decreases to some extent

BARRIERS IN USE OF GREEN CONCRETE:

Since we get so many benefits by using green concrete, despite there are many barriers in wide application of this. Some of them are explained below:

- I. Properties of concrete: using waste products as a material in production of concrete, it increases certain properties like compressive strength but on the other hand it decreases the thawing action of concrete
- II. Industry practice: The construction and building product industry is conservative in nature due to the fear of product failure, which becomes a barrier to the utilization of waste materials. They also indicated the existing negative perceptions of the industry on non-conventional practice

in concrete production, which may not be always, true [2].

Results & conclusions:

The review presented in this report clearly indicates that if we want to reduce the adverse effects of cement industry on environment, the aim to check energy consumption and reduce green house gas emissions [3]. Since we know that there has been a huge development in the production of concrete. In the past we produce concrete by simply hand mixing of all the intergradients, after that we mixers & now we have batching plants from which we get ready mix concrete. But this development is not sustainable .for future generations we have to take steps to make this development sustainable otherwise we have to bear serious consequences. From recent investigations it is found that if we dispose off large volume of fly ash on landfills, the lands are degraded .but if we use this high volume of fly ash (waste product) in construction sites then it is an innovative step in the protection of natural resources .it was first used in US but now it is widely used all over the world in different percentage with cement. The use of this high volume of fly ash is nothing but green concrete. Since by using this there is no emission of carbon di oxide gas therefore it also helps in reducing the green house gases and global warming. It have only one negative point that by using fly ash in cement, it gains slowly early strength & final strength .but this negative point is overcome by its durability.fly ash have high durability as compare to OPC

At last I want to say that this fly ash can not replace the Portland cement completely, however it is a environmentally attractive option in some appropriate situation.

References

- 1) Duxson, P., Provis, J. L., Lukey, G. C., & Deventer, *The role of inorganic polymer technology in the development of "green concrete."* Cement and Concrete Research, J. S. J. V., 2007.
- 2) Bentz, D. P., "Powder additions to mitigate retardation in high-volume fly ash mixture", ACI Materials Journal, 2010
- 3) Mehta, P.K., "Greening of the Concrete Industry for Sustainable Development", Concrete International, July 2002
- 4) Van Geem, M.G. and M.L. Marceau, "Using Concrete to Maximize LEEDS Points", Concrete International, November 2002
- 5) Aggrawal Vanita, Gupta S.M., Sachdeva S.N., "High volume fly ash concrete: a green concrete", Journal of Environmental Research And Development, Vol. 6 No. 3A, Jan-March 2012
- 6) Raju. N.K., Production, "Properties of High Strength Concrete Using Super plasticizers", Nati. Sem. High Strength Structure Concrete, India, Concrete Institute, Bangalore, 1991
- 7) Patel Raj, Kinney Fred, Schumacher Glenn, "Green concrete using 100% fly ash based hydraulic binder", International Concrete Sustainability Conference, 2012
- 8) Meyer c., "Concrete as a Green Building Material", Columbia University, New York, NY 10027, USA

- 9) Berry Michael, cross Doug, Stephens jerry, ” *Changing the environment : An alternative green concrete produced*

Without Portland cement”, world of coal ash conference, 2009

- 10) Garg chirag & jain aakash, “ green concrete: efficient & eco-friendly construction materials”, ijret, vol. 2, issue 2, feb 2014,
- 11) Jin Ruoyu & Chen Qian, ” An Investigation of Current Status of “Green Concrete in the Construction Industry, 49th ASC Annual International Conference Proceedings
- 12) Chetna M Vyas, Darshana R Bhatt, ” Concept of Green Concrete Using Construction Demolished Waste As Recycled Coarse Aggregate” ,*International Journal of Engineering Trends and Technology (IJETT) - Volume4 Issue7- July 2013*
- 13) Swamy RN, Mehmod HB. Mix proportions and strength characteristics of concrete containing 50% low calcium Fly ash. International congress on fly ash, silica fume, slag and national pozzolanas in concretes, Madrid, *Vol 1, 1986*