Eco-Concrete? Opportunities and Challenges

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ABSTRACT

20th century is known as the concrete century as during this century cement-industries has contributed a lot towards the development of the society .So moving toward the 21st century has bought new revolution in this field .One of them is Eco-concrete .Eco-concrete is a new type of concrete which is being developed to solve the waste management problem of the municipal and the industries. It will also help the environment by recycling the waste produced by big industries which otherwise would have been dumped in landfills or seas etc. The eco-concrete is not a completely different concept but is same as that of ordinary concrete but the difference is that it uses supplementary cementing materials. These supplementary cementing materials are a class of materials that can be used in the manufacturing of concrete as partial replacement of Portland cement. The most frequently used SCMs are: fly ash – a by-product of coal-fired power plants; silica fume – also known as micro-silica. Less-commonly-used SCMs include: natural pozzolans (or volcanic ash) .There are numerous opportunities like making environmental friendly constructions, restoration of environment by removal of CO_2, conservation of energy as this requires less heat during its construction etc on the other hand there are some problems or we can say challenges that we need to face for instance the conservative behavior of the construction companies. But sooner or later we have to go for this so why not now?

Keywords:-Eco-concrete, Supplementary cementing materials, Advantages of Eco-concrete

1. INTRODUCTION

The concrete has proved itself to be the best constructional material over the years. It has helped us to create those things which were once considered impossible to be constructed. But with the passage of time as its demand has increased over the years**,** its ill effects has also affected the society a lot .The world's yearly cement production is around 1.6 billion tons . The production of cement on such a large scale has started to destroy the environment with the release of carbon dioxide in the atmosphere. About 5% of the total CO_2 produced due to various activities around the world is produced by the cement industries. But we cannot abandon its need. Keeping all these things in mind researchers and scientists have come up with a solution named as Eco-concrete. Eco-concrete is a special type of concrete that uses industrial and municipal waste as its raw material for its construction reducing the need of cement and its demand.

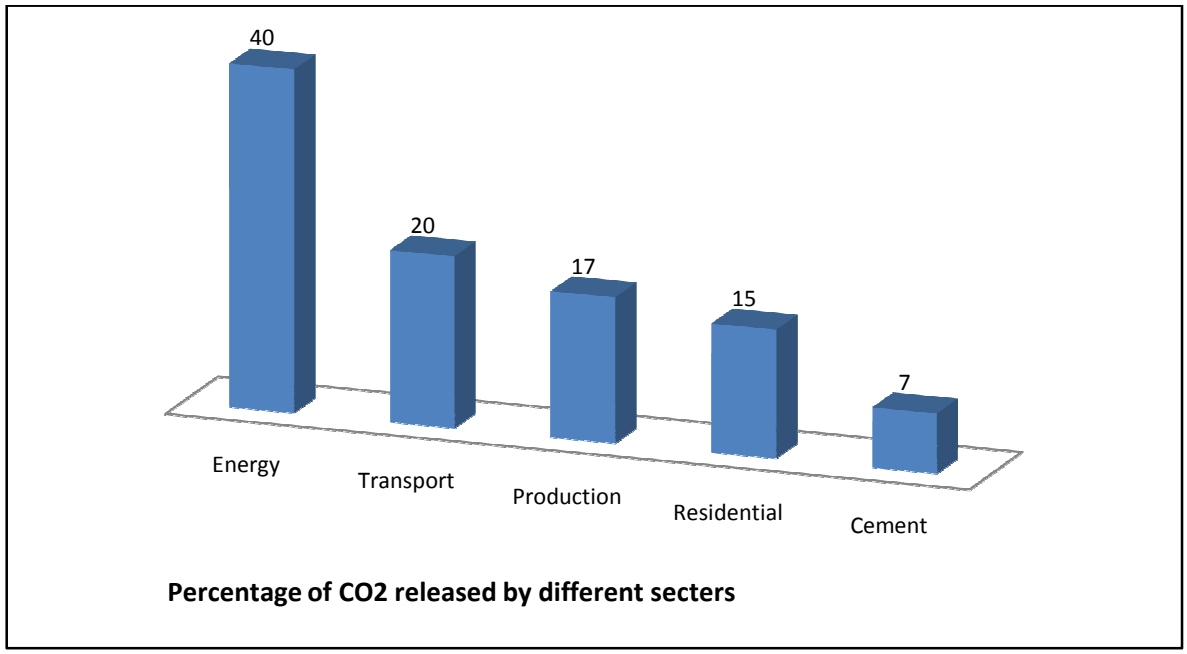

Fig. 1: Presenting percentage of CO_2 released by different sectors

Portland cement is that variety of cement whose production represents maximum release of CO_2 in the atmosphere, which is ultimately affecting the environment and causing global warming. This impact of cement and its production has to be reduced by adopting Eco-concrete.

Eco-concrete reduces the use of cement in concrete production by using industrial waste. It helps in reducing carbon dioxide release in the atmosphere. This concrete has the ability to capture CO_2 by a carbonation process and by using industrial waste and reducing the need of cement. Although carbonation levels for current concrete structures is low but still it's quite considerable. Eco concrete has many advantages over the conventional concrete because it uses the recycled industrial waste and materials as its aggregates, which reduces the extra load in landfills and lessens the wastage of aggregates thus, the total CO_2 emission is reduced to a considerable extent and the reuse of materials also contributes intensively to economy since the waste material like aggregates from a nearby area and fly ash from a nearby power plant are not much expensive and also transport costs are very less.

2. SUPPLEMENTARY CEMENTING MATERIALS (SCM)

Cement conservation is the first step in reducing the energy consumption and greenhouse-gas emission. Resource productivity consideration makes us to think about minimizing Portland

cement use while meeting the future demands for more concrete. This brings in the supplementary cementing materials (SCM) into consideration. These materials can substitute or minimize the use of cementing materials in the concrete mix, making it economic and environment friendly. These materials include cementitious or pozzolanic by products such as ground granulated blast-furnace slag and fly ash, vast quantities of which are still used in low valued applications like land filling etc. There is a huge potential of Eco-concrete if these by products along with different industrial wastes are used properly in the production of Eco-concrete. Some of the important supplementary cementing materials are –

1) Fly ash-

Fly ash a byproduct from coal-fired electricity production is one of the most widely used cementitious material which now a days can replace cement in concrete up to 40% .it has very low hydration characteristics thus providing very little contribution to early age strength but it's very good substitute to Portland cement as it shows similar characteristics to that of Portland cement in production of concrete. The hydration product formed from the high-volume fly ash system is much more homogeneous and well-bonded with aggregate, needed for crack resistant concrete.

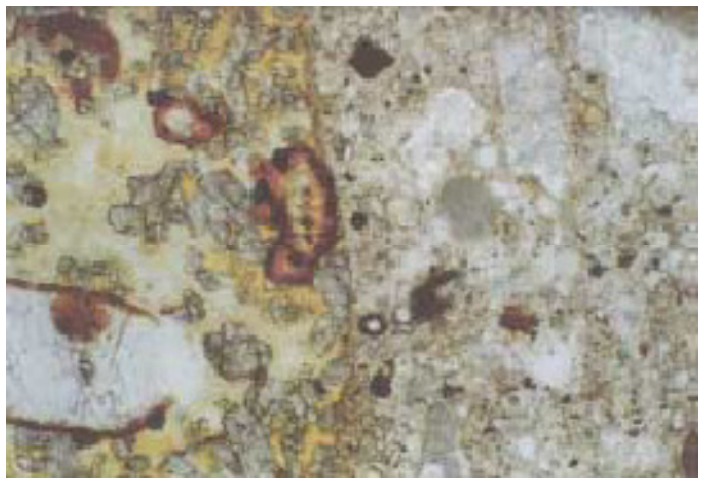

Fig. 2

Photomicrograph of a thin section from the concrete core Obtained from the high-volume fly ash system used for the Construction of the Iraivan temple foundation in Kauai. A 40x magnification in plane polarized light of a coarse aggregate particle and the adjacent cement mortar shows no interfacial transition zone and no microcracks

2) Silica fumes-

Silica fume is a by-product from the production of the silicon metal with high pozzolanic activity. This by-product is responsible for a denser concrete microstructure with in turns increases both strength and durability. It makes the Eco-concrete resistant to the adverse climatic conditions like heavy rains and heat.

3) Rice husk ash-

Rice husk ash is a very reactive pozzolan which is obtained when rice husks are calcinated below the crystallization temperature at 780 ºC. RHA based concrete has high strength and high durability performance.

4) Sewage sludge ash-

SSA is a siliceous material obtained by the calcinations of water treatment wastes. Its pozzolanic activity is influenced by its chemical composition and the temperature on which it is calcinated.

5) Non reactive wastes as aggregate replacements-

It's very conventional to use non reactive and demolished wastes for the replacements of the natural aggregates. It's very economic and feasible to all and most importantly it's highly user friendly

6) Tyre rubber wastes-

According to a survey almost 1000 million tyres reach the end of their lives every year. So it becomes mandatory to use these wastes in Eco-concrete if possible .Rubber aggregates are collected from waste tyres using two different technologies that are a) Mechanical grinding at ambient temperature and b) Cryogenic grinding.

The researchers suggest that it is possible to make 40MPa concrete by replacing 16% of aggregates by rubber waste.

3. OPPORTUNITIES WITH ECO-CONCRETE-

Eco-concrete is an important sub element of sustainable development since it is eco friendly and thinks about the future generation and its needs. We are actually leaving a dying planet behind us for our future generation and it will be difficult to make it worth living in upcoming years if strict steps are not taken soon. Eco-concrete has many advantages and opportunities over conventional concrete that we need to understand and consider in promoting its use. Some of them are

- Eco-concrete is being widely used in green building practices. It also helps the green buildings achieve L.E.E.D (Leadership in Energy & Environmental Design) and Golden Globe Certifications (for sustainable construction)
- Reduced CO_2 emission
- Reduction in production costs as waste directly substitutes the cement.
- Saves energy, reduces the emission of waste water
- Contributes in recycling industrial wastages
- Reduces the overall consumption of cement
- Eco-concrete is having good thermal and fire resisting abilities
- Eco-concrete has good workability
- A part of Sustainable development
- Greater strength and durability than normal concrete
- Compressive strength and flexural behavior is fairly equal to that of the conventional concrete
- Eco-concrete might solve some of the society's problems with the use of inorganic residual products which should otherwise deposited

Now after studying its opportunities we need to understand the challenges that it offer

Challenges with Eco-concrete-As every coin has two faces the concept of Eco-concretes along with its opportunities brings some challenges that we need to face if we want to make effective use of Eco-concrete some of them are –

1. First and the foremost challenge that it offers is the conservative behavior of the building industry as a complete revolution will be needed for making Eco-concrete a day to day concept but the construction industry is not willing to accept this change.
2. It still requires a lot of research work and experimentation.
3. The mixing compositions for different SCM are different so it's not very user friendly.
4. It's not possible for common man to produce or use Eco-concrete until big cementing industries come forward for its production.
5. Strength so obtained by using by-products is not certain so can't be trusted directly.

4. CONCLUSION

The greatest challenge that arises now is to develop the concrete industry in a sustainable manner along with taking extreme care of the environment. In simple words we need to develop concrete industry in an environment friendly way. Portland cement production represents a great part of total

CO_2 production, so it's very important to decrease the use of Portland cement by promoting the use of Eco-concrete and to make more research and development in this field. This will help us to get rid of two problems at a time one is CO_2 and other is industrial and municipal waste. At last I would like to say that Eco-concrete is must to take into consideration as it uses the principle of Reduce, Reuse and Recycle on a Macro scale making a great difference.

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