Utilisation of Fly Ash in Construction Activites to Combat Impact of Global Warming

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Abstract

Climate change is one of the most critical challenges of our time. It has become very serious issue world over. Latest projection indicates that temperature will rise by 1.4 to 5.8 degree Celsius from 1990 to 2100 as per Intergovernmental Panel on Climate Change in 1996. Current level of rainfall would become both heavier and less regular posing a grave threat to agriculture. The greatest contributor to climate change is emission of carbon dioxide (Co2), methane, nitrous oxide, etc. In the present paper the attempt has been made to reduce the effect of climate change by utilization of fly ash in construction activities to combat climate change. Fly ash is a waste material produced by thermal power stations during the process of generation of electricity by using Coal. Huge quantities of fly ash are getting accumulated near thermal power plant posing environmental problems. Fly ash can be used to replace million ton of cement in making concrete. Using a ton of fly ash instead of cement reduces carbon dioxide production by a ton resulting in reduction of global warming.

Keywords: Fly Ash, Thermal Power Plant, Waste, Global Warming, Carbon Dioxide, Concrete.

Introduction

Many factors are responsible for Climate Change, such as burning of natural gas, coal and oil, industrial gases, Deforestation, Population growth, etc. Scientists are agreed on the issue of global warming and weather changes leading towards change in the patterns of cloud cover, precipitation, wind patterns, the frequency and severity of storms, and the duration of seasons. Intergovernmental Panel on Climate Change, has estimated that the atmospheric concentration of carbon dioxide increased from about 280 to 379 parts per million between 1750 and 2005, and now it is increasing at a rate of 1.9 parts per million per year. As a result, by 2100, the global average surface temperature could rise.

Intergovernmental Panel on Climate Change has shown deep concern that the about the effect of Climate Change in coming decade. The Global warming is the result of our day to day activities, which produce greenhouse gases like such as carbon dioxide, methane, nitrous oxide, etc.

The accumulation of green house gases in the atmosphere is major cause of climatic disturbances. In the 20th century, the average global temperature may be increased by 0.60 C. By analysis in computer climate models, the leading scientists have estimated that the average global temperature will increase by 1.40 C to 5.80 C by the end of 20th century (IPPC,1996).

A suitable utilization of alternative building materials for making concrete such as fly ash taking into account in our country circumstances, can lead to energy saving, combat the global warming, preserve the environment and minimize the effect of climate change in India. The reduction in greenhouse gases resulting from energy savings associated with use of fly ash in making concrete is a fundamental advantage. Because a large proportion of global Co2 emissions come from buildings and these buildings have long lifetimes, even a relatively small decrease in energy consumption has a significant impact on climatic change.

Utilization of Fly Ash to Combat Climate Change

The power plants generate electricity by consuming coal and residue left over is called “fly ash”. Chemically, fly ash is classified as a “pozzolan” — a material that, when mixed with water and lime, reacts to form cementitious compounds. It is a waste product produced during combustion of coal in the boiler of thermal power plant which is loading the atmosphere with carbon dioxide. In India more than 75 major coals based thermal power plant which is producing 120 million ton of fly ash per year

(Choudhary, 2009). Fly ash possesses dual problem of environmental pollution and difficulty in disposal. Previously it was assumed that fly as was completely a waste material and can not be used except filling low lying land. But in recent years with the help of advanced technologies, it becomes possible to use an alternative building material. It can be used in the form of Portland Pozzolana Cement, ready mixed fly ash concrete, clay fly ash bricks, construction of dams and hydraulic structures, as a filler material in mines, soil conditioner and fertilizer in agriculture and extraction of products like alumina, magnetite etc. lime fly ash bricks etc.

The present level of utilization is very low in India. The level of utilization of fly as is more than 70% of its total production in industrialized nation like United Kingdom, Germany and France while level of utilization of fly ash in our country is only around 3% for different purposes (I.S. 1727-1967).

A number of researches are being conducted in our country and aboard to investigate the possibility of using fly-ash. Various institutions are studying the suitability of fly-ash as a binding material. Some techniques of its use have also been established. But the use is so far limited compared to the availability of fly-ash in our Country.

I.S. 10153 (1982) has approved the process of utilization of fly-ash in various ways. It has been observed that fly-ash may be well used as a fill material in embankment construction or as a stabilizing material. It can be used for reclamation of low lying waste land including filling of mines. Fly-ash has a low specific gravity, it can be effectively used to make the embankments light weight.

Sufficient methodologies have been all ready given for use of fly-ash in combination with cement or lime but they are relatively costlier for developing countries.

The use of fly-ash for partial replacement of cement as an admixture for concrete have been already tried and now there is need to pay greater attention to full exploit the potentialities of fly-ash as construction material. It has been observed after study of experimental results that concrete containing 20% to 25% fly ash shows justified spectrum of compressive strength. This concrete also shows good resistance and increase in modulus of elasticity (Gupta, 2003).

To combat climate change, utilization of fly ash in civil engineering application for manufacturing of bricks, cement concrete, fly ash cement, Pre-stressed Concrete Sleeper(PSC), roofing materials, Road Construction and high volume fly-ash concrete (HVFC) will be a welcome step.

Potential of HVFC

High volume fly-ash concrete (HVFC) is an approach to maximize the fly-ash input in concrete. Concrete is extremely versatile in terms of its structural and material properties, which is one of the reasons for its success. Briefly this type of concrete has very low water to cement ratio, very low water content and incorporates about 50% of fly ash (ASTM Class F, low calcium fly ash). In view of the low-water content, high range water reducer (super plasticizer) are used. The HVFC has all attributes of high performance concrete namely excellent mechanical properties, low permeability and superior durability High volume fly ash concrete can be used in foundation and concrete block masonry. For example a low cost house having a plinth area of 249 square feet consisting of living room, a Hall, Kitchen, bath and verandah has been considered and the total consumption of fly ash has been estimated and reported in Table-1.

Table 1: Consumption of Fly ash in Cost Effective Housing

S. No	Particulars	Quantity	Fly ash per m^3	Total Quantity of Fly ash
1.	Cement Concrete in Foundation	1.44 m^3	400Kg	576Kg
2.	Concrete block masonry in foundation	10.61 m^3	500Kg	5305 Kg
			Total	5881 Kg

India needs to construct millions dwelling unit in order to meet the demand due to shortage of housing. Millions of people are homeless in India at present. Homelessness is a global phenomenon, but problem is more acute in India. Prevailing housing shortage in India is alarming as per the Census of India 2001 data. The Housing and Urban Development Corporation (HUDCO) has estimated housing shortage equal to 31.1 million based on Census of India 2001 data (24 million in rural areas and 7.1 million in urban areas) including excess of households over number of houses, congestion, obsolescent katcha houses (HUDCO, 2001). Assuming that 50% of the above dwelling unit use HVFC, the total requirement of fly ash can be estimated as following:

No. of House = 15.55Million

Fly ash required = 15.55 x 5881 = 91.45 Million Ton

The present generation of fly ash is nearly 120 Million ton in India. Therefore even if 50% of total housing stock uses HVFC in foundation and concrete masonry block in foundation only, 80 percent of the total production of fly ash would be utilized.

Apart from cost effective housing, HVFC can be used in column, beam of multistoried building, bridges, road etc. to mitigate climate change. However, different uses of fly ash in low volume in bricks, doors and windows, roofing, etc., have already been experimented in different Research Laboratory in India. Utilization of HVFC in cost effective housing will also reduce CO2 load which is a major culprit of climate change on atmosphere. The fly ash as an ingredient in concrete will improve the finished product and minimize the use of cement, the reduction in Carbon dioxide (CO2) released in atmosphare because of decreased cement production.

Conclusions

A simple calculation for estimation of Fly ash utilization potential in housing construction in India has been done. Large scale utilization of fly ash, especially in manufacturing of concrete, bricks, road construction, embankments, etc should be encouraged. Fly ash utilization for making concrete is resulting in stronger and durable concrete, and it didn't cost any more. Making better use of this under-utilized resource represents one of the easiest ways available to accomplish significant reductions in CO2.

Therefore, the fly ash utilization strategy has to be developed and executed in India.

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