

## Activated Fly Ash Blended Cement

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Developing and under developing countries increases the annual cement production exponentially, since it relates the growth and economy of the country. The production of one Tonne of cement contributes about 1.1 Tonne of carbon dioxide gas to the atmosphere together with oxides of nitrogen and methane. These are the main pollutants of the atmosphere which leads to the global warming. The total carbon dioxide contribution by the world cement production industries accounts around 7 %. This paper discusses the issues of global warming and the need for the development of efficient blending material of concrete. Activated fly ash concrete at various replacement levels was found that it reduces the emission of CO<sub>2</sub> gases and enhances the inhibition to corrosive atmosphere.

**Key Words:** Fly ash blended cement, Carbon dioxide, Global warming.

### INTRODUCTION

Since from the beginning of the industrial revolution around 1800, the concentrations of the green house gases CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O in the troposphere have risen sharply. Climate scientists warn that the average global temperature expected to rise between 1.4 and 5.8 °C between 2000 and 2100<sup>1</sup>.

The scientists clearly proved that there is an apparent correlation between increase in fossil fuel, atmospheric concentration of CO<sub>2</sub> and global temperature between 1970 and 2002. The significant climate change caused by atmospheric warming has important implications for human life wild life and the worlds economies. The average increase in green house gases for the past hundred years are given in Fig. 1.

Apart from the industries and vehicles another important contributors are the portland cement manufacturing plants. The wet processing plants releases 1.1 tonnes of carbon dioxide gas and pre-calcinator plants 0.8 tonnes of CO<sub>2</sub> for the production of one tonne cement.

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According to world energy outlook 1995 issued by the international energy authority the worldwide corbondioxide emission from all sources were 21.6 billion tones of which 7.0 % from cement industries<sup>2</sup>.

Hence concrete industries should consider the reduction of environmental impact by finding suitable new technologies in the production of Portland cement. So far no new technologies are developed. An alternative solution is reducing the output of cement production. This has been done by blending it with rice husk ash<sup>3</sup>, ground granulated blast furnance slag (GGBS)<sup>4</sup>, silica fumes<sup>5</sup>, fly ash, *etc*<sup>6</sup>. In this study, fly ash is activated by chemicals like CaO and Na<sub>2</sub>SiO<sub>3</sub> blended with cement are used to reduce the volume of cement effectively in the concrete structure to increase the durability and to improved the tolerance against corrosion.

### EXPERIMENTAL

The potential time study, anodic polarization are used to evaluate the potential variation and tafel extrapolation is used to find the corrosion rate of rebar in cement concrete<sup>7</sup>.

### RESULTS AND DISCUSSION

Why should we worry about the possible rise of only a few degrees in the earth's average surface temperature? There is often much change between February and March or even between morning and afternoon. The key point is that we are not talking about the normal swings in local weather but a projected global change in climate. Melting of the ice in the Antarctic glaciers and in the north pole, rises sea level that may cover the coastal low lying areas, damage to ecosystems are the most likely outcome of climate change.

In view of huge production of ordinary portland cement<sup>8</sup> and the emission of almost equal tonnage of CO<sub>2</sub> during the manufacture, it is necessary the manufacturing of the cement should be ecofriendly. Otherwise blending and supplementary materials with cement is inevitable. In countries like India (900 million tones worldwide) huge tonnes of fly ash and bottom ash are available and are kept as waste material. Blending high volume fly ash with cement technology is available<sup>2,4</sup>. However the activated fly ash concrete materials studied provides a better blending material in terms workability and inhibition to corrosive atmosphere.

Activated fly ash mortar in its various replacement levels (10, 20 and 30 %) and their potential value (Table-1) clearly indicates that the tolerance to corrosive atmosphere is increased for the activated fly ash mortar than the unactivated fly ash.

From the Table-2, the pH value of concrete blended with fly ash activated by Na<sub>2</sub>SiO<sub>3</sub> and CaO are on the higher side for various replacement levels than the unactivated fly ash blended cements. The higher pH value

TABLE-1  
RESULTS OF ACTIVATED FLY ASH AT VARIOUS  
REPLACEMENT LEVELS<sup>7</sup>

Tests conducted	Activator ratio CaO:Na <sub>2</sub> SiO <sub>3</sub>	Results obtained for various percentage replacements with fly ash		
		10 %	20 %	30 %
Potential time (mV)	1:2	-600	-595	-592
	1:4	-592	-590	-585
	1:6	-586	-585	-576
	1:8	-550	-500	-400
Anodic polarization (mV)	1:2	750	758	765
	1:4	756	764	779
	1:6	765	772	792
	1:8	800	800	850
Tafel extrapolation (mmpy)	1:2	0.0100	0.0195	0.0182
	1:4	0.0198	0.0188	0.0175
	1:6	0.0189	0.0175	0.0159
	1:8	0.0177	0.0137	0.0111

TABLE-2  
CORROSION RESISTANCE AND pH OF ACTIVATED FLYASH (AFA)  
AND ULTRAFINE FLYASH (UFA)

Characteristics	AFA 30 % Replacement	UFA 30 % Replacement
pH	12.600	11.0500
Corrosion rate (mmpy)	0.111	0.0265

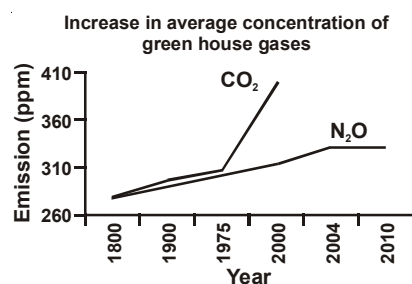


Fig. 1

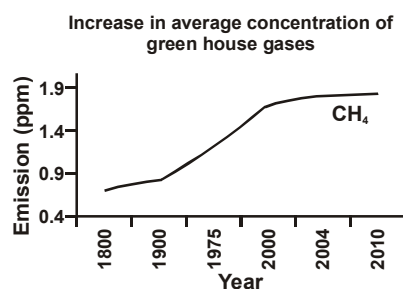


Fig. 2

Fig. 1 and Fig. 2. Increase in average concentration of green house gases

of activated flyash is due to the destruction of glassy layer of flyash which enhances the alkalinity during its action. From the Table-2 it is inferred that activated flyash in the 30 % replacement level with chemical activation has very high pH value and this is the reason for the enhanced corrosion tolerance capacity.

Activated flyash in 30 % replacement level is used in concrete that will reduce 30 % world wide production of ordinary portland cement and thereby 30 % reduction in emission of CO<sub>2</sub> gas in its 7 % contribution<sup>2</sup> (Table-3).

TABLE-3  
PROJECTED REDUCTION OF GLOBAL WARMING GAS CO<sub>2</sub>

Year	World cement production in billion tonnes	CO <sub>2</sub> Gas emission by OPC manufacturing	CO <sub>2</sub> Gas emission by 30% blended AFA cement	% Reduction in CO <sub>2</sub> emission
1995	1.5	1.5 billion tonnes	1.05	30.00
2010	1.9	1.981	1.38	30.33

### Conclusion

Ecofriendly technologies in all fields of development is the need of the hour to save the globe. Otherwise an alternative material has to be used to reduce the environmental impact. The chemically activated fly ash in 30 % replacement level has reduced about 30 % of CO<sub>2</sub> gas emission from cement industries and also reduces environmental impacts in general through the use of waste and industrial by products. The reduction in CO<sub>2</sub> gas emission will be helpful for preserving the monuments and structures. It is proposed that the installation of new cement plants should be avoided. For the sustainable development political decision makers and cement manufacturing companies has to cooperate with each other in this aspect to reduce the global warming green house gases.

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