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Efficacy of Cement Using Fly Ash, Rice Husk Ash and Sugarcane Straw Ash: A Review

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ABSTRACT
Fly ash is waste generated from combustion of coal in power generation plant. Due to its pozzolanic properties utilized in construction industry. In this paper Fal-G brick masonry prism test study and economy have been described. The observations, limitation and suggestion in various areas have been described. The preliminary and investable interest in the use of partial replacements or by – products as complementary pozzolanic materials was mostly induced by enforcement of air pollution control resulted from cement production industry. Rise husk is by – product taken from the rice mill process with approximately the ratio of 200 kg per one ton of rice, even in high temperature it reduces to 40 kg, This research addresses the suitability of sugarcane ash in concrete used as partial cement replacement. Two grades of concrete M15 and M20 were used for used for the experimental analysis.

Keywords : *Cement, Fly ash, Rice husk ash, Sugarcane straw ash, strength*

1. Introduction

Fly Ash: Electricity is the key for development of any country. Coal is a major source of fuel for production of electricity in many countries. In this process of electricity generation large quantity of fly ash gets produced and becomes available as coal-based power stations. It is a fine powder and it's collect in the Electrostatic Precipitators(ESP). The shape of the fly ash is spherical. Fly ash is pozzolonic material which can be used in construction industry. The fly ash can be divided in two groups; low calcium fly ash is produced from combustion of bituminous coals por anthracite coals and it has low calcium (Cao) content and percentage about 3% and silica +alumina + iron oxide more than 70%. High calcium fly ash is produced from combustion of sub-bituminous of lignite coals and it has about 20%of calcium (Cao) content and percentage of sio_2+al2o3+fe2o3 in this fly ash is less than 70%.

Rice Husk Ash: Rice husk is an agricultural residue which accounts for 20% of the 649.7 million tons of rice produced annually worldwide. The produced partially burnt husk from the milling plants when used as a fuel also contributes to pollution and efforts are being made to overcome this environmental issue by utilizing this material as a supplementary cementing material. The chemical composition of rice husk is found to vary from one sample to another due to the differences in the type of paddy, crop year, climate and geographical conditions. Burning the husk under controlled temperature below 800 °C can produce ash with silica mainly in amorphous form.

Sugarcane Straw Ash: The present work is to carry out a detailed analysis of the Concrete mix designs for various grades of concrete (M35 and M40) with different percentages of SUGARCANE BAGASSE ASH (0%, 5%, 10%, 15%, 20%, 25%). Cubes are subjected to normal chemical curing and Testing the specimens at various ages. Plotting graphs and comparing the compressive strengths of blended concrete cubes in normal and chemical curing. Ordinary Portland cement is the most commonly used building material throughout the world and it will retain its status in near future also because of demand and expansion of construction industry all over the world. Further the greatest challenge before the concrete construction industry is to serve the two pressing needs of human society, namely the protection of environment and meeting the

infrastructure requirements of our growing population Structures which are constructed in aggressive environments are liable to be subjected to acidic attack. One of such major problems is sulphate attack against concrete structures due to which there will be loss of weight and reduction in strength of concrete. Contaminated ground water, seawater, industrial effluents are some of the sources of sulphate that attack on concrete. The use of blended cements have shown a sharp results in resisting the sulphate attack on concrete, sugarcane bagasse ash which shows pozzolanic properties is being used as a partial replacement in concrete in regular intervals of 5% upto 25%. SCBA is being produced from sugar manufacturing units as a waste material which will be grinded to the fineness less than cement for obtaining good bonding between cement and SCBA. This project discusses the very severe exposure of magnesium sulphate on concrete. Bagasse is a by-product from sugar industries which is burnt to generate power required for different activities in the factory. The burning of bagasse leaves bagasse ash as a waste, which has a pozzolanic property that would potentially be used as a cement replacement material. It has been known that the worldwide total production of sugarcane is over 1500 million tons. Sugarcane consists about 30% bagasse whereas the sugar recovered is about 10%, and the bagasse leaves about 8% bagasse ash (this figure depend on the quality and type of the boiler, modern boiler release lower amount of bagasse ash) as a waste, this disposal of bagasse ash will be of serious concern. Sugarcane bagasse ash has recently been tested in some parts of the world for its use as a cement replacement material. The bagasse ash was found to improve some properties of the paste, mortar and concrete including compressive strength and water tightness in certain replacement percentages and fineness. The higher silica content in the bagasse ash was suggested to be the main cause for these improvements.

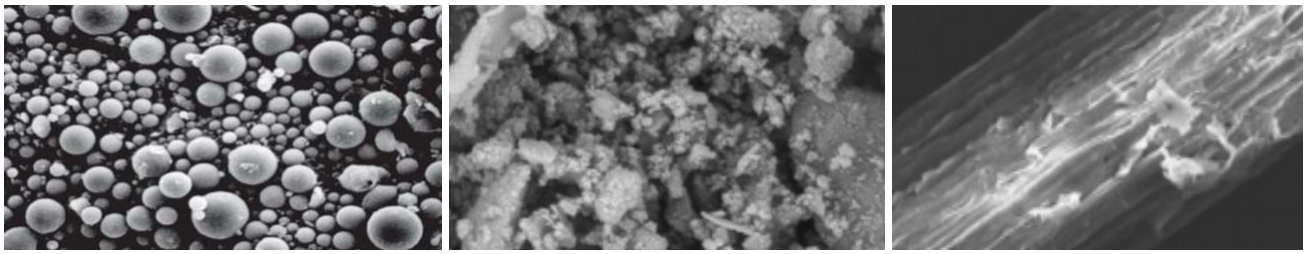
OBJECTIVE:

To compare the strength of Fly Ash cement, Rice Husk cement, Sugarcane Straw cement

Content	Source
Fly Ash	Fly ash is extracted form flue gases through Electrostatic Precipitator in dry form.
Rice Husk	Rice husk is a major product of milling industry.
Sugarcane Straw	• Agro waste from sugar cane industry. • Bagasse- fibrous waste after extraction of juice. • Exhibits pozzolanic property.

COMPOSITION:

Compounds	Percentage of the compounds (%)										
	Silica (SiO2)	Alumina (Al2O3)	Ferric Oxide (Fe2O3)	Calcium Oxide (CaO)	Magnesium Oxide (MgO)	Sodium Carbonate (Na2O3)	Potassium Oxide (K2O)	LOI	Sulp--hur (SO3)	S3O	Specific Gravity
OPC	20.99	6.19	3.86	65.96	0.22	0.17	0.60	1.73	01	Nil	2.94
Fly Ash	49-67	16-29	04-10	01-04	0.2-02	Nil	Nil	Nil	0.1-0.2	Nil	2.50
Rice Husk	88.3	20.46	0.67	0.67	0.44	0.12	2.91	5.81	Nil	Nil	2.11
AshSugarcane Straw Ash	87.40	3.60	4.95	2.56	0.69	0.15	0.47	8.25	Nil	Nil	1.80



(Microscopic photographs of Fly Ash) (Microscopic photographs of Rice Husk Ash) (Microscopic photographs of Sugarcane Ash)

HOW FLY ASH, RICE HUSK ASH, SUGARCANE STRAW ASH WORKS WITH CEMENT IN CONCRETE

- **Fly Ash with Cement in Concrete:**

Ordinary Portland Cement (OPC) is a product of four principal mineralogical phases. These are:

Components	Percentage
1. TricalciumSilicate C_3S ($3CaO.SiO_2$)	25-50
2. Dicalcium Silicate C_2S ($2CaO.SiO_2$)	20-45
3. Tricalcium Aluminate C_3A ($3CaO.Al_2O_3$)	05-12
4. Tetracalciumalumino-ferrite C_4AF ($4CaO.Al_2O_3.Fe_2O_3$)	06-12

The reaction between these compounds and water are shown as under:

$2C_3S$ + 6H → $C_3S_2H_3$ + 3CH
(Tricalcium silicate) (water) (C-S-H gel) (Calcium hydroxide)

$2C_2S$ + 4H → $C_3S_2H_3$ + CH
(Dicalcium silicate) + (water) (C-S-H gel) (Calcium hydroxide)

In this case the hydration products from C_3S and C_2S are similar but quantity of calcium hydroxide(lime) released is higher in C_3S as compared to C_2S.
Now, the reaction of C3A with water takes place in presence of sulphate ions supplied by dissolution of gypsum present in OPC. This reaction is very fast. The reaction is shown as under:

C_3A + $3(CSH_2)$ + 26H → $C_3A(CS)_3H_{32}$
tricalciumalluminate gypsum water ettringite

C_3A + CSH_2 + 10H → C_3ACSH_{12}
Monosulphoaluminate hydrate

Tetracalciumalumino-ferrite(C_4AF) forms hydration product similar to those of C_3A, with iron substituting partially for alumina in the crystal structures of ettringite and monosulpho-aluminatehydrate.

Above reactions indicate that during the hydration process of cement, lime is released out and remains as surplus in the hydrated cement. This leached out surplus lime renders deleterious effect to concrete and make the concrete weak, give chance to the development of micro- cracks, weakening the bond with aggregate sand thus affect the durability of concrete.

So, If fly ash is apply in the mixture, then this surplus lime becomes the source for pozzolanic reaction with

fly ash and forms additional C-S-H gel having similar binding properties in the concrete as those produced by hydration of cement paste. The reaction of fly ash with surplus lime continues as long as lime is present in the pores of liquid cement paste.

- **Rice Husk Ash with cement in Concrete:**

OPC reacts with water to form two products:

1. Calcium Silicate Hydrate: It gives strength & durability on the concrete.

2. Calcium Hydroxide:

i. Reacts with CO_2 causing efflorescence.
ii. It creates negative effect on concrete.

Addition of RHA:

i. Increases Calcium Silicate Hydroxide.

ii. DecreasesCalcium Hydroxide.

$Ca(OH)_2 + SiO_2 \rightarrow H_2O + CaSiO_3$

The major benefits of the reaction areit gives high strength and reduce efflorescence, reduce sulphur attacks & also reduceChemical attacks.

- **Sugarcane Ash with cement in Concrete:**

Same Reactions happened as Rice Husk Ash mixed with Cement.

SUMMARY

I. Cement mixture with fly ash and rice husk ash had similar appearance when compared to the conventional cement morter.
II. The mixture having both fly ash and rice husk ash as admixtures in equal proportions showed a marginal increase in strength for higher percentages of admixture.
III. Adhesive power of rice husk ash and sugarcane straw ash was found much higher than the mixture of fly ash mixture.
IV. Heat energy discharge is much higher in sugarcane straw ash than rice husk straw ash.

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