A Survey on Utilization of Sugarcane Bagasse Ash And Coal-Fired Boiler Ash

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Abstract- *Portland cement is the most important ingredient of concrete and is a versatile and relatively high cost material. Large scale production of cement is causing environmental problems on one hand and depletion of natural resources on other hand. This threat to ecology has led to researchers to use industrial by products as supplementary cementations material in making concrete. A number of studies are going on in India as well as abroad to study the impact of use of these pozzolanic materials like Sugarcane Bagasse Ash and Coal fired boiler bottom Ash as a cement replacements and the results are encouraging. Addition of these materials to concrete has many advantages like high strength, durability and reduction in cement production.*

Due to increasing construction activities, there has been a huge environmental impact especially the risks related to depletion of river bed and its consequent effect on the aquatic life, natural water table and over all ecology of the system. Various replacements of sand is a hot research topic worldwide. Thermal power plant coal bottom ash is a waste material if used as construction material will contribute to sustainability. Advantages of using coal bottom ash are that, it will give us an eco-friendly concrete and cost of dumping these waste material also decreased, thus serving the need of the hour.

Keywords- Sugarcane Bagasse Ash (SBCA), Coal fired boiler bottom Ash (BA), Pozzolonic, Eco-friendly

I. INTRODUCTION

Since the construction industry is developing very fast the requirement of concrete and their constituent materials are also increasing day by day. Hence the need becomes in evitable to find various alternate means for the aggregate and accordingly the researchers are going on in this way. But the availability of fine aggregate becomes difficult day by day. Hence the need arises to find alternative for the fine aggregate. The material which is known as bottom ash is available ash waste by-product material from the thermal power plants. In India most of the thermal power plants use wet system for disposal of ash. Bottom ash will be generated as a residue after burning pulverised coal at boiler cyclone and collected from bottom ash hopper located under boiler structure. In the backdrop of waste management, scientists and researchers all over the world are always in quest for developing alternate binders that are environment friendly and contribute towards sustainable management. Sugarcane bagasse (SCB) which is a voluminous by-product in the sugar mills when juice is extracted from the cane. It is, however, generally used as a fuel to fire furnaces in the same sugar mill that yields about 8-10% ashes containing high amounts of un-burnt matter, silicon, aluminum, iron and calcium oxides. The ash, therefore, becomes an industrial waste and poses disposal problems. In our project we replace cement with SCBA and sand with BA to utilize both the by-products at equal interval of 5% and test compressive strength and durability of the test specimen.

II. COAL FIRED BOILER ASH

A supplementary cementing material, when used in concrete, contributes to the properties of the hardened concrete through hydraulic or pozzolanic activity, or both. A well-proportioned bottom ash concrete mixture will have improved workability when compared with a Portland cement concrete of the same slump. This means that, at a given slump, bottom ash concrete flows and consolidates better than a conventional Portland cement concrete when vibrated. The use of bottom ash also improves the cohesiveness and reduces segregation of concrete.

III. SUGARCANE BAGASSE ASH

Bagasse is the fibrous matter that remains after sugarcane stalks are crushed to extract their juice. Therefore, 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, that incorporates a pozzolanic property that would potentially be used as a cement replacement material. 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. The higher silica content in the bagasse ash was suggested to be the key reason for these enhancements. Although the silicate content may vary from ash to ash depending on the burning conditions and other properties of the raw materials including the soil on which the sugarcane is grown.

IV. FORMATION AND COLLECTION

When p ulverized coal is burned in a bottom boiler, most of the unburned material is caught in the flue gas and captured as fly ash by Electro Static Precipitators (ESP) before reaching the atmosphere. Some melted ash accumulates on the boiler walls and against steam tubes and solidifies to form masses called clinkers. The clinkers build up and fall to the bottom of boiler/furnace and are cooled in the water sump before passing through clinker grinder. The coal ash collected at bottom of boiler is called bottom ash.

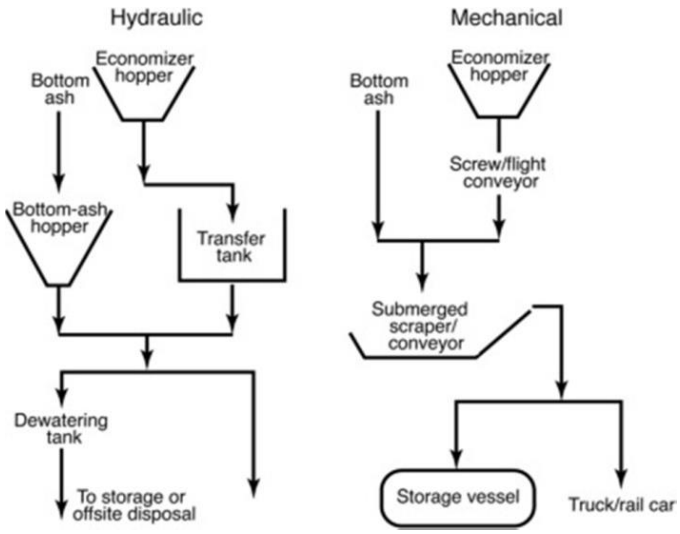

Fig 1 : Handling Options For Bottom Ash

Bagasse is the fibrous extract remaining after the removal of the cane juice from sugarcane. In a lot of sugarcane industries, the bagasse generated is usually used as fuel while also reducing its volume for disposal. This remaining ash generated from burning or incineration is called bagasse ash comprehensive of both bottom and fly ashes. In most up-to-date plants, the bottom ash gets mixed with fly ash in the water channel that comes from the gas washer. This waste is usually disposed of into pits and is also applied on land as soil modification in some areas

SUGARCANE BAGASSE BAGASSE ASH

V. RELATED WORKS

I.M. Martins and J.C. Marques, had investigated on "Durability and Strength Properties of concrete containing coal bottom ash". They observed that "Tests on concrete showed that the ground bottom ash reduces the workability, and it is therefore necessary to increase the admixture content to ensure the same slump and keep the w/b ratio, particularly for lower binder contents. If the w/b ratio is maintained, concretes made with bottom ash exhibit performance similar to that of concretes with fly ash, both in terms of compressive strength and resistance to environmental actions".

Mr. Lavanya M.R et al., had studied on "An Experimental Study on the Compressive Strength of Concrete by Partial replacement of Cement with Sugar cane bagasse ash". The test includes the Feasibility of using sugar cane bagasse ash, a finely grounded waste product from the sugarcane industry, as partial replacement for cement in conventional concrete is examined. The test was conducted as per Bureau of Indian Standard (BIS) codes to evaluate the stability of SCBA for partial replacement up to 30% of cement with varying water cement (W/C) ratio. They showed that addition of SCBA results in improvement of strength in all cases and according o the results obtained, it can be concluded that Bagasse ash can increase the overall strength of concrete when used up to a 15% cement replacement level with W/C ratio of 0.35, bagasse ash is a valuable pozzolanic material and it can potentially be used as a partial replacement for cement.

G. Nithin Kumar Reddy, S. Vijaya Bhaskar Reddy and G. Harsh Vardhan, had studied on "Partial Replacement of Cement in Concrete with Sugarcane Bagasse Ash and its Behaviour in Aggressive Environments" and concluded that the test results of compressive strength of cement concrete in which cement is partially replaced with sugarcane bagasse ash under normal conditions and which is exposed to 5% MgSo4 solution at the age of 7 days. The results indicate that the compressive strength of concrete increases up to a percentage replacement of 10% after which there is a gradual drop in compressive strength.

M.P. Kadam and DR. Y.D. Patil, had experiments on "Effect of Coal Bottom Ash as Sand Replacement on the Properties of Concrete with Different W/C Ratio" and concluded that The compressive strength for 7, 28, 56 and 112 days was increased up to 20% replacement and after that compressive strengths were decreased from 30% to 100% replacement.

T. Subramani and T. Sumathi, had done experimental investigation on "Partial Replacement of Cement with Fly Ash and Sand with Bottom Ash and Glass Used in Concrete". The study was conducted to evaluate the strength characteristics of concrete with bottom ash and glass and fly ash in concrete. The concrete mix design was done for M30 grade concrete. They conclude that the Strength of concrete containing flyash 40% and 20% of bottom ash and 30% of glass was high compared with that of the conventional mix. Cement replacement level of 40 % flyash in concrete mixes was found to be the optimum level to obtain higher value of the strength and durability at the age of 28 days and by cost analysis it is found that by 40 % replacement of flyash, cost is reduced up to 45 % on Cement.

R.S. Patil, H.N. Rajkumara and Rudraswamy M.P., had studied "Effect of Replacement of Natural Sand by Blends of Fly Ash and Bottom Ash on Properties of Concrete" and give conclusion that the workability of concrete produced by replacing natural sand by blends of flyash and bottom ash is high at (10+10) % replacement level. The water absorption and sorptivity values of concrete produced by replacing natural sand by blends of flyash and bottom ash is minimum at (10+10) % replacement level. The compressive strength of concrete produced by replacing natural sand by blends of flyash and bottom ash is higher at (25+25) % replacement level.

A.K. Mandal and O.P. Sinha, had studied on "Review on Current Research Status on Bottom Ash: An Indian Prospective" and observed that Rheological behaviour of BA in slurry form indicates that, due to the coarser in size, addition of BA in slurry increases the transportation efficiency. BA has been fruitfully employed for the removal of hazardous dye. At lower concentrations BA adsorbs almost 100 % of the dye. However, at higher concentrations the adsorption takes place via particle diffusion process and the thermodynamic parameters reveal feasibility of the process.

Siti Nabihah Sadon, had studied on "Coal Bottom Ash as Sustainable Material in Concrete – A Review" and concluded that CBA was significantly a well-graded material with variations size of particle distribution. The specific gravity of CBA ranges between 1.39- 2.98 and it depends on the chemical com- position which controlled by the source of coal and combustion temperature. Due to the decreasing of slump result by increasing the amount of CBA it can conclude that as the replacement level increases and huge amount of water was required in order to mix the concrete. This condition was affected by the extra finest of the CBA. For compressive strength it shows that the early strength of the concrete was at low level due to the higher percentage of the replacement with the effects of the shorter curing period; 7 days. It also can be concluding that, concrete with CBA content will reach its optimum strength beyond 28 days due to the effect of pozzolanic action of CBA.

Kai Kannan and R. Vijaya Kumar had experimental investigation on topic "An Experimental Study on Effective Utilization of Bottom Ash as Fine Aggregate in Concrete under Flexure" and concluded that the density of concrete reduces with the increase in the percentage of bottom ash. The compressive strength of concrete with bottom ash increases with increased curing period. The split tensile strength of concrete with bottom ash increases with increased curing period. While bottom ash is used the workability is reduced. For obtaining the required workability the super plasticizers are added while preparing the concrete. The more bottom ash we add the more super plasticizers are required to be added for obtaining the required workability. With increasing replacement of fine aggregate with bottom ash, the average density of concrete shows a linear reduction due to its lower specific gravity.

Ajay Goyal, had studied on "Properties and Reactivity of Sugarcane Bagasse Ash" and concluded that Ashes obtained after control burning of SCB at 600oC/5hour were reasonably reactive given by the fact that little crystallization of minerals occurred. Morphological, XRD and TGA/DTA study of the blended pastes confirmed the hydration reaction of SCBA with in the cement gel. Compressive and flexural strength tests confirmed the actual behaviour of SCBA blended mortars and it suggested that up to 15% substitution of OPC with SCBA can be made with better strength results than that with pure cement.

Dinesh Kumar and Ravi Kumar, had experimental investigation on topic "Study the Effect of Coal Bottom Ash on Partial Replacement of Fine Aggregate in Concrete with Sugarcane Molasses as an Admixture" and gives the conclusion that the compressive strength at early stages is larger as compared to 28 days strength. Compressive strength compared to nominal mix design strength is increased by 7.5%. Flexural strength initially increases up to 20%of replacement than decrease significantly at early stages but gradually decreases with increase in percentage of

replacement after 28 days. Split tensile strength at 7 days with mix MX3 i.e. 30% coal bottom ash and 0.01% sugarcane molasses. The durability of mixes was examined by water absorption test, sorptivity test and ultra-sonic pulse velocity test the result showed that coal bottom ash absorbs less water up to mix MX3 and water absorption increase afterward. Sugarcane molasses contribute significantly in initial setting time and water absorption; hence it will use as an admixture to enhance the properties of concrete.

Bhavya Rana and Dr. Jayesh kumar Pitroda, had studied on "Sugar Cane Bagasse Ash For Eco-Friendly Fly Ash Bricks" and concluded that if fly ash is replaced by Sugarcane Bagasse Ash in fly ash brick by using 10%, 20%, 30%, 40%, 50%, 60% Sugarcane Bagasse Ash; we can save 0.0993m², 0.1987m², 0.2981 m², 0.3975m², 0.4968 m², 0.5962m² in 1m depth of fertile agricultural land, respectively .Uses of Sugarcane Bagasse Ash in brick can save the agriculture industry's disposal costs and produce a 'greener' bricks for construction. An innovative supplementary cementitious Construction Material is formed through this study.

VI. CONCLUSION

It can be concluded from the discussions that

- If we increase replacement of cement content with Boiler Ash , the workability of concrete mix was decrease.
- As the amount of Coal-fired Bottom Ash increases, there is a slight decrease in density of concrete.
- As the percentage of B.A. increase, huge amount of water or admixture is require to maintain Water/Binder ratio.
- We can maintain workability of mix by using Sugar Cane Baggase Ash.
- Admixture is require if we use boiler ash.

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