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Effect on Properties of Concrete Using Agro-West as Replacement of Sand

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Abstract - High demand of natural resources due to rapid urbanization and the disposal problem of agricultural wastes in developed countries have created opportunities for use of agro-waste in the construction industry. Many agricultural waste materials are already used in concrete as replacement alternatives for cement, fine aggregate, coarse aggregate and reinforcing materials. This paper reviews some of the agro-waste materials, which are used as a partial replacement of fine aggregate in concrete. Different properties of fresh and hardened concrete, their durability and thermal conductivity when admixed with agro-wastes are reviewed. Agro-waste used in self-compacting concrete and mortar are also reviewed and their properties are compared. It has been seen that the agro-waste concrete containing groundnut shell, sugarcane ash , oyster shell, cork, rice husk ash and tobacco waste showed better workability than their counterparts did. Agro waste concrete containing bagasse ash, sawdust ash and oyster shell achieved their required strength by 20% of replacement as fine aggregate, which were maximum among all agro-waste type concrete. Close relations were predicted among compressive strength, flexural strength, tensile strength, and elastic modulus of agro-waste concrete. Addition of sugarcane ash as fine aggregate in mortar increased the resistance of chloride penetration whereas inclusion of cork in mortar showed better thermal resistance and improved cyclic performance. After the review, it is of considerable finding that more research is deserved on all fine aggregates replacing agro-waste materials, which can give more certainty on their utilization in concrete.

Use of agricultural waste in construction industry holds a high potential of reducing global environmental pollution. There are a number of agricultural wastes used as a full or partial replacement of coarse aggregate. This paper reviews some of the agro-waste However a grave necessity is felt to properly understand and characterize other waste materials as aggregate replacement. This paper compares different physical and mechanical properties of agro-waste and agro-concrete, and also presents their reviews with comparative behaviors. Structural behavior and thermal conductivity of these materials are also reviewed and compared with controlled concrete. Reviews indicate that very good compressive strength, but low slump, and they require more cement paste to become workable owing to their angular and flaky shape. oyster shell and groundnut shell shows good performance in structural members which can be comparable to controlled concrete. It is felt that further detailed investigations are required for date seed and rubber shield to firmly characterize them and understand their behavior

1. INTRODUCTION

Technological innovations has demanded a huge amount of natural resources in the construction industry, which has resulted in scarcity of resources. This scarcity motivates the researchers to use, solid wastes generated by industrial, mining, domestic and agricultural activities. It is observed that in India more than 600 MT wastes have been generated from agricultural The current Green Building Rating (GBR) systems evaluate the sustainability of buildings according to various categories of which the construction material is one such category in most of the systems. Issues like emission of carbon dioxide, use of energy, water, aggregates, fillers and demolition waste in concrete look less compatible with environmental requirement of a modern sustainable construction industry. At the same time, concrete made using agricultural wastes has shown better thermal property in research which can result in sustainability points in the energy and atmosphere category of the LEED rating system

1.1. Agricultural wastes used as a fine aggregate replacement in concrete The Agricultural wastes used as fine aggregate in concrete are sugarcane bagasse ash, groundnut shell, oyster shell, sawdust, giant reed ash, rice husk ash, cork and tobacco waste. The major differences of these agro-wastes are the place from where they collected and the processes to convert into a fine aggregate. It can be observed that sugarcane, giant reed, and rice husk are produced worldwide and they have a similar type of processing, those are burnt to convert into sugarcane bagasse ash, giant reed ash and rice husk ash. These are used as partial replacement of fine aggregate which provide additional pozzolanic property in concrete. Groundnut shells are crushed in mill to convert into fine aggregate prior to use in concrete. Oyster shells are the sea shells generally available in coastal areas. These are used as partial replacement of fine as well waste, which is seriously leading to a disposal problem. Reuse of such wastes as sustainable construction materials take care of the issue of contamination, as well as the issue of area filling and the expense of building materials (Madurwar et al., 2013). The Major quantity of solid wastes generated in India is reported in . (2014) expressed that research on the utilization of agricultural waste, as an aggregate substitution is generally new and more research is needed for long-term durability properties of concrete. They also studied the relationship between the concrete made using this type of materials; environmentally friendly concrete and green building rating systems as coarse aggregate in coastal regions. Sawdust is generated from mechanical processing of raw wood from saw mill industry. These are dried by leaving in sun and sieved properly before using in concrete (Oyedepo et al., 2014). Cork and tobacco wastes are collected and processed from cork oak trees and cigarette making industries which were used as fine aggregate replacement in concrete. The shape, size and availability of mentioned agro-wastes are discussed below. The purpose of this review is to study the properties such as workability, mechanical properties, durability, thermal conductivity of agricultural wastes used as a partial replacement of fine aggregate in concrete

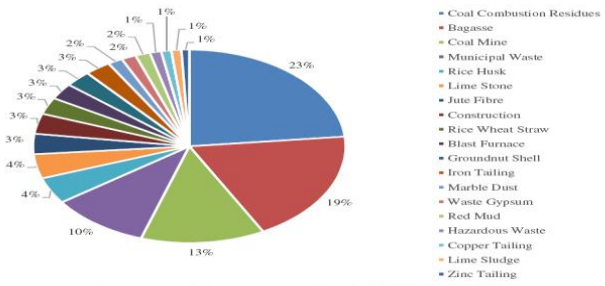


Fig. 1. Status of solid waste generated in India (Madurwar et al., 2013).

1.2 Materials used for Agro West

1)Sugarcane Ash: Sugarcane bagasse ash (SCBA) The fibrous residue (about 40–45%) of sugarcane after crushing and extraction of its juice is known as "bagasse" (Loh et al., 2013). The bagasses are reused as fuel for heat generation which leaves behind 8–10% of ash, known as sugarcane bagasse ash (SCBA) Modani and Vyawahare, 2013. Sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose and 25% of lignin (Modani and Vyawahare, 2013). Rukzon and Chindaprasirt (2012) reviewed that a lot of sugarcane bagasse from the sugar factory is accessible in Thailand. Sugarcane bagasse is partly utilized as fuel in sugar plant but the rest is treated as waste and unutilized. As production of sugar cane is more than 1500 million tons in the world and in India, about 10 million tons of sugarcane bagasse ash are treated as a waste material, it can therefore be advantageous to use it as a fine aggregate replacement in concrete to mitigate the disposal problem as well as to minimize the use of natural aggregates bagasse and the sugarcane bagasse ash which is used as fine aggregate replacement in concrete. Sales and Lima (2010) analysed the SCBA samples to determine the crystallinity by X-ray diffractometry, leachability and particle morphology by scanning electron microscopy (SEM). The X-ray diffractometry test result revealed the absence of an amorphous halo in the diffractograms (Sales and Lima, 2010). Quartz appeared as the principal element of SCBA. The SEM analysis revealed that the SCBA samples were composed of grains with varied shapes and sizes up to 150 lm. Authors (Sales and Lima, 2010) suggested that these findings reinforce the hypothesis of using SCBA as a substitute for fine aggregate which has binding properties

Fig. 2. Sugarcane bagasse ash.

2) Groundnuts shell: Groundnut shell Groundnut shell can be found in large quantities as agricultural farm waste in Nigeria, producing up to 2.699 million metric tons per year (Sada et al., 2013). Groundnut shell was first planted in South Africa mainly Brazil and later spread to other part of America, Asia, and northwestern Argentina (Tata et al., 2015). The outer part of groundnut is called groundnut shell. Over a period of years, it is treated as a solid waste. Utilization of groundnut shell in the construction industry is expected to solve the pollution problem and increase the economic base of farmers, which encourage them to increase the production (Sada et al., 2013). Groundnut shell is already used for developing roof

Fig. 3. Groundnut shell.

3)Oyster Shell: . Oyster shell Aquaculture is one of the key businesses in island nations. The southwestern seaside territory of Taiwan primarily develops oysters. As per the information of fishery commercial enterprises, the oyster shell yield was 300,000 tons over the last five years, which would initiate environmental pollution concerns (Kuo et al., 2013). Yang et al. (2010, 2005) stated the same problem created by oyster shell in South Korea, can be solved by their utilization in the construction industry. One of the most popular uses of oyster shell in construction industry throughout history has been in its burnt form as lime known as quicklime. Recently researchers (Kuo et al., 2013; Yang et al., 2010, 2005) studied the properties of oyster shell based concrete using oyster shell as fine aggregate, which are discussed briefly in following sections. Fig. 4 shows the shape of the oyster shell used in concrete. Oyster shell grows over the years and it is found in several sizes. The shells are spiral in structure and having rough surface texture. It should be crushed properly as per the code requirement prior to use in concrete.

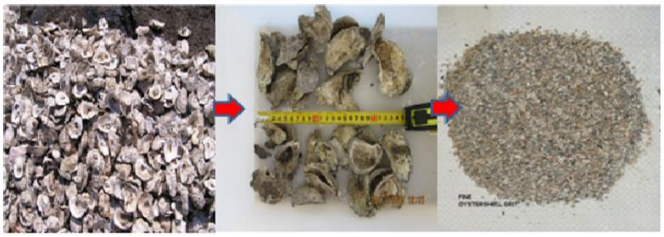


Fig. 4. Oyster shell.

4)Saw Dust: Sawdust is the main component of particleboard. It has a variety of other practical uses including serving as mulch, an alternative to clay cat litter, or as a fuel. It can present as a hazardous material in manufacturing industry, in terms of its flammability (Ganiron, 2014). The use of sawdust for making lightweight concrete has received some attention over the past years (Udoeyo and Dashibil, 2002). Mageswari and Vidivelli (2009) reported, that as a substitution material for natural sand, sawdust ash might be the right choice as fine aggregate in concrete. It can considerably reduce the dumping problem and simultaneously helps the preservation of natural fine aggregate. Fig. 5 shows the shape of the sawdust which is treated as a waste material. Many researchers tested the behaviour of sawdust ash in concrete and reported that sawdust possessed unique characteristics, which make it competitive among other construction materials

Fig. 6. Giant reed fibres and its ash.

5)**Rice Husk Ash:** Rice husk is one of the fundamental agrarian wastes obtained from the external covering of rice grains amid the processing procedure. Fig. 7 shows the shape of the rice husk and its ash. The rice husk has no useful application and is treated as a waste material that creates the pollution problem (Givi et al., 2010). Because of low nutrition property of rice husk, it is unsuitable and does not have edibility yet in a few nations, it has been utilized generally as fuel for rice plants and electric power plants as a compelling technique to reduce the volume of rice husk waste (Madandoust et al., 2011). Many researchers in the past had used rice husk ash as a cement replacement material in concrete (Givi et al., 2010; Madandoust et al., 2011; Zaid and Ganiyat, 2009). After colossal researches Iam and Makul (2013) tested the properties of selfcompacting concrete using rice husk and

limestone as a fine aggregate replacement. It was reported that use of rice husk ash in self-compacting concrete reduced the unit weight, flowability, porosity, water absorption, compressive strength, ultrasonic pulse velocity and the cost. Shafigh et al. (2014) reported the use of rice husk as cement replacing material, fire making, litter material, marking the concrete, board production, as silicon carbide whiskers to reinforce ceramic cutting tools and aggregate replacement in concrete in low-cost housing.

Fig. 7. Rice husk ash.

1.2 Objective of Work:

The objective of this study is to optimize well use of Agro West as a replacement of fine aggregate in concrete without compromising the properties of concrete or strength

With this experiment we also study well utilization of Agro West in construction and hence requirement of natural material for concrete decreased with this project we also study to achieve the economy in constriction

2. Mix Design

a) Methodology

1)Analyses the project title ⟹2) Study of material properties ⟹ 3)Material collection ⟹4)Mix Design ⟹5)Casting of Specimen ⟹6) Curing Process ⟹7) Testing of specimen⟹8) Results

b)Material mix Design :IS10262-2009
Grade of concrete M20 (1:1.5:3)
Type of Cement; OPC
Size of Mould(15cmX15cmX15cm)
Quantity of Materials required For 1m3
1)Cement :360kg/m3
2)Coarse aggregate :1223.8kg/m3
3)Water-cement ratio 0.50
4)fine aggregate :584kg/m3
Quantity Required for Mould

Sr Nu	Material Used	Amount/mould
1	Cement	1.21kg
2	Coarse aggregate	4.13kg
3	Water	0.607lit
4	Fine aggregate	1.97kg

(Replacement value of F.A.5%=98.5gm)

Sr.Nu	Material Used as Replacement of FA With %	Amount /Mould
1	Sugarcane Ash 25%	24.62
2	Rise Husk Ash 25%	24.62
3	Groundnut Shells 25%	24.62
4	Saw Dust 15%	14.77
5	Osteler Shells 10%	9.85

(Replacement value of F.A.10%=197gm)

(Replacement value of F.A.15%=295.5gm)

Sr.Nu	Material Used as Replacement of FA With %	Amount /Mould
1	Sugarcane Ash 25%	49.25gm
2	Rise Husk Ash 25%	49.25gm
3	Groundnut Shells 25%	49.25gm
4	Saw Dust 15%	29.55gm
5	Osteler Shells 10%	19.70gm

Sr.Nu	Material Used as Replacement of FA With %	Amount /Mould		
1	Sugarcane Ash 25%	73.87		
2	Rise Husk Ash 25%	73.87		
3	Groundnut Shells 25%	73.87		
4	Saw Dust 15%	44.32		
5	Osteler Shells 10%	29.50		

(Replacement value of F.A.20%=394gm)

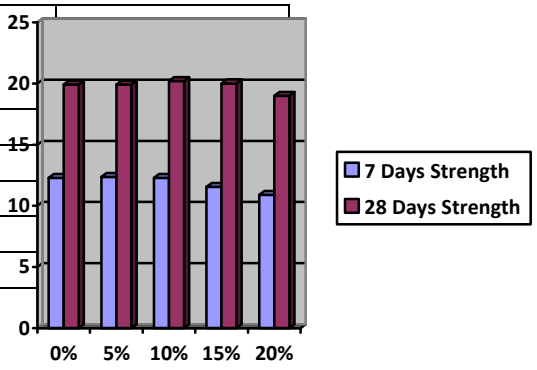
Sr. Nu	Material Used as Replacement of FA With %	Amount /Mould
1	Sugarcane Ash 25%	98.5gm
2	Rise Husk Ash 25%	98.5gm
3	Groundnut Shells 25%	98.5gm
4	Saw Dust 15%	59.19gm
5	Osteler Shells 10%	39.40gm

Test Resuls:

a) Compressive strength on cube:

Sr Nu	Material Used as Replacement of FA With %	Compressive strength in MPA 7Days				Compressive strength in MPA 28Days			
		1	2	3	Avg	1	2	3	Avg
1	0%	12.22	12.35	12.31	12.29	19.91	20	19.86	19.92
2	5%	12.31	12.4	12.4	12.37	20.08	20.22	20.31	20.20
3	10%	12.35	12.22	12.31	2.39	19.95	20.08	20	20.01
4	15%	11.55	11.64	11.51	11.56	19.64	19.55	19.68	19.62
5	20%	11.11	10.88	10.75	10.91	19.11	18.88	19.15	19.04

Graph



Graph showing Compressive strength of 7 Days and 28Days with adding agro west

3. CONCLUSIONS

From test results of Compressive Strength indicate that we can use Agro West as a Replacement of fine aggregate in concrete effectively without compromising the strength of concert

As results shows that the replacement value 5%,10%,15% shows effective strength of concrete but when we exceed more than 15%to20% it shows the in strength

Thus due to replacement we can utilized an Agro West effectively also we can get a replacement approach towards natural material which are conventional it also shows the minimization the cost of concrete hence economy also achieved

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