# Sustainable Application of Agro-Waste as Substitute for Construction Materials: A Review

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***Abstract-*** *The major amount of throw away or waste generated from agricultural sources are wastes of vegetables, food products, cotton stalk, sugarcane bagasse, paddy and wheat straw and husk, jute fiber, groundnut shell, wooden mill waste, coconut husk, etc. The utilization of locally obtainable agro-waste materials have been considered and reviewed depending on the required end product construction material (viz. particle boards, thermal insulators, masonry composites/bricks, cementations/binder, aggregates, etc.). The agricultural wastes are going to wind up being destroyed or predisposed off in the environment, retrieving them in the form of aggregate for concrete production, can be a well thought-out and environmentally profitable technique that will be acknowledged by the majority of the sustainability rating system.*

***Keywords-*** Agro-Waste, Rice Husk, Cotton Stalk, Coconut Pith, Bagasse

## I. INTRODUCTION

Growth of inhabitants, mounting urbanization, intensifying standards of livelihood owing to hi-tech innovations have add on to the increase in the amount and diversity of solid wastes generated by manufacturing, mining, household and farming activities. An outsized demand has been placed on structure building material industry particularly in the last decade due to the ever-increasing population that causes a never-ending scarcity of structure building materials.

Swift urbanization is creating an underperformance of conventional structure building materials owing to restricted accessibility of natural resources. Alternatively energy devoted for the fabrication of conventional structure building materials contaminates air, water and land. So as to meet the persistently escalating demand for the energy proficient structure building materials there is a call for to take on cost effective, environmentally fitting expertise and upgrade long-established conventional techniques with obtainable and easily accessible local materials. In order to meet constantly rising housing requirement, there is an exponential call for production of construction materials similar to bricks, cement, aggregates, steel, aluminum, wood, cladding and partitioning materials.

Agro-industrial and other solid waste removal is an additional grave matter of distress in emergent and developing countries. Per annum, Asia single-handedly generates 4.4 billion tones of solid wastes. The fabrication of usual building materials for instance cement, bricks and steel devour a lot of thermal and electrical energy and consecutively contaminate air, water and land. The utilization of suitably fitting structure building materials has not received ample consideration.

The major amount of throw away or waste generated from agricultural sources are wastes of vegetables, food products, cotton stalk, sugarcane bagasse, paddy and wheat straw and husk, jute fiber, groundnut shell, wooden mill waste, coconut husk, etc. The utilization of locally obtainable agro-waste materials have been considered and reviewed depending on the required end product construction material (viz. particle boards, thermal insulators, masonry composites/bricks, cementations/binder, aggregates, etc.)

The current paper reviews the possible application of some of the agro-waste as the constituent for alternating sustainable construction materials. Based on the availability of agro-waste substances, sustainable construction materials are appraised for their physico-mechanical properties, methods of production and ecological impact. The relevance of agro-waste for sustainable construction materials provides a solution which put forwards decline in natural resource utilization as well as energy.

## II. UTILIZATION OF AGRO-WASTE FOR STRUCTURE BUILDING MATERIAL

### 1. RICE HUSK

Ramasamy and Biswas made use of Rice Husk Ash (RHA) as a cement substitute material. Their end results signified that optimum amount of RHA boosts the mechanical properties of concrete.

Nair et al. inspected the long-term potency of diverse rice husk ashes as a pozzolana along with lime or cement to recommend a sustainable reasonably priced alternative for rural housing in India.

Memon et al. made use of rice husk ash as viscosity transforming agent in Self Compacting Concrete (SCC). On the basis of their investigational test results it was observed that the likelihood of developing low cost SCC by means of RHA is feasibly viable.

Rahman fabricated bricks from clay–sand mixes using varying percentages of rice husk ash. The effects of rice husk ash substances on feasible amalgamation water content, linear shrinkage, density, compressive strength and water absorption of the bricks were examined. The end results indicated that the use of rice husk ash contents increased the compressive strength of the bricks.

Chiang et al. developed lightweight bricks from the sintering mixes of desiccated water treatment sludge and rice husk. Samples having upto 20% wt. of rice husks were fired up by means of a heating schedule which permitted efficient organic burn-out. They observed that adding up of rice husk below 15% wt. and sintered at 1100 °C created low density and relatively high strength bricks which were compliant with appropriate Taiwan standards for lightweight bricks.

Ling and Teo developed bricks from the agro-waste rice husk ash and Expanded PolyStyrene (EPS) beads. RHA was used as fractional substitute cement replacement while EPS was used as partial aggregate replacement in the amalgamations. They found that the properties of the bricks were largely subjected to the content of EPS and RHA in the blend and also the curing condition used.

Lertsatitthanakorn et al. also developed rice husk ash based sand–cement block. Its performance was weigh against that of a customary marketable clay brick and it was found that the RHA based sand–cement block trims down solar heat transfer by 46 W.

Xu et al. studied the microstructure of RHA from X-ray Diffraction (XRD) to analyze the compressive strength results. It was observed that the most favorable ignition temperature for acquiring highly reactive RHA is 600 °C. Based on the observed results it was deduced that RHA can to some extent replace cement as a mineral admixture for structure construction purpose.

Tashima et al. following a line of investigation reported that the addition of RHA augments the strength and diminishes the water absorption of concrete.

## 2. COTTON STALK

Environment friendly Binder-less Cotton Stalk Fibre-board (BCSF) was manufactured from cotton stalk with no chemical additions by Zhou et al. The obtained results illustrated that the thermal conductivity values had a well-built linear correlation with the board density. The inner or Internal Bonding Strength (IBS) of boards was fine at the moderately low density level. As an ecologically friendly and renewable material, the BCSF is predominantly fitting for ceiling and wall application to save energy.

Rajput et al. had made use of salvage paper mills waste and cotton waste to fabricate Waste-Create Bricks (WCBs). His results indicated that bricks thus formed were thermally stable and meet the complied standard (IS 3495 (Part 1–3): 1992).

Algin and Turgut made use of an amalgamation of cotton wastes (CWs) , limestone powder wastes (LPWs) and a combination wood sawdust wastes (WSWs) for the production of low cost and lightweight complex as a structure building material. It resulted in the manufacture of a strong light weight compound having probability to be used for walls, wooden board replacement, cost-effectively substitute to the concrete blocks, ceiling panels, sound barrier panels, etc. The resultant compressive strength, flexural strength, unit weight and water absorption standards meet and satisfy the applicable international standards.

## 3. COCONUT PITH

Amalgamation of optimized durian peel and coconut coir was used by Khedari et al. for developing low thermal conductivity particleboards. Two parameters which were investigated in order to test the durability of the thus formed particle board were, the mixture ratio of durian peel and coconut coir and board density. It was observed that in contrast with either durian or coconut-based particle boards, combination of these two have improved thermal and mechanical properties.

Sampathrajan et al. manufactured particle boards from five different agro wastes namely maize husk, paddy straw, maize cob, coconut coir/pith and groundnut shell. He made use of urea formaldehyde as the required binding material and the mechanical and thermal properties of the boards were assessed.

## 4. BAGASSE

Sand replacement and performance tests were carried out by Sales and Lima for preparing mortars and concretes with SugarCane Bagasse Ash (SCBA). Their results indicated that the SCBA samples show cased physical properties comparable to those of natural sand. They also found that the mortars produced with SCBA instead of sand presented enhanced mechanical results as opposed to the conventional mortar.

Thermal properties of cement composites reinforced with vegetable bagasse fibres was examined by Onésippe et al. The experimental investigations disclosed that addition of authorized bagasse fibres decreased the thermal conductivity of composites and yields a weaker specific heat.

Waste product of sugar industries (Bagasse ash) as a cement replacement in concrete was studied by Amin. His results indicated that Bagasse Ash (BA) is an efficient and valuable mineral admixture and pozzolana when used with the original ratio of 20% cement, cuts down the chloride diffusion by more than 50% with no undesirable effects on rest of the properties of the hardened concrete.

Rukzon and Chindaprasirt made use of bagasse ash (BA) as a pozzolanic material for fabricating high-strength concrete. The concrete mixtures, to a certain extent, were substituted with 10%, 20% and 30% of BA respectively. The compressive strength, porosity, the coefficient of water absorption, the rapid chloride penetration and chloride diffusion of concrete were determined. The results indicated that the integration of BA upto 30% substitution level not only augments the resistance to chloride infiltration but also increases the compressive strength convincingly.

## III. CONCLUSION

Assuming that agricultural wastes are going to wind up being destroyed or predisposed off in the environment, retrieving them in the form of aggregate for concrete production , can be a well thought-out and environmentally profitable technique, that will be acknowledged by the majority of the sustainability rating system.

Concrete made by means of agricultural wastes has publicized improved thermal properties in research. For this reason, agricultural waste when used as an aggregate in concrete production can contribute in making the material and as a result, the structure further environmental friendly. Buildup of unmanaged industrial or agricultural solid waste particularly in developing countries has resulted in an greater than before environmental apprehension. Recycling of such wastes as a sustainable construction material comes into view as a feasible solution not only to pollution crisis but also an cost-effective alternative for designing of green buildings.

Research based study on the use of agricultural waste as aggregate in structural concrete production, is reasonably new. More research on long term resilience and durability of this sort of concrete would provide more self-assurance and confidence to the construction industry.

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