Use of Waste & Recycled Material in Construction & Its Applications

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Abstract

The primary objective of this research review is to find the possible utilization of different reused and waste material and for final supply of those materials for Construction. As we are producing waste in tones day by days so we need to utilize that waste in some different and efficient manner so that we can reduce that threat to environment.We are increasing loads on nation's landfills as well. For economicviability andto find best solution for environment we can utilize the waste products and can reuse them after suitable modification in their properties we can use them as some foreign to enhance the mechanical, chemical and other properties of the building in addition to construction material. By using these materials in construction we can reduce load on Nations landfills as well.Reuse of waste materials helps to preserve natural resources, save energy, helps in to decrease solid waste, reduction in pollution levels and other factors which effects our environment directly. Construction companies can being aware and they can take the advantage by using these waste and recycled material. This review paper discusses the implications caused due to various waste products and features their reusing possibilities and conceivable use for producing good construction material. This paper deals with proper use of waste and recycled material in construction and application in this field.

Key words : Recycled material, Solid Waste, Environment, Construction Material.

INTRODUCTION

Waste material generally produced by from different sources like from power plants, from demolition sites domestic waste and from commercial waste. Waste can be blast furnace slag, silica fumes recycled aggregate from demolished buildings sites, solid waste, plastic waste and rubber waste depending upon the types of source.

India generally generates around 1,00,000 metric tonnes of solid waste in a day , which is higher than numerous nations,Several issues exist with respect to diminishing waste.A key natural issue is Waste incinerators, furnaceto burn waste materials, trash and cinders. These incinerators produce 210 distinctive dioxin mixes in addition to mercury, cadmium,

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nitrous oxide, hydrogen chloride, sulfuric acid and fluorides.This is harming the earth because of nonstop exploitation and exhaustion of natural resources. Above all in addition this incinerator also produces particulate matter which size varies in microns and remains in lungs of a human being which results in various health and respiratory issues.

These waste materials and its disposal proved to be a serious problem to the environment, the proper use of different type of solid waste can provide a big relief to society by using them as a material in construction activities. The yield of these waste materials in India are almost doubled then the cement and other construction material used for construction activities.A portion of the significant components in this regard are the reduction of the utilization of vitality and natural crude materials,precise utilization and utilization of waste materials by and large. Various research and development activities have been taken up in India for demonstrating its practicality, monetary feasibility and cost viability for the utilization of waste materials in all the activities related to construction.

Table 1. Different types and sources of solid wastes and their recycling andusage possibilities as a construction materials (adapted from Pappu et al., 2007).

S/No.	Type of solid wastes	Source details	Recycling and utilization potentials
1.	Agro-waste (organic)	Baggage, rice and wheat straw andhusk, saw mill waste, ground nutshell, jute, sisal, cotton stalk,vegetable residues	Cement boards, particle boards, insulationboards, wall panels, roof sheets, binder,fibrous building panels, bricks, acid-proofcement, coir fiber, reinforced composites, and polymer composites.
2.	Industrial waste (inorganic)	Coal combustion residues, steel slag,bauxite red mud, construction debris.	Bricks, blocks, tiles, cement, paint, fine andcoarse aggregates, concrete, wood Substitute products, ceramic products.
3.	Mining/mineral waste	Coal washeries waste; mining wastetailing from iron, copper, zinc, goldand aluminium industries	Bricks, fine and coarse lightweight aggregates, tiles
4.	Non hazardous waste	Waste gypsum, lime sludge, lime stone waste, broken glass and ceramics, marble processing residues, kiln dust	Blocks, bricks, cement clinker, hydraulic binder, fibrous gypsum boards, gypsum plaster, super-sulfated cement
5.	Hazardous waste	Contaminated blasting materials, galvanizing waste, metallurgical Residues, sludge from wastewaterand waste treatmentplants, tannerywaste.	Boards, bricks, cement, ceramics, tiles

Different Types Of Waste And Their Use As A Construction Material:

Growth of population, increasing urbanization, and rising standards of living due to technological innovations have contributed to increase the quantity of a variety of wastes generated by industrial, mining, domestic and agricultural activities to cater their needs. Different types and sources of solid wastes are shown in Table 1.

There is a developing mindfulness even in India about broad harm being caused to the nature because of Accumulation of waste materials from Industries, power houses, colliery pits and destruction locales. Utilization of waste items isn't just a partial solution for natural and ecological issues;it essentially improves the microstructure, and thus the properties of Concrete. As a result of the above components, there is a need and expanding interest for better understanding the behavior of waste material properties just as better control of the microstructure developing in the construction material, to build the toughness & durability. Following are some waste material with normal use in construction activity.

Plastic:

As per the reports say in 2020, plastic waste generated approximately 21 million tonnes, which represents around 15 % of municipal solid waste. As plastic is nearly indestructible and has very bad impact on environment as well. Use of recycled plastic waste in construction industry is generally used in soil embankments for their reinforcing and using them as a plastic strips which improves their measured strength. Studies carried out by the author (Awwad and Shbeeb, 2007) and they found HMA mixture has higher stability and it also reduces pavement deformation, increase fatigue resistance and provide better adhesion between asphalt and aggregate.

Malagavelli and Paturu (2011) also found some useful facts in their studies they carried out experimental investigation on concrete and found that the load carrying capacity of the concrete is increased by using plastic waste fibers material. It was further reported that the maximum 2% of fibres could be used for strength purpose and that up to 6%, for disposal purpose.

Rubber Waste:

As per (RMA, 2011) the report says nearly 250 million tires unaccounted for are discarded yearly. In an estimate it is found that around one billion of tire scrap is disposed in huge piles in US. These discarded tires can be used in artificial break waters, dock bumpers, playground equipment or as a soil erosion control mats.

Various investigations were carried out by using scrap tire particles in PCC. As per (Li et al., 1998) these discarded scrap tire can be used to replace coarse aggregate and fine aggregate depending on the fineness of the particles present.as we know concrete is the widely used construction material and has a positive impact on the environment as well by incorporating the tires particles in the concrete in large quantity. Several mechanical properties of the concrete is also improved by using these scrap particles in the concrete.as per experimental investigation carried out by (Li et al., 1998; Topcu, 1995) the rubberized concrete shows flexibility, ductility and better energy absorbency as compare to traditional concrete.

Construction and Demolition debris:

We are leading our lives in a developed country and for development and economic growth it results in huge quantity of construction and demolition activities. While these activities generate debris during the construction and development works.as the construction industries grow it generates more construction and demolition which results in more debris which share a major portion in solid waste. The amount of debris depends upon the type and nature of the construction site.as per (Rao et al.,2007) most of the C&D debris are dumped in uncontrolled waste landfills pits and in open area.

RCA which is also known as recycled concrete aggregate is made up of processed concrete rubble.as per (Collins, 1994) it can be used in producing concrete and by (GTAA, 2007; Sherwood, 1995) RCA can be used in the pavement construction for Roads and aircraft runways. These aggregates can be used in some % to reduce the quantity of coarse aggregate which has the material possesses same mechanical properties like the hardened concrete, without disposing the waste into the environment.

Waste glass:

Glass is made out of silica or sand and contains a few measures of limestone and soda ash used to deliver uniform quality and color.

Glass cullet affects the workability of concrete mix which is the major property of concrete mix and the likely hood of alkali-silica reaction. Best use of waste glass is in the secondary applications like manufacturing of fiberglass insulation, roadbed aggregate, decorative tiles and driving safety reflective beads. Experimental investigation carried out by Demir (2009) on the properties of fire clay brick by adding waste glass. He found the compressive strength of the fire brick samples is improved significantly by addition of waste glass. Due to the amorphous nature of waste glass it enhances the sintering action which helps to achieve better strength in bricks.

By Shao et al., (2000) using waste glass powder as a substitute for Portland cement in concrete. Waste glass possesses pozzolanic behavior if the finely grounded glass having size finer than 38 μm which contains a high amount of amorphous silica.

Slag:

The blast furnace slag is obtained from manufacturing process of steel which is the by-product which mainly consists of around 35-37% of calcium oxide (CaO).The nonmetallic waste that grows all the while with iron in a blast furnace consists of alumina silicates and silicates of calcium and other bases. As per Malhotra and Tehri, (1996) a genuinely huge amount of granulated blast furnace slag is being consumed in the production of portland slag and supersulfated cements.by the experimental investigations by (Aitcin and Laplante, 1992;Malhotra, 1987) the use of GGBS i.e ground granulated blast-furnace slag with cement improves microstructure, durability and final strength of the hardened concrete. Moreover, the research carried out by (Malhotra and Tehri, 1993) using small briquettes revealed that good quality bricks can be produced by pressing the slag-lime mixture at sufficiently low pressure (Malhotra and Dave, 1992).

Fly Ash:

Fly Ash (FA) is obtained during the process of

combustion of coal in power generation as a byproduct.Coal contributes more than 50% in generation of nation's electricityand keeps on being the fuel of choice for generating power. Flying Ash (FA) is the laced substance laced with heavy metals such as mercury, arsenic and lead. Ramesh et al. (2003) investigation reported thatthe replacement of cement with high volume fly ash up to 20% has been practice for long for durability and economy for concrete pavements. Basak et al. (2004) pointed in their experimental investigation that the part replacement of cement with fly ash is accepted and approximately 25% of the volume of cement of actual consumption is saved; thereby if fly ash is collected properly then 15% of cost of construction is saved.

Organic fibers:

Organic fibers can be obtained from the various solid waste such as coconut, bamboo, oil palm, sugar palm, date palm vegetables waste and sugarcane. Some fibers are chemically more inert then either steel and glass fibers.They are likewise less expensive and more importantly most of them can be natural.

Bamboo fibers can easily be extracted and obtained from solid bamboo waste. As per (Jain and Kumar, 1994; Deshpande et al., 2000) these fibers are useful to produce polymeric composites such as polyester composites and bamboo fiber reinforced plastic.

Coconut fibers can be used to manufacture fiber cement board with portland cement. In the research (Sivaraja and Kandasamy, 2009) coconut fibers were used in reinforced concrete beam along with rice husk and sugarcane waste fibers

Use Of Waste Materials In Real Construction:

Critical investigations have been carried out on the advancement of new construction materials by utilizing various types of waste materials. However their application in real is very limited and we need to identify the appropriate location of their application in Real world. We need to find their different mechanical and chemical properties for application in construction field. Also more research is required to study their properties and to encourage using of these waste materials in construction.

CONCLUDING REMARKS:

During various activities like mining, Industrial, agricultural and domestic activities, huge amount of solid waste is generated as a by-product, which requires a lots of efforts to dispose and requires large area in terms of landfill for their storage/disposal.There is a huge scope for setting up auxiliary industries for the recycling of these large quantity of solid waste which can be used as resource in construction material.

Review of a few studies proposed that the utilization of reused materials has positive effect through various viewpoints. This helps in enhancing the sustainability of construction industry while reducing cost, also helps to provide solution for environmental pollution and diminishing the use of natural resources as well.A maximum utilization of waste materials might be applied to different businesses, industries, communities, home & schools. Likewise the use of waste materials like solid waste, Hazardous waste in these construction activities will decrease the load on the landfills but also save the earth and lead to a considerably more gainful, effective, and sustainable future.

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