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A review on utilization of waste materials for sustainability

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Abstract: Infrastructure development of a nation is one of the indices of a country's growth and to establish and maintain this, natural resources are essential. One of the daunting problems faced by the construction industry is the shortage of or inconsistencies in the supply of construction materials. Another common problem faced is that of handling the waste or debris originating at various stages in infrastructure management like construction, remodeling, repair and demolition. An attempt has been made to review the research work done so far on utilization of waste materials for sustainability. It was observed that Construction and Demolition Wastes (CDW), Polypropylene fiber, ground granulated blast furnace slag(GGBS), Copper slag, fly ash, recycled concrete, coconut shell ash, cow dung ash and plastic waste were successfully used for making concrete. It was found that This knowledge of the source of materials used for concrete is important in mix design and mixing of concrete . This reuse of waste materials had an economic advantage and has saved about 3 to 6% in cost of concrete. The cost savings include savings in the form of reduction in the amount of natural aggregate purchase, transportation of wastes, and transportation of new aggregates. The saving would be more if some sort of tax for disposal is considered.

Keywords: Concrete , CDW, GGBS, Copper slag, coconut shell ash, cow dung ash, plastic waste

1 INTRODUCTION

Infrastructure development of a nation is one of the indices of a country's growth and to establish and maintain this, natural resources are essential. One of the daunting problems faced by the construction industry is the shortage of or inconsistencies in the supply of construction materials. Another common problem faced is that of handling the waste or debris originating at various stages in infrastructure management like construction, remodeling, repair and demolition. The advantage of using waste materials like recycled concrete, reduces the amount of C02 is the atmosphere. Cost saving & significance reduction and construction cost . It also conserves landfill use space, reduces the need for new landfills. It preserves natural environmental resources and losing of land used as a graveyard for demolition waste concrete buildings, recycling concrete aggregate is one of the green sustainability practices and keep the land and reduce material losses(1). Concrete is a blended material of cement, sand, water, and coarse aggregate or lightweight material. Where coarse aggregate act as building blocks of the concrete and fine aggregate act as filler material to remove air entraining into the concrete and reduce the shrinkage of concrete and cement act as glue to mix fine and coarse aggregate to make it harden form. The concrete will become a hardened element when the above components react with water(2). Pozzolonic material to a siliceous, and Aluminum material, which in ont Possesses little or no Cementious properties but which will in finely divided form and in the pressure of moisture. Low calcium (class f fly ash, and silica fume are the most common pozzolanic material in use(3). Environmental sustainability can be achieved in this sector by replacing conventional aggregates in concrete with solid waste(6).

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Polypropylene (PPF) is a kind of polymer material with light weight, high strength and corrosion resistance. Polypropylene of PP is a type of fiber used in concrete because it is resistance to drying shrinkage and plastic shrinkage. The fiber helps reduce water bleeding un concrete and reduces the Concrete's Permeability significantly. GGBS has been widely used as a cement replacement material to enhance the physical, chemical and mechanical properties of cements and concretes. Copper slag (CS) is an industrial by-product obtained during the smelting and refining of copper and has an annual production of about 35 million tonnes. This would be sufficient, at 50% replacement of natural sand, for producing about 100 million cubic metres of concrete(4). Different types of cement replacement materials such as metakaolin, fly ash, slag, Nano silica are being used investigated by scientists with different replacement levels of Ordinary Portland Cement s. More than 65% of post-consumption tires were prepared for reuse/export, rebuilding, recycling and energy regeneration, whereas less than 35% was stored in dumps. (5). Structural lightweight concrete can be produced by replacing conventional aggregates with alternative lightweight aggregates, such as pumice, blast-furnace slag, vermiculite, expanded clay, clinker, foamed slag. fly ash and cow dung ash can also be used for preparing concrete cubes by replacing different amount of cement percentage(6). Plastic is composed of several toxic chemical and therefore plastic pollutes soil,air and water ;since plastic is a non-biodegradable material. The plastic waste is now a serious environmental threat to modern civilization(7). The utilization of recycled coarse aggregates (RCA) from construction and demolition wastes to produce green concrete serves as a sustainable solution with manifold environmental benefits(8). Construction and Demolition Wastes (CDW) are the status of building materials after the end life of buildings. CDW could be concrete, steel, wood products and also bricks from building(9).

II METHODLOGY

In present study, research work on utilization of Construction and Demolition Wastes (CDW), Polypropylene fiber, ground granulated blast furnace slag(GGBS), Copper slag, fly ash, recycled concrete, coconut shell ash, cow dung ash and plastic waste is reviewed to understand the effect of these materials on properties of concrete to find their suitability for the replacement of aggregate and cement.

III RESULTS AND DISCUSSIONS

1. The workability will have affected by replacing natural aggregate concrete (NAC) with recycled concrete aggregate (RCA). The physical and mechanical properties for recycled concrete aggregate (RCA) have significant role on concrete workability, due to adhered mortar on aggregate partials (1).
2. Among hardened concrete properties compressive strength and other mechanical and physical properties of hardened concrete, such as tensile strength, elastic properties, shrinkage, creep, cracking resistance, electrical, thermal, transport and other properties are covered. Testing, interpretation, modeling and prediction of properties are addressed, as well as correlation with properties of fresh concrete and durability, effects of special binders, recycled and natural aggregates, fiber reinforcement, mineral and chemical admixtures. Special attention is given to the properties of hardened lightweight and self-compacting concrete(2).
3. The FA geopolymer concrete specimens display a significantly lower sorptivity than the control concrete. As the level of GGBS in the blended concrete increased, the sorptivity decreased and became comparable with the FA-based geopolymer(3).

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4. The use of Copper slag(CS) as a sand component should, if anything, enhance the performance of concrete in the fresh state, particularly workability. In this respect a simple model for estimating potential mix water saving has been proposed and the laboratory trial tests results show how Copper slag(CS) can be used to improve the performance of other waste materials in concrete, as well as in the development of high-performance concrete, in terms of strength and possibly also durability(4).
5. The performance of concrete is significantly affected by the type and content of the rubber particle as well as by cement type and admixture properties(5).
6. Fiber reinforced coconut shell concrete with fly ash is suitable to be utilised as a sustainable eco-friendly construction material in the production of structural concrete(6).
7. Irrespective of the type of plastics and amount of substitution, the incorporation of plastic aggregate lowers the various strength properties of resulting concrete and mortar specimens. This is mainly due to the very low binding strength between the surface of the plastic particles and the cement paste(7).
8. RCA replacement reduced the compressive, splitting tensile and flexural strengths of pervious concrete(8).
9. CDW use had an economic advantage and has saved about 6% in cost by employing a recycling crusher to crush the sources mentioned. The cost savings include savings in the form of reduction in the amount of natural aggregate purchase, transportation of wastes, and transportation of new aggregates. The saving would be more if some sort of tax for disposal is considered(9).

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