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PARTIAL REPLACEMENT OF CEMENT IN CONCRETE TO WOOD ASH

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ABSTRACT

Wood ash is produced as a waste product of combustion in boilers at pulp and paper mills, steam power plants, and other thermal power plants. Because wood is a sustainable energy source and a natural product, There is a growing need for waste wood as an energy source because it is an environmentally favourable commodity. As a result, there will be more wood ash waste produced. The research focuses on the use of wood ash in construction. When used in various structural tasks, it can be mixed with conventional Portland cement. In sieve, a critical review research was conducted. Wood ash added to OPC will generate analysis, consistency, and water absorption, as well as setting time and slump tests. key findings to demonstrate the thoroughness of the research method. Uncontrolled burning of sawdust produces wood ash, which is used to partially replace cement, altering its physical and chemical qualities. These qualities are comparable to those of fly ash. The amorphous wood ash is used as a cement additive in the concrete mixes. having grain sizes of less than 75 microns in proportions of 7%, 14%, 21%, 28% and 35% by weight of cement A study is carried out in this study to determine the change in work-ability or consistency of concrete mix. Compressive strength, split tensile strength, flexural strength, and other features are discussed, as well as certain durability characteristics. To get efficient outcomes, foundry sand is employed as a fine aggregate.

Keywords: Wood Ash, Ivestigation, OPC, CMT.

I. INTRODUCTION

Growing environmental awareness and energy security have led to increased demand for renewable energy supplies and diversification of current energy production technologies in recent years. Biomass (forestry and agricultural wastes) is a viable source of renewable energy among these resources[7]. In today's energy production trends, power plants that Biomass-powered systems are low-cost to operate and provide a steady supply of renewable energy. These energy sources are thought to be. When the rate of fuel consumption is lower than the rate of growth, the resource will be a CO2 neutral energy resource. Also, using biomass industry wastes (sawdust, wood chips, wood bark, saw mill scraps, and hard chips) as fuel provides a safe and efficient means to dispose of them[8].

Wood wastes are frequently selected as fuels over other herbaceous and agricultural wastes because they emit less pollution when burned. There is a lot less fly ash and other leftover ash. The use of forest and lumber waste products as fuel is causing a huge concern. The ash produced in substantial amounts after the combustion of such wastes is referred to as fuel[9]. It's a well-known fact that the Hardwood produces more ash than softwood, while the bark and leaves produce more ash than the interior of the tree. the woods Wood ash is the strong leftover after burning of wood. It shifts significantly in quality, accordingly there is no question that wood ash from various sources or species may lead to inconstancy in nature of the wood ash substantial squares. Wood ash is persistently created everyday, and this guarantees its timeless accessibility and use. The usage of wood ash as a halfway replacement for concrete is one of the promising techniques to expand the strength and warm protection for concrete squares. The actual properties of wood ash, including a lower explicit gravity than that of general Portland concrete, make it a great concrete substitution material. The particular gravity of wood ash and Portland concrete is 2.0 and 3.14, individually[4].

Rice husk ash and fly ash, are key part which previously demonstrated to be viable mineral admixtures to solidify at different rates. Wood ash (WA) is likewise a comparable waste materials created from wood it is principally utilized as a to consume enterprises which compost for soil. Critical amounts of wood ash is as of now land filled close to the businesses that involves wood as a fuel to some extent or completely which represents a danger to the climate in numerous ways to life stock around. Synthetic examination of wood ash shows that it has pozzolanic property, and involving it as a halfway substitution to concrete might be one of the most amazing application in the ongoing climate situation.

II. METHODOLOGY AND MATERIALS

Materials

SCement: Ordinary Portland cement was utilized having molecule size of 3.9 μm, explicit gravity of 3.01. The physical and compound examination properties are given in Table 1. [6]

Table 1: Constituents in cement

Constituents (% Age)	Values
Chemical properties	
SiO2	21.25
Al2O2	5.04
Fe2O2	3.24
CaO	63.61
MgO	4.56
Losson Ignition	3.26
Physical properties	
Specific Gravity	3.1
Mean Size	23 μm

Wood ash: wood ash was made accessible from wood outfitting industrial rural area in Dongargaon. The wood ash was gotten by burning of carpentry squander and other horticultural squanders like spoiled wood.

Physical properties of wood ash

Wood ash particles are of various sizes and shapes. To acquire the fineness for supplanting with concrete strainer examination is conveyed. Udeyou et al [4]. noticed the actual properties of wood ash as of shifting shapes. The typical misfortune on start was found out to be equivalent to 10.46.

Chemical composition

A portion of the significant parts of wood ash are lime, (ca(OH)2), CaCO3 and calcium silicate. Nike et al. proposed a portion of the synthetic qualities wood ash with various sorts of wood. The % age misfortune on start was between 6.5% to 58.1% and dampness content of 0.5% to 3.3%.

Aggregates: Foundry sand having grain size of 4.75 mm alongside specific gravity as 2.6. The coarse totals utilized were squashed rock of size around 10 mm and specific gravity of 2.6. The grain size or molecule size conveyance was by ASTMC33/C33M-08

III. METHODOLOGY

The desired compressive strength for M20 mix was determined as 27.8 N/mm2 according to IS: 10262 2009. [5] for a period of 28 days The water-cement ratio, fine aggregate content, and coarse aggregate content are all factors to consider. As a result, the aggregate content was carried out in accordance with the above-mentioned IS. code. As a result, the following mix proportion was obtained:

409.9 kg/m3 cement content

545 kg/m3 Fine Aggregate Content

1163 kg/m3 coarse aggregate content

Preparation of the mix: The control mix (M20 Design mix considered) was created first, followed by the trial mix with a water-cement ratio of 0.47. Slump Cone Tests were used to evaluate the results and check for work-ability (to ensure a constant mix). Foundry sand was caste for 7 days, 14 days, and 28 days as a control specimen.

Second, the mix was prepared using wood ash in varied proportions of 7%, 14%, 21%, 28% and 35% by weight of OPC with the same 0.47 water cement ratio. The specimens were cast for 7days, 14 days, and 28 days. To test compressive strength, 150 mm x 150 mm x 150 mm cubes were casted. Split was tested using cylindrical specimens.

For each test, a minimum of three specimens were collected. The entire procedure took place at room temperature. Concrete was compacted with the help of a vibrating machine. Curing of blocks: All specimens were cured for 7days, 14 days and 28 days respectively. Compressive strength, water absorption, and drying shrinkage tests were performed.

IV. RESULTS AND DISCUSSION

Strength in compression

By weight of cement, the replacement %ages were 7%, 14%, 21%, 28% & 35%. The digitalize CTM (compression Testing Machine) was used to conduct tests for 7 days, 14 days, and 28 days, resulting in a minimal accumulation of faults in this study.

The following are the conclusions reached as a result of the findings:

1. The compressive strength of the control mixes was 18 N/mm2, 32 N/mm2, and 36 N/mm2 after 7 days, 14 days, and 28 days, respectively.

2. There was an increase in compressive strength with the addition of wood ash, but it was not comparable to the control specimens. For each day, the compressive strengths obtained are listed.

3. The best outcomes were obtained at a 21% replacement rate.

4. When tested under CTM, the ductile behaviour of concrete for wood ash replacement improved. When compared to the control specimen, the time required to break the wood ash specimen was sufficient, as the development of cracks began to increase slowly at the same rate of loading.

The effects of wood ash on the compressive strength of concrete blocks were studied by Rajamma et al. [1]. Wood ash was utilised to replace cement in %ages of 10%, 20%, and 30% by weight of cement, with the 10% substitution exhibiting the best and most significant outcomes in terms of 28-day strength. However, when 20% and 30% of the cement by weight was replaced, the 28-day strength was negligible and significantly diminished.

Udoeyo et al. [2] measured the compressive strength of concrete with cement substitutions of 5%, 10%, 15%, 20%, 30%, and 30% by weight.

Abdullia et al. [3] measured compressive strength for 10%,15%, 20% and 25%. The best outcomes were obtained when the %age was 15 %. However, the curing was done for seven days, fourteen days, and twenty-one days. This demonstrated the wide range of outcomes.

Absorption of water

At 28 days, there was a maximum rise in water absorption of 17%, indicating that the rate of pozzolonic response is substantially higher at 17% replacement. Water absorption dropped dramatically after 17% replacement.

[4,2] Udoey et al. According to the results of the t-test, using wood ash as a replacement for cement at levels of 5%, 10%, and 25%, there was a substantial increase in water absorption for 28 days. However, water absorption levels up to 10% were shown to be significant, resulting in positive results both with and without wood ash.

Shrinkage due to drying

The shrinkage of concrete with wood ash was noticed by Naike et al. [11]. The replacement of 5%, 8%, and 10% by weight of cement as a binder was completed. The following outcomes were achieved:

1. At 7 days, the concrete cube shrank by 0.0092 %, and at 232 days, it shrank by 0.052 %.

2. At a 5 % substitution of wood ash for cement, shrinkage was 0.012 % after 7 days and 0.027 % after 232 days.

3. At an 8 % substitution of wood ash for cement, shrinkage was 0.014 % after 7 days and 0.014 % after 232 days.

4. At a 12 % substitution of wood ash for cement, shrinkage was 0.0051 % after 7 days and 0.044 % after 232 days.

V. CONCLUSION

The following are some of the research findings from the previous study:

1. The quantity and quality of wood ash can vary depending on a number of parameters, including temperature, the type of wood or biomass used, and the method of combustion used. As a result, prior to use, it is critical to analyse the wood ash.

2. The strength parameters obtained were far superior to the M20 attainment target. The compressive strength results were really substantial. The optimal level of wood ash replacement yielded great outcomes.

3. The addition of wood ash increased the water absorption capacity.

4. The addition of wood ash made concrete sufficiently ductile. Because the failure was not instantaneous, concrete was able to bear loads for a longer period of time.

VI. REFERENCES

[1] Rajamma R, Ball RJ, Luis AC, Tarelho S, Allen GC, et al. (2009) Characteristics and use of biomass fly ash in cement based materials. J Hazard Mater 172: 1049–1060.

[2] Udoeyo FF, Dashibil PU (2002) Sawdust ash as concrete material. J Mater Civlil Eng 14: 173–176.

[3] Abdullahi M (2006) Characteristics of wood ash/OPC concrete. Leonardo Electr J Pract Technol 8: 9–16.

[4] Udoeyo FF, Inyang H, Young DT, Oparadu EE (2006) Potential of wood ash waste as an additive in concrete. J Mater Civ Eng 18: 605–611.

[5] Indian Standard Concrete Mix Proportionng – Gltideiliiyes (First Revision) ICS 91.100.30O BIS

[6] Amir Shafi Batt* and Anshul Garg Department of Civil Engineering, Lovely Professional University, Punjab, India

[7] Rajamma R, Ball RJ, Luis AC, Tarelho S, Allen GC, et al. (2009) Characteristics and use of biomass fly ash in cement based materials. J Hazard Mater 172: 1049–1060.

[8] Chee CB, Ramli M (2012) Mechanical strength: Durability and drying shrinkage of structural mortar containing HCWA as partial replacement of cement. Constr Build Mater 30: 320–329.

[9] Loo SV, Koppejan J (2003) Handbook of biomass combustion and Co firing. Twente University Press, The Netherlands.

[10] Etiegni L, Campbell AG (1991) Physical and chemical characteristics of wood ash. Bioresour Techno 37: 173–178

[11] Naik TR, Kraus RN, Siddique R (2002) Demonstration of manufacturing technology for concrete and CLSM utilizing wood ash from Wisconsin, Wisconsin Department of Natural Resources (Madison, WI) for project #1-06 UWM report no. CBU-2002-30, Center for By-products Utilization, Department of Civil Engineering and Mechanics, University of Wisconsin-Milwaukee, Milwauke.