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Agricultural Wastes as Partial Replacement for Cement in Concrete- An Experimental Investigation

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ABSTRACT

In this examination the correlation Wood ash, sugar cane bagasse ash, Rice husk ash and concrete quality utilizing destructive test equipment have been completed. In this investigation three sorts of squanders materials (Wood ash, sugar cane bagasse ash, Rice husk ash) and ordinary aggregate were utilized for preparing cube specimens. There are M25 grade of blended extent are used. Squander materials are used in concrete with the substitution bond of 5%, 10%, 15% and 20%. These beams, cylinder and cube are tried on 7, 14, and 28 days. The compressive Strength, flexural Strength, and tensile strength are determined with the help of destructive test equipments. Compressive strength From the experimental investigation it is observed that the compressive strength results represents that concrete casted with in M25 grade of concrete at 7, 14 and 28 days are decrease when the percentage of the wood ash increment from 0% to 20%.similarly it is observed that the compressive strength results represents that concrete casted with M25 grade of concrete at 7, 14 and 28 days are decrease with replacements of 5 to 10%, and increments, when the percentage of the SCBA increment from 15 to 20% at 7, 14 and 28 days and it is observed that the compressive strength results represents that concrete casted with in M25 grade of concrete at 7, days are decreases with substitution of 5%, 15% and 20% at 10% have increments, and 14, 28 days have decrease with substitution of 5%, 15% to 20% and increments when the level of the RHA increase from 0% to 20% at 28 days. Split tensile strength From the results it is seen that the tensile strength in M 25 grade of concrete at 28 days are decrease when the percentage of the wood ash increment from 0% to 20%, .similarly it is seen that the tensile strength in M25 review of concrete at 28 days are increments when the level of the SCBA increment from 0% to 20% usage of SCBA and it is seen that the tensile strength in M25 review of concrete at 28 days are higher than when the percentage are increases from 5, 10, 15 and 20% usage of RHA.It is observed that the Split tensile strength of concrete is decreases with the substitution of wood ash. Also, tensile strength is expanded with the substitution of SCBA and RHA increments, with the age of 28 days. Flexural strength From the investigation it observed that the flexure strength in M25 grade of concrete at 28 days. Flexure Strength is increase when the 5% of wood ash increment and abatement from 10%, 15% and 20% used of wood ash.similarly it is seen that the flexure strength in M25 grade of concrete at 28 days. Flexure strength is increase when the 5% 10% & 20% of SCBA increment and reduction from 15% used of SCBA and it is seen that the flexure strength in M25 grade of concrete at 28 days. Flexure strength is increase when the 10% and 15% of RHA increment and reduction from 5% and 20% used of RHA.

Keywords: Compressive Strength, Split Tensile Strength, Flexural Strength, Workability, Wood ash, Sugar Cane Bagasse ash, Rice Husk Ash, Wood Ash.

INTRODUCTION

Concrete is a complicated substance made up of cement paste as the binding agent and coarse and fine particles as the filler. Concrete is a mixture of rock, sand, crushed stone, or other aggregate held together by a cement-and-water glue that has hardened under pressure. When the ingredients are properly combined and proportioned, a plastic mass that may be hurled or moulded into a predetermined size and shape is created. Infinite supply of cement by the water produces concrete that is visibly stone-like in quality and hardness and is useful for a variety of purposes.

There are currently tonnes of innovations being developed in the field of concrete that can regulate the use of cement in concrete. In the unlikely event that fine aggregates, such as sand, wood dust, or another substance, will be substituted. The amount of CO2 emissions will be lower at that time. We are producing excellent concrete by using the production waste material. By using industrial waste in place of it and by item, the natural problem can be understood. The structure and condition may benefit from the replacement of fine aggregates (sand) with the help of waste products (wood powder). As a result, concrete's characteristics are evolving, such as workability, pressure testing, elongation index, etc.

The objectives of the present investigation are:

• To investigate the effects of waste products such as wood ash, sugarcane bagasse ash, and rice husk ash on the durability of concrete.

• Using various waste resources, such as wood ash, sugarcane bagasse ash, and rice husk ash, in place of standard building materials like cement.

• To investigate the compressive strength

LITERATURE SURVEY

Raheem et al. (2012) has given thought to the observation that dust and ash are a poor substitute for cement in concrete. The investigation looked at the physical properties and composition of saw dust ash (SDA), as well as the workability and compressive properties of the concrete produced by substituting SDA for 5%, 10%, 15%, 20%, and 25% of the weight of ordinary Portland cement. Concrete that was still fresh underwent testing for slump and compacting factor, while solidified concrete underwent tests for compressive strength. The age of the concrete solid shapes was tested at 3, 7, 28, 56, and 90 days. With a combined SiO2, Al2O3, and Fe2O3 of 73.07%, the results showed that SDA is a respectable pozzolanic. As the SDA content increased, the slump and compacting factor dropped, demonstrating that concrete becomes less workable as the SDA level increases.

Sabet et al. (2013) By using silica fumes, fly ash, and natural zeolites in place of concrete, researchers looked at high performance concrete and self-consolidating concrete. Various mixes were tested for characteristics such as slump flow, compressive strength, electrical resistivity, durability, etc. Results indicate that natural zeolite boosts mechanical and durability properties and is also economically advantageous. On the other hand, fly ash and silica fumes help to slightly enhance mechanical and durability characteristics.

Nochaiya et al. (2013) examined the use of fly ash mixed with silica fume and the characteristics of Portland cement. They looked into the system's workability, normal consistency, compressive strength, and setting time. The combination is prepared by substituting different weight percentages of fly ash (5%, 10%, 25%, and 30%) and silica fume (2.5%, 5%, and 10% by weight) as an additive. According to the study, more water was used to make the fly ash pastes with silica fume than to make the fly ash pastes without silica fume. The compressive strength of concrete with silica fume added increases by up to 145% (at 10% silica fume by weight) compared to concrete alone. The filler effect and pozzolanic reaction caused the rise in compressive strength.

Kayathri et al. (2014) has studied the effects of using fly ash, stone power, and copper slag as a partial replacement for fine aggregate. In this study, we provide the results of a trial analysis conducted to ascertain the mechanical properties of a concrete mix in which fly ash, copper slag, and stone powder were used primarily in place of fine aggregate (sand). The concrete used was M30 review concrete. Fly ash, copper slag, and stone powder were added at four different weight percentages (0%, 25%, 50%, and 75%) in place of fine aggregate (sand). Tests were run to determine the properties of crisp concrete. At 7, 14, and 28 days, the split elasticity and compressive characteristics were resolved.

•By adding the previously described industrial waste as a partial replacement of fine aggregate (sand), test results show a significant improvement in the characteristics of plain concrete, proving that it may be used successfully in basic concrete.

• The characteristics of Copper slag, Granite powder, Fly ash, and rate replacement determine the qualities of concrete.

• The results of the exploratory work and the discussion indicate that the CCGF mix can produce concrete of a high calibre.

• The combination of CCGF can reduce material costs, resulting in development costs that are low and abundant in industrial waste. Realistically possible prevents the deterioration of conditions by keeping industrial wastes.

• At 28 days, the compressive characteristics of various mixtures of fly ash fibre, granite powder, and copper slag will be 51.8 N/mm2.

Malik et al. (2015) has conducted research on concrete testing, using quarry dust as a partial replacement for fine aggregates. For the M-25 mix, quarry dust was used in the amounts of 0, 10, 20, 30, and 40% in place of fine aggregates. At 28 days old, the concrete underwent tests to determine its compressive strength, thickness, and durability (water retention), and the results were compared to those of regular concrete. Expanding the quarry dust content has the impact of increasing workability and compressive quality.

• It is learned that quarry dust can be utilised in place of sand as a substitute material.

• Quarry dust's physical and material qualities meet the requirements for fine aggregate.

• It has been found that quarry dust improves the mechanical properties of concrete.

Quarry dust is a waste product from quarries, so using it cuts down on the cost of concrete as well as the problems with transportation.

• The use of quarry dust in place of sand shows improved compressive qualities of the concrete. • The use of quarry dust in place of sand reduces the workability of the concrete because it absorbs more water.

• A 30% quarry dust substitution for some of the sand is ideal.

• Water retention rate increases as quarry dust content rises.

• Normal weight decreases as quarry dust content rises, making quarry dust concrete lighter.

• As the percentage of quarry dust in the concrete mixture rises, it becomes less workable.

• Quarry dust can be effectively used in concrete because it is a free, non-valuable waste product.

N.Kavibala et al. (2016) has gained knowledge of the fractional substitution test for fine aggregate, cement, and quarry dust with polypropylene fibre growth. The studies are designed to examine the effects of 5%, 10%, and 15% substitutions of marble powder for cement on compressive strength and split elasticity, compare them to conventional concrete, and determine the optimal substitution of marble powder between 10% to 145%. Quarry dust and marble powder are used as the best substitutes for fine aggregate at 10%, 20%, and 30%, and their compressive strength and split stiffness are examined. Polypropylene fibre is added to support the change in quality in order to achieve these optimal results.

In light of the results presented above, the following conclusion can be made:

The ideal rate of substitution of cement with marble powder and fine mixture with quarry dust is 12% and 30 minutes, increasing the compressive strength of cubes up to 12% substitute by weight of cement. When compared to conventional concrete, the compressive strength is increased by about 8.5%, and the part elasticity is increased by about 8.57%. • As the replacement level increases, workability decreases, necessitating the use of the superplastizer.

With the addition of 0.5% polypropylene fibre and the addition of cement to the concrete, the compressive strength of the concrete grew by about 13.87% and the split elasticity by about 15.08%.

Perarasan et al. (2017) Has research on the trial replacement of fine aggregate with sawdust and quarry dust halfway through. Sawdust & quarry dust are used in place of fine aggregate in concrete preparation to a certain extent. This investigation was undertaken to examine the impact of sawdust and quarry dust at levels of 0%, 10%, 20%, 30%, and 40%. Additionally, sawdust of 0%, 5%, 10%, 15%, and 20% has generated with the fine aggregate. The results show that

• The highest compressive strength of 36.26 N/mm2 and split tensile strength of 3.8 N/mm2 over a period of 28 days are provided by 30% quarry dust and 15% saw dust, respectively.

The investigation revealed that saw dust can typically be added in amounts up to 15% without affecting any of the mechanical or physical qualities.

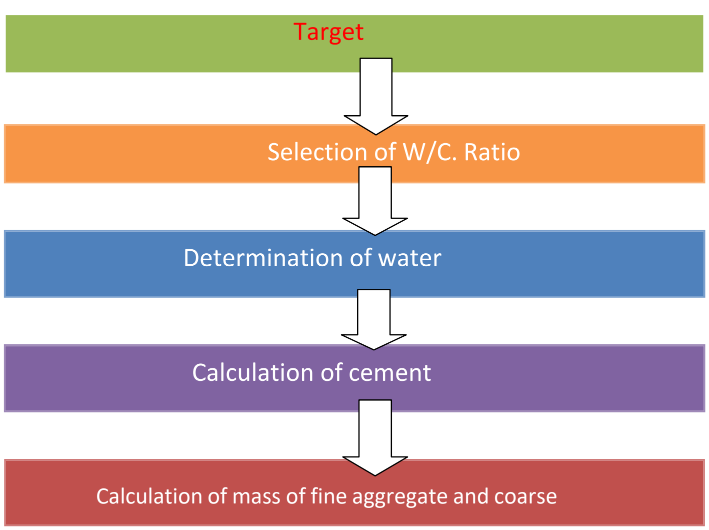
• A fascinating and important finding is that by accelerating the amount of sawdust, the value of the entire concrete mixture will be reduced and the weight will be reduced by up to 20.

METHODOLOGY AND FLOW CHART

The methodology of mix configuration incorporates the possibility of properties and costs of fixings. Essentials of setting and finishing the new concrete and characteristic of cemented concrete for instance strength sturdiness and volumetric dauntlessness etcetera. The standard goals of the concrete blend configuration would hence have the capability to be started as era of concrete which may be:

• Desired quality and sturdiness of cemented concrete which thusly is addressed by water-bond degree law.

• Conditions at the site, which helps in picking workability, quality and sturdiness prerequisites.



Step 1. Target Strength for Mix Design Proportion

f 'ck = f ck + (ts)

f 'ck = Target mean strength of 28 Days f ck = Characteristics strength at 28 days t = Tolerance factor = (IS- 10262)

s = Standard Deviation given in table 3.1

Table 1 Standard Deviation

S. No.	**Grade of Concrete**	**Assume Standard Deviation (N/mm^2)**
1	M-10	3.5
2	M-15	
3	M-20	4.0
4	M-25	
5	M-30	5.0
6	M-35	
7	M-40	
8	M-45	
9	M-50	
10	M-55	

Step 2. Selection of Water Cement Ratio

Different Cement additional cementitious material and aggregate of different grading surface texture, maximum size, shape and other properties may generate concrete of different compressive properties for the similar free water cement ration. Therefore, the relation between strength and free water-cement ration should preferable be established for the materials existent to be utilized.

Table 2 Water Cement Ratio (IS – 456-2000, Table- 5)

S. No.	**Exposure**	**Maximum W/c Ratio**
1	Mild	0.55
2	Moderate	0.50
3	Severe	0.45
4	Very Severe	0.45
5	Extreme	0.40

Step -3 Water Content

Table 3 Approximate Water Content

S. No.	**Nominal Maximum Size of Aggregate (mm)**	**Maximum Water Content**
1	10	208
2	20	168
3	40	165

Note:

- These amounts of blending water are utilized in estimate cementitious material content for testing batches.
- Slump Deduction for over 500 millimeter Slump

Step 4. Calculation of Cementitious Material Content

The cement and additionally cementitious material composition per unit volume of concrete is also determined from the free water-cement ratio and also the amount of water per unit volume of concrete.

Cement content =content/ (w/c) ratio

Step 5. Estimation of Coarse Aggregate Proportion.

Table 4 Coarse Aggregate Proportion

S. No.	Nominal Maximum Size of Aggregate. (mm)	Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zone of Fine Aggregate			
		Zone-4	**Zone- 3**	**Zone-2**	**Zone - 1**
1.	10	0.50	0.48	0.46	0.44
2.	20	0.66	0.64	0.62	0.60
3.	30	0.75	0.73	0.71	0.69

Content of Fine Aggregate = (1- Content of Course Aggregate)

Volume of Cement = $\frac{Mass\ of\ Content}{Specific\ Gravity\ of\ Cement} \times \frac{1}{1000}$

Volume of Water = $\frac{Mass\ of\ Water}{Specific\ gravity\ of\ water} \times \frac{1}{1000}$

Volume of Admixture = $\frac{Mass\ of\ Chemical\ Admixture}{Specific\ gravity\ of\ Chemical\ Admixture} \times \frac{1}{1000}$

Mass of Coarse Aggregate

= Va ×Volume of C.A× Specific gravity of C.A×1000

Mass of Fine Aggregate

= Va ×Volume of F.A× Specific gravity of F.A×1000

Where,

Va = Volume of Admixture

CA= Coarse Aggregate

FA= Fine Aggregate

RESULTS AND DISCUSSION

The Experimental programmed were carried out in three cases:

Sample 1:

In this investigation the trial work is done by used cement, fine aggregate, coarse aggregate & wood ash. The experiment were casted for M25 grade of concrete by replace the cement 0%, 5%, 10%, 15% and 20% by wood ash.

The new concrete is tested for workability by slump test while threw example is tested for compressive, flexure & split tensile test at the age of 7, 14 and 28 days. The outcomes are appeared in for bidden too in graphical frame for both the analysis of concrete.

Sample 2:

In this investigation the trial work is completed by used cement, fine aggregate, coarse aggregate & sugar cane bagase ash The experiment were casted for M-25 grade of concrete by replace the cement 0%, 5%, 10%, 15% and 20% by sugar cane bagase ash.

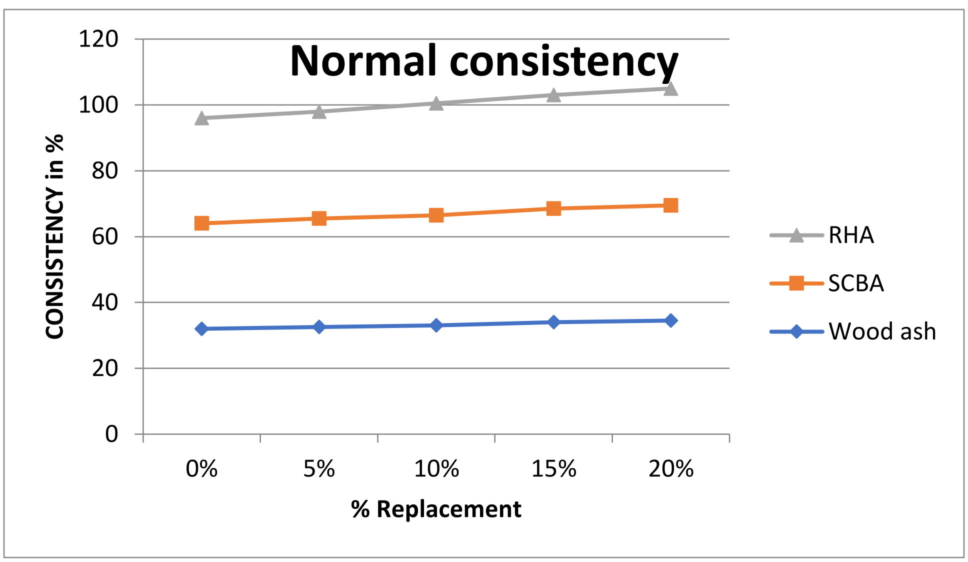
The new concrete is tested for workability by slump test while threw example is tested for compressive, flexure and split tensile test at the age of 7, 14 and 28 days. The outcomes are appeared in unthinkable also in graphical frame for both the analysis of concrete.

Sample 3:

In this investigation the trial work is done by used cement, fine aggregate, coarse aggregate & rice husk ash. The experiment were casted for M-25 grade of concrete by replace the cement 0%, 5%, 10%, 15% and 20% by rice husk ash.

Table-5 Percentage of Replacement

S. No.	Material	Percentage of Replacement				
		0%	5%	10%	15%	20%
1	Wood ash	32	32.5	33	34	34.5
2	SCBA	32	33	33.5	34.5	35
3	RHA	32	32.5	34	34.5	35.5



Graph 1 : % replacement v/s consistency in %

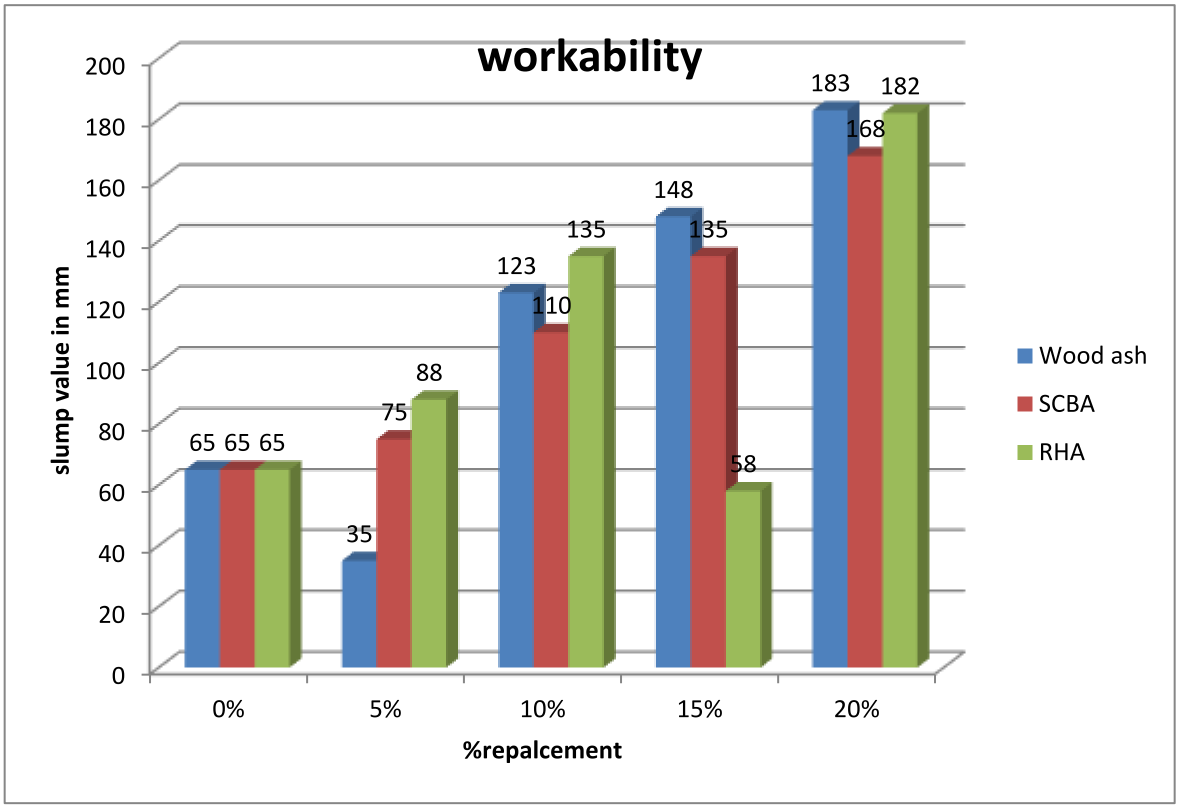
All of the pastes containing wood ash, sugar cane bagase ash and rice husk ash showed normal consistency equal and higher than the control paste. Up to 5% 10%, and 15% replacement the standard consistency has mostly constant minor differences, at 20% replacement the standard consistency has shown a slight increment to 35%.

Workability of Concrete

In this part different test results on concrete are presented and analyzed. This includes workability of concrete include wood ash, sugar cane bagase ash and rice husk ash blended mortar which is assessed by the compressive strength of concrete with M25 grade as shown in Table 4.7

Table 6. Workability of Concrete with Different Properties of Different Material

S. No.	Material	Percentage of Replacement				
		0%	**5%**	**10%**	**15%**	**20%**
1	**Wood ash**	65	35	123	148	183
2	**SCBA**	65	75	110	135	168
3	**RHA**	65	88	135	58	182

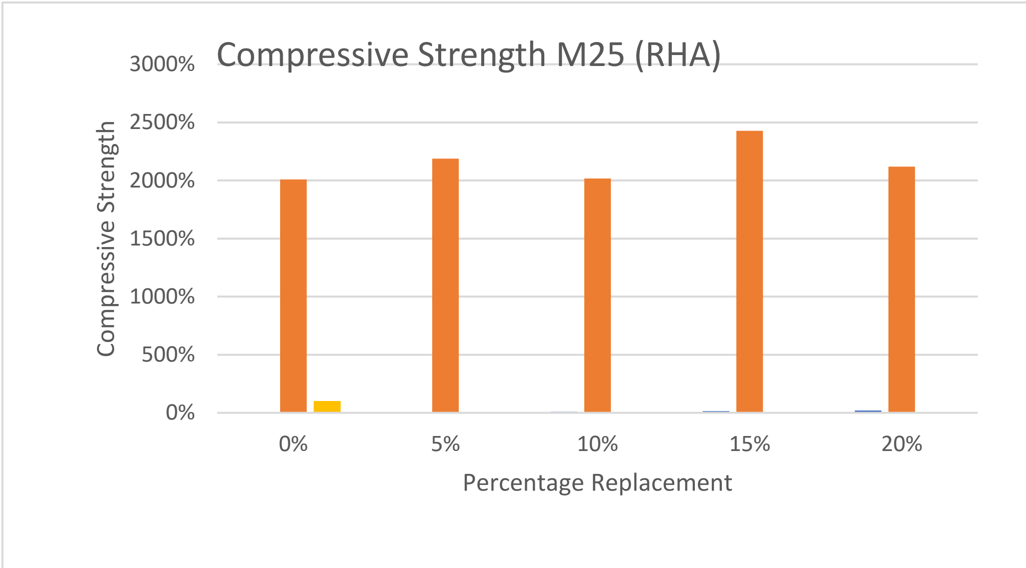


Graph 2. % replacement v/s Slump Values of Different Waste Material

From the above graph for slump demonstrates that the workability increments with the expansion in the rates of contain wood ash, sugar cane bagase ash and rice husk ash. All explored containing wood ash, sugar cane bagase ash and rice husk ash blends has stature slump esteems and worthy workability.

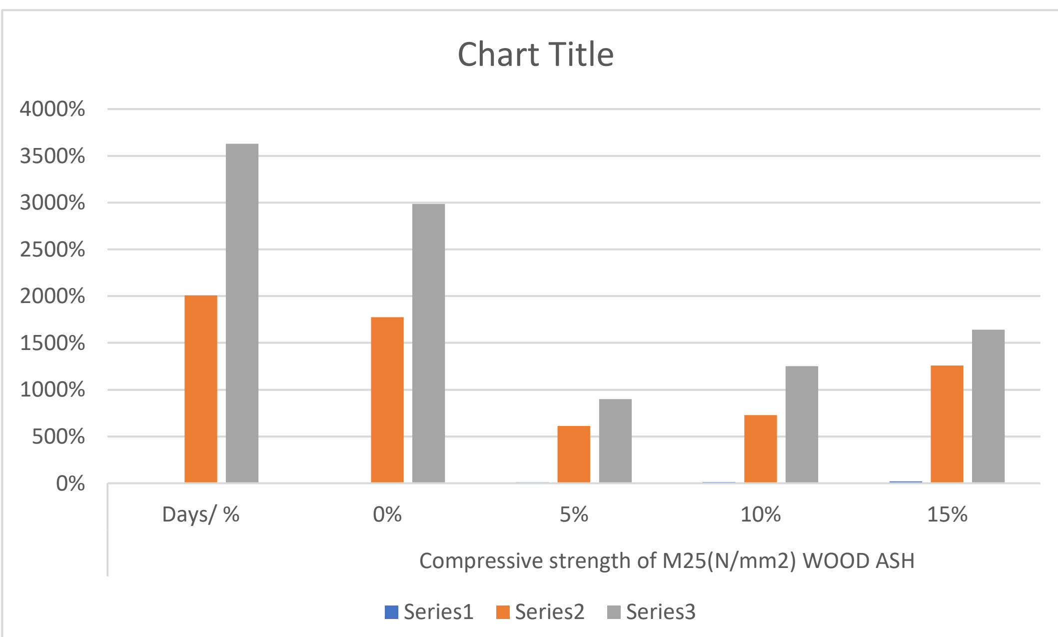
Compressive Strength

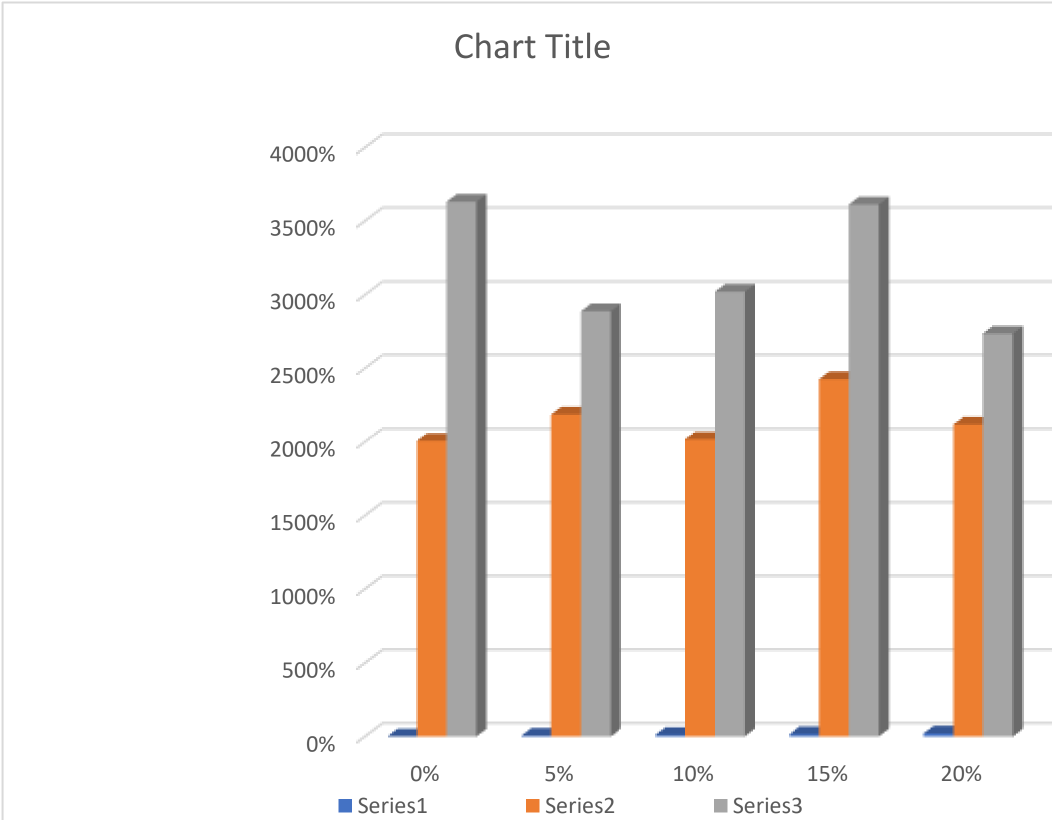
It is a destructive test. Concrete cubes specimens examples are tried by CTM. These sample specimens comprise of various synthesis of aggregate having ordinary aggregate piece test with 10 mm (40%) aggregate, and 20 mm (60%) aggregate having distinctive waste materials (wood ash, sugar cane bagase ash and rice husk ash) utilized the extent of 5%, 10%, 15% and 20% as substitution of bond utilized in concrete solid shape examples.



Compressive strength of M25(N/mm²)					
Days	**0%**	**5%**	**10%**	**15%**	**20%**
7	20.08	19.31	22.74	19.78	19.43
28	36.3	33.2	37.1	31.95	29.22

Similarly compressive strength for scba and wood ash can be drawn





CONCLUSION

According to the results of the aforementioned studies, the study focuses on the relative performance of concrete using wood ash, sugar cane bagasse ash, and rice husk ash dust as partial substitutes for cement. The following points are examined in the strength analysis that is currently being done:

• Each and every batch of concrete including rice husk, sugar cane bagasse, and wood ash displayed normal consistency on par with or better than the control batch. Up to 5%, 10%, and 15% of replacement, there were only modest variations in the typical consistency; however, at 20% replacement, there had been a slight increase to 35%.

• Slump demonstrates that when the percentages of pine wood ash, sugar cane bagasse ash, and rice husk ash increase, so does the workability. All of the studied mixes containing wood ash, sugar cane bagasse ash, and rice husk ash showed acceptable workability and height slump values.

REFRENCES

1. Raheem, A., Olasunkanmi, B., & Folorunso, C. (2012). Saw dust ash as partial replacement for cement in concrete. Organization, Technology & Management in Construction: An International Journal, ISSN: 2248-962, 4(2), 474-480.

2. 2. Sabet, F. A., Libre, N. A., & Shekarchi, M. (2013). Mechanical and durability properties of self consolidating high performance concrete incorporating natural zeolite, silica fume and fly ash. Construction and Building Materials, 44, 175-184.

3. Nochaiya, T., Wongkeo, W., & Chaipanich, A. (2013). Utilization of fly ash with silica fume and properties of Portland cement–fly ash–silica fume concrete. Fuel, 89(3), 768- 774.

4. K Kayathri, et. al. (2014) Kayathri, K., Vigneshkumar, C., Rani, G., & Karthick, K. (2014). Effect of Copper slag, Fly Ash and Granite Power as a Partial Replacement in Fine aggregate. International Journal of Innovative Research in Science, Engineering and technology, pISSN: 2347 – 6710, 3(5), 439-443.

5. Mohammad Iqbal Malik, et. al. (2015) Study of Concrete Involving Use of Quarry dust as Partial Replacement of Fine Aggregates, IOSR Journal of Engineering, ISSN (e): 2250-3021, ISSN (p): 2278-8719, 05(02), 05-10.

6. N.Kavibala, (2016). Experimental Study on Partial Replacement of Cement with Marble Powder and Fine Aggregate with Quarry Dust and with Addition of Polypropylene Fiber. International Conference on Current Research in Engineering Science and Technology, E-ISSN: 2348 – 8352, 39-42.
7. Dr. suji. D, Narayanan.A.M ,Kartic Kumar.M , Perarasan. M, (2017). Experimental Study on Partial Replacement of Fine Aggregate with Quarry Dust and Saw Dust, International Journals of Advancement In Engineineering Technology, Management Applied Science, ISSN NO. 2349-3224.
8. Rohini, V.Arularasi, (2018). Effect of Fly Ash and Quarry Dust as a Partial Replacement of Cement and Fine Aggregate in Concrete, International Journal of Latest Research in Engineering and Technology, ISSN 2454-5031, 02(08), 15-33
9. Kamlesh Saini, Vijay Chaudhary ,Ankush Bisnohi, Harshit Agarwal, Meghalal Ram,Sandeep Saraswat, (2019). Effect on strength properties of concrete by using waste wood powder as partial replacement of cement." International Journal of Civil Engineering 3: 172-176.
10. Raheem, A., Olasunkanmi, B., & Folorunso, C. (2012). Saw dust ash as partial replacement for cement in concrete. Organization, Technology & Management in Construction: An International Journal, ISSN: 2248-962, 4(2), 474-480.
11. Blessen SkariahThomasabcJianYangabeKim HungModJamal A.AbdallacRami A.HawilehcErandiAriyachandraf (2021) Biomass ashes from agricultural wastes as supplementary cementitious materials or aggregate replacement in cement/geopolymer concrete: A comprehensive review Journal of Building Engineering Volume 40, August 2021, 102332. ELEVISER https://doi.org/10.1016/j.jobe.2021.102332.
12. Bheel, ., Ali, M.O.A., Tafsirojjaman et al. Experimental study on fresh, mechanical properties and embodied carbon of concrete blended with sugarcane bagasse ash, metakaolin, and millet husk ash as ternary cementitious material. Environ Sci Pollut Res 29, 5224–5239 (2022). https://doi.org/10.1007/s11356-021-15954-4
13. Gupta, C.K., Sachan, A.K. & Kumar, R. Experimental Study on Microstructural and Mechanical Behaviour of Self Compacting Concrete Using Agricultural Waste. Iran J Sci Technol Trans Civ Eng 47, 925–942 (2023). https://doi.org/10.1007/s40996-022-00980-0