ANALYSIS OF THE COMBINED USE OF MARBLE DUST POWDER AND RICE HUSK ASH (RHA) AS PARTIAL REPLACEMENT OF CEMENT IN CONCRETE FOR GREEN BUILDING CONSTRUCTION.

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Abstract- Today, green concrete's production and use are mandated in an effort to lessen its harmful impact on the natural world. This research provides the investigation of cement replacement by MDP and RHA at varying concentrations in concrete. Many supplemental cement and pozzolanic materials are introduced and partly employed as a replacement of cement in the concrete. Due to their negative effects on the environment, industries like the tile and rice milling industries now have to find ways to recycle their waste products. Marble has a long history of widespread usage in construction. Dust is produced when marble is cut. Huge amounts of powder are produced. It is estimated that dust accounts for around 25% of the total mass lost from cut marble. Directly releasing this trash into the environment is bad for the ecosystem. Husk is a byproduct of the rice milling process in India. RHA is a byproduct of the burning process that is used to generate steam in rice mills. The husk itself contains around 75% organic content, and the remaining 25% is transformed into ash. The amorphous silica content of RHA is quite high, at about 85% to 90%. The characteristics of concrete may be enhanced by including RHA into the mix. Building using recycled materials such as marble dust and RHA instead of conventional cement is an environmentally friendly option. In this research, measures are taken to increase concrete's eco-friendliness so that it may be used in "Green Buildings." The marble dust and RHA used in this lab experiment were sourced from nearby locations and processed there. The lab work was conducted at MRIEM in Rohtak. The impact of the partial replacement on concrete characteristics is investigated by changing the ratio of the two materials. The test results reveal that marble powder &RHA additive is effective, with 10% and combination of both (5%+5%) as replacement ratio of cement. 15% substitution of both materials results in the highest tensile strength. The compressive strength of concrete decreases after reaching 10% MDP and RHA .

KeyWords - Marble Dust powder (MDP), RHA (RHA),Green Concrete, Environmental Issues, Compressive Strength,TensileStrength,Flexuralstrength

1. INTRODUCTION

The globe over, concrete is the material of choice for building structures. Its popularity may be attributed to a number of benefits that are common knowledge at this point: its accessibility, affordability, and versatility. However, there is a substantial ecological cost associated with concrete's widespread use. An enormous quantity of natural resources are extracted and refined

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every year, leaving an undeniable imprint on the ecosystem. Cement production is very harmful to the environment due to the vast amounts of energy needed and the carbon dioxide emissions. Concrete's environmental friendliness may be greatly enhanced by replacing Portland cement with other materials, such as marble dust or RHA , both of which are waste products from other industries. The scientific community has put in a lot of work over the last several decades to come up with sustainable ways to reduce non-biodegradable garbage and other types of waste that are hazardous to the environment [1]. Substituting eco-friendlier options for traditional materials is the ultimate goal. To make my own little contribution to the cause, I've experimented with replacing some of the cement in concrete with marble dust and RHA ..

Marblepowder:Mining, processing, and finishing operations in the stone marble industry have all contributed significantly to the emergence of a number of serious ecological threats. The disposal of marble wastes generated during the manufacturing and chopping of marble slabs is one such danger. Waste from shaping and cutting marble, which contains a lot of calcium oxide, is a major environmental hazard. China, Iran, Italy, Turkey, and Brazil are the world's top five producers of marble, followed by India. Marble is a metamorphic rock made up of re-crystallized calcite or dolomite, according to the scientific definition. Marble powder is a byproduct of the marble industry that can be recycled to alleviate some of the world's environmental problems.

RHA :The ash from rice husks is a byproduct of the rice milling process. The outer covering of rice seeds or grains is called the rice husk (rice hull). The seed or grain is shielded by this covering until it may mature. Opaline silica and lignin are two of the hard substances transformed from the husk. Rice husk, when properly burned, releases significant quantities of silica (SiO_2). As a result, it may be used as a cementitious material, similar to cement, in the manufacture of concrete products. About 75% of the organic volatile substance in rice husk is moisture. In the kiln, this husk loses 25% of its weight as ash. RHA is the name for this ash.

Some of the environmental and ecological issues may be resolved if this waste material were used to make concrete that was both inexpensive and long-lasting. The goal of this study is to reduce the needless use of raw materials and the pollution of natural ecosystems by recycling materials such as MDP and RHA .

1.I RESEARCHSIGNIFICANCE

The “waste marble dust and RHA” causes serious threats to ecosystem. Problems that are most face dare-

1) Reduced porosity, water absorption, water percolation, etc., caused by marble dust, have a negative impact on crop yields. When dry, it enters the air and contributes significantly to pollution levels. It also lowers water storage capacity and harms aquatic life, all during the rainy season.

2) In 2010, it was estimated that worldwide paddy output would reach 678 million tonnes, which would imply a rice husk production of 149.16 million tonnes, from which 37 million tonnes of RHA might be extracted [18]. This massive amount of RHA is wasted without being put to good use, posing a significant risk to the environment by damaging the soil and the surrounding region where it is deposited. If most RHA were utilised in concrete, not only would

dumping RHA be eliminated, but the amount of cement produced may be reduced, resulting in a net increase in CO2 emissions to the environment.

Cement made from recycled materials like marble dust and RHA may help slow the rate at which our natural resources are being depleted.

1.II OBJECTIVEOFTHESTUDY

Themainobjectiveistorealizeandsynthesizenovelmaterials for sustainable green building construction usingrecycled materials like marble dust and RHA assubstitutesinconcrete.

Belowareoutlinedgoalsforthisresearchwork-

➔ To study the effect of the waste materials - MarblepowderandRHA aspartialreplacementofcement on the basis of workability, compressiveandSplittensilestrengthofconcreteat7,14and28daysrespectively.

➔ Tocomparetheresultswithreferenceconcretemix.

2. LITERATUREREVIEW

Many construction researchers have recently focused on the task of finding viable alternatives to cement and natural aggregates in cement-based products. Understanding the latest findings from studies on the properties of concrete made from marble debris and RHA as cement replacement materials is vital. Although there was just a little amount of work done with both materials.

1. Ahmadiet.al(2020)reportedthe improvement of self-compacting concrete and regular concrete mixes with rice-husk ash (RHA), a byproduct of the rice paddy milling industry, in terms of mechanical qualities up to 180 days. The self compacting and normal concrete samples employed 10% and 20% cement substitution by RHA, respectively, and 0.40 and 0.35 water/cementitious material ratios. Self-compacting concrete with and without RHA were examined for their respective outcomes. Stronger compressive and flexural strengths and a lower modulus of elasticity may be seen in SCC mixes compared to regular concrete. By substituting up to 20 percent of the cement in the matrix with RHA , both the quantity of cement used and the cost of making the concrete were reduced, while the durability of the concrete was increased for periods longer than 60 days. It has been suggested that after 60 days, RHA has a positive influence on mechanical characteristics.
2. Rajni,Vipasha Rishi, HimanshuGuleria (2019) This research looked at how well MDP worked as a cement and sand replacement. After experimenting with various replacement ratios of MDP and sand, the optimal proportion was determined to be 10% powder and 25% sand. In addition, studies have shown that waste marble powder has promising performance because of its strong micro filling capacity.
3. MesBelouadahsaoudaetal.(2019)As an alternative to cement, marble and glass powder are tested here to see what happens to the material's mechanical and physical qualities. After a 10% marble addition, the compressive strength of the material was found to rise. Glass may have a compressive strength increase of up to 10%, and the maximum possible increase was 10%. Therefore, up to 10% is ideal for glass and marble.
4. S.Suresh,J.Revathi(2019)InthisproposalThe goal of the study is to see whether the powdered marble can be used to make concrete. Testing showed that adding only 10% marble

dust boosted the material's compressive strength by 24%, flexural strength by 25%, and tensile strength by 17.82%. It was also discovered that, in comparison to regular concrete, there is a considerable reduction in chloride penetrations and a marked increase in water absorption.

5. P.PadmaRao,etal (2018) studied An effort has been made to look into the strength characteristics of concrete by studying the viability of using RHA as an additives too cement that has previously been substituted with fly ash (Portland Pozzolana Cement). In this research, we focus on replacement at five distinct levels: 5%, 7.5%, 10%, 12.5%, and 15%. A wide variety of curing times, from 3 days to 7 days to 28 days to 56 days, are taken into account in this study. Before beginning the results, all ingredients must be warmed to room temperature, ideally 270+30 C. Compressive strength increases from three days to seven days, regardless of the percentage of RHA used as a cement substitute. However, compressive strength significantly increases from 7 days to 28 days, and then gradually increases from 28 days to 56 days.

6. Obilade, I.O. (2014) They investigated concrete made using a portion of RHA instead of conventional cement. This study investigates the performance of concrete made using RHA as a partial substitute for Ordinary Portland Cement (OPC). At 0%, 5%, 10%, 15%, 20%, and 25% of the original OPC was swapped out for RHA. The control group had no replacement at all. The weight ratio of the concrete mixture was 1:2:4. 150mm cubes of hardened concrete were tested for their compressive strength at 7, 14, and 28 days after curing in water. Concrete was created using a binder, sand, and gravel for this study. As the fraction of OPC replaced by RHA grew, the findings showed that the compacting factor dropped.

7. AnkitaKhatri, AbhishekKanoungo et al. (2014) Thefocus This research explores the potential of using marble debris in place of cement to create cheap, sustainable building materials. Due to the presence of a superplasticizer blend. Mechanical qualities were little impacted by marble scrap. It was also discovered that marble dust added to the concrete lowered the material's permeability.

8. A.ManjuPawar et.al (2014) Studies on the value of partially substituting leftover marble dust for cement were conducted on a regular basis. This research investigates the relative compressive and tensile strengths of mortar and concrete that use marble dust as a component while decreasing the amount of cement used. When cement is partially replaced with discarded marble dust at varied percentages, the resulting mortar and concrete exhibit higher strengths. Thus, adding discarded marble dust to concrete up to 12.5% by weight of cement increases the concrete's compressive strength, but adding any more marble dust causes the strength to drop. Waste marble dust, up to 12.5% by weight of cement, increases the tensile strength of concrete, whereas more than that actually diminishes it. They concluded that 12.5% cement is the sweet spot for replacing marble dust, improving both compressive and tensile strength.

9. HuseyinYilmazArunta et al. (2010) According to these findings, marble dust that would have otherwise been thrown away may be utilised as an additive in cement manufacture. 10% of marble dust from demolition may be utilised as a cement ingredient, it was found. It is possible to raise the specific gravity of concrete by using waste marble dust.

3. MATERIALS

In order to create concrete, fine and coarse aggregate, cement, and water are combined to form a composite material. The research herein examines the effects of using MDP and RHA as partial cement replacements.

3.I. Cement:

All of the experiments were conducted using Pozzolana Portland Cement from Ambuja cement, Grade 53, which claims to fulfil all relevant Chemical & Physical standards as per the IS specification - IS 1489: Part 1: 2015. As a result of the cement's observed qualities, is shown in the Table - 3.I.Igivenbelow-

Sr. No.	TEST	RESULT	ISREQUIREMENTS
1.	Consistency	30%	As per IS 403125-35%
2.	Fineness	5.4%	AsperIS269-1976 max-10%
3.	Initial settingtime	35min	AsperIS4031-1968 min30min
4.	Finalsettingtime	270min	AsperIS4031-1968 max600min
5.	CompressiveStrength	18.42 N/mm^2in3daysand 24.54 N/mm^2in7days.	AsperIS1489-1991 16N/mm^2 in 3 days.AsperIS1489-1991 22N/mm^2in7days.

Table3.I.I

3.II. Coarseaggregate:

Theaggregatesusedinthistestarepurchasedfromlocalavailabletrader(ShivShaktiMaterialSuppliers,Rohtak)(Image3.II.I).About45-50%oftheaggregateusedareof10-15mminsizeandremaining50%areofalmost20mmin size. The physical and mechanical properties ofaggregatesareshowninthetables(3.II.I&3.II.II)given-

Image- 3.II.I CoarseAggregates used in thetest

PhysicalpropertiesofCoarseaggregate

Properties	Values

SpecificGravity	2.8
BulkDensity(Loose)	1.74gm/cm^3
BulkDensity(compacted)	1.88gm/cm^3
FlakinessIndex	12.1%
ElongationIndex	10.16%
Waterabsorption	0.56%
FinenessModulus	6.71%

Table3.II.I

MechanicalpropertiesofCoarseaggregate

Properties	Values	BIS(IS:383-1970)limits
Impactvalue	20.84 %	Less than 30% for wearingsurfacesandlessthan45%forotherthanwearingsurface
Crushingvalue	25.26 %	Less than 30% for wearingsurfacesandlessthan45%forotherthanwearingsurface
LosAngelesAbrasionresistance	22.24 %	Less than 30% for wearingsurfaces and less than 50%forotherconcrete.

Table3.II.II

3.III. Fineaggregate:

Sand is used as fine aggregates, and it is analysed using sieve analysis after being obtained from a nearby supplier (Shiv Shakti Material Suppliers, Rohtak). Fine aggregate conformsto “GradingZone-IIasperIS:383-1970”.PropertiesareshowninTable3.III.I

Physical propertiesofFineAggregates

Properties	Values
Finenessmodulus	2.75
Specificgravity	2.63
Waterabsorption	0.25%

3.IV. Marblepowder:

Marble powder was collected from the ‘Rana Marble and Granite’ processing unit in Rohtak, Haryana. Marble dust is directly obtained from deposits from marble slurry which is in wet form, after that it was dried by exposing in the sun and then it was sieved by IS-90 micron sieve for further testing. Physical properties of MDP are shown in Table 3.IV.I. and Chemical Properties in Table 3.IV.II.

PhysicalpropertiesofMDP

Properties	Values
odour	odourless
color	white
PH(5%solution)	6.2
SpecificGravity	2.6
Moisture	0.54%
Particlesize	90micron

Table 3.IV.I

ChemicalpropertiesofMDP

Chemicalcomposition	Values
Silica(SiO_2)	11.36%
FerricOxide(Fe_2O_3)	0.08%
Alumina(Al_2O_3)	0.24%
MagnesiumOxide(MgO)	0.22%
MagnesiumCarbonate($MgCO_3$)	0.44%
CalciumOxide(CaO)	45.20%
CalciumCarbonate($CaCO_3$)	89.5%

Table3.IV.II

3.V. RHA :The 2.1 Specific Gravity RHA utilised in this experiment came from Shiv Industries in Bahadurgarh, Haryana. ChemicalPropertiesofthisRHAaregiveninTable3.V.I.

Chemicalcomposition	Values
Silica(SiO_2)	84.10%
FerricOxide(Fe_2O_3)	2.02%
Alumina(Al_2O_3)	1.40%
MagnesiumOxide(MgO)	0.88%
CalciumOxide(CaO)	0.62%
Sulfurtrioxide(SO_3)	89.5%

Table3.V.I

Properties	Values	BIS(IS:383-1970)limits
Impactvalue	20.84%	Less than 30% for wearingsurfacesandlessthan45%forotherthanwearingsurface
Crushingvalue	25.26%	Less than 30% for wearingsurfacesandlessthan45%forotherthanwearingsurface
LosAngelesAbrasion resistance	22.24%	Less than 30% for wearingsurfaces and less than 50%forotherconcrete.

Table3.III.I

4. TESTRESULTSANDDISCUSSION

4.1SlumpTest

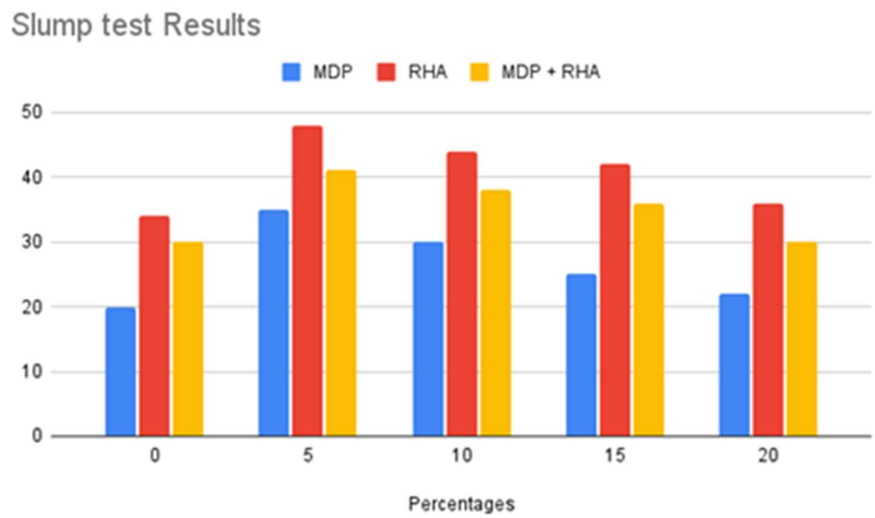
Concrete's workability is evaluated by the slump test. It's a gauge of the uniformity of the mix over its many iterations, too. Coneosed stands 30 centimetres tall, with a 20-centimeter base and a 10-centimeter hole at the bottom. The foundation was laid out on a level surface before the concrete was poured on top. A rod 1.6 cm in diameter was used to tempt 25 times while filling each of the cone's three levels. Later, the surface was smoothed out after being filled into the mould. A rod was used to determine the droop after the mould was inverted. Table 4.3.I displays the frustum of concrete and its observed settling (slump value). The percentages of MDP, RHA, and MDP + RHA used to replace cement in the various mixtures ranged from 5% to 25%.

In Rohtak, Haryana, at a facility known as "Rana Marble and Granite," marble powder was gathered for analysis. The marble dust used in these experiments was produced by collecting deposits from wet marble slurry, drying them in the sun, and then sieving them using an IS-90 micron sieve. Physical properties of MDP are shown inTable3.IV.I.andChemicalPropertiesinTable3.IV.II.

ResultofSlumpTest

%	MDP	RHA	MDP+RHA
0%	20	34	**30**
5%	35	48	**41**
10%	30	44	**38**
15%	25	42	**36**
20%	22	36	**30**

Table4.I.I



4.II Compressivestrength

Compressive strength tests are done of MDP, RHA and MDP+RHA are done. In order to evaluate compressive strength, 15 cm 15 cm 15 cm cube specimens were created. On the cubes, we examined the durability of concrete after 7, 14, and 28 days. Concrete's initial strength was tested after 7 days, its median strength after 14 days, and its ultimate strength after 28 days. Image 4.II.I shows the compression testing equipment at MRIEM's Rohtak facility being used to conduct a strength test on a cube. Since the strength of concrete depends greatly on the hydration reaction, the cube was first dried to remove any moisture before being subjected to the test. In thisexperiment, for all the cases test results are as shown inTable4.II.I,4.II.II,4.II.III.

Image4.II.IExperimentalsetupforcompressivestrengthtest

Test result of Compressive strength of 7 ,14, 28 days ofMDP
Unit = N/mm²

Marbled ust	Compressive Strength (7days)	Compressive Strength (14days)	Compressive Strength (28days)
0%	22.21	33.52	33.64
5%	23.54	34.75	34.80
10%	24.12	35.85	36.00
15%	20.95	29.91	30.45
20%	18.45	29.27	29.33

Table4.II.I

The Compressive strength of concrete cubes prepared isobservedtobeincreased by adding upto 10% of wastemarble dust. Any addition of marble dust beyond 10%, inthistestingitwas15%and20%,decreasesthecompressivestrength.

Test result of Compressive strength of 7 ,14, 28 days ofRHA
Unit = N/mm²

Rice Hus kAsh	Compressiv eStrength (7days)	Compressiv eStrength (14days)	Compressiv eStrength (28days)
0%	28.20	38.20	40.08
5%	29.55	38.26	40.12
10%	30.20	38.38	40.26
15%	29.40	40.90	42.28
20%	26.45	38.45	40.33

Table4.II.II

TheCompressivestrengthofcubespreparedusingRHAisoptimumat15%.

TestresultofCompressivestrengthof7,14,28daysofMDP +RHA
Unit = N/mm²

MDP+R HA	Compressive Strength (7days)	Compressive Strength (14days)	Compressive Strength (28days)
0%	22.32	33.84	33.96

5+5%	24.28	35.61	35.8
10+10%	20.41	31.43	31.68
15+15%	18.19	26.64	26.82
20+20%	14.8	25.45	25.58

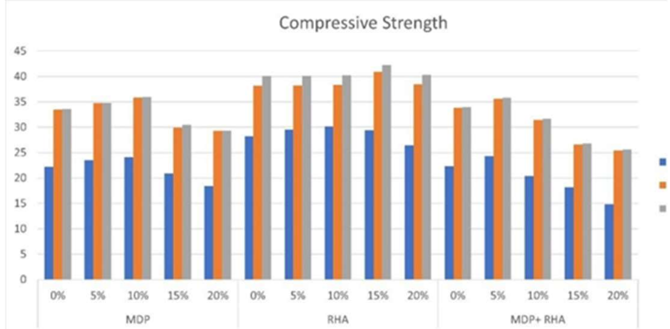
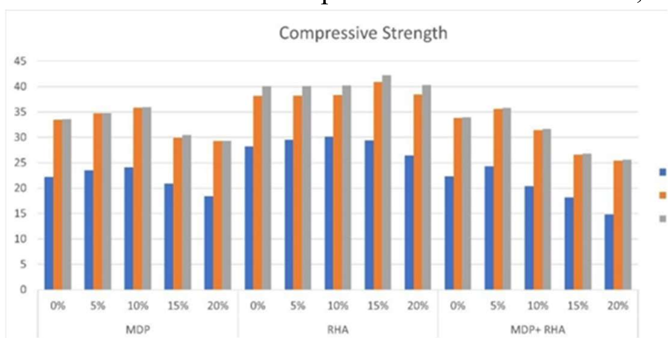


Table4.II.III

As concrete ages, its compressive strength grows to the compressive strength of concrete decreases when MDP and RHA are used to replace 5+5% of the cement, respectively. .



4.III Tensilestrength

The split tensile strength results of mixes at the age of 7,14and 28 days for different replacement levels such as 5%,10%,15%,and20%ofcementwithMarbledust,RHAand mixture of both MDP + RHA are as shown inTables-.4.III.I.,4.III.II,4.III.III

TestresultofTensilestrengthof7,14,28daysofMDP

Unit = N/mm²

Marbledust	TensileStrength(7days)	TensileStrength(14days)	TensileStrength(28days)
0%	3.32	3.72	4.5
5%	3.65	3.85	4.62
10%	3.9	4.3	4.81

15%	4.25	4.6	5.12
20%	3.8	4.2	4.78

Table4.III.I

It is observed that the tensile strength increases maximumupto15%replacementofcementbymarbledust&beyondthatthereisdecreaseintensilestrengthofconcrete.

Test result of Tensile strength of 7 ,14, 28 days of RHA

Unit =N/mm²

Rice HuskAsh	**TensileStrength(7days)**	**TensileStrength(14days)**	**TensileStrength(28days)**
0%	1.06	1.75	2.05
5%	1.25	1.90	2.12
10%	1.15	2.05	2.20
15%	2.94	2.89	3.25
20%	2.25	2.38	2.41

Table4.III.II

Thetensile strengthincreases till 15% replacement ofcement by RHA , just like MDP & increasing more that15% of RHAshows decreaseinthetensile strength.

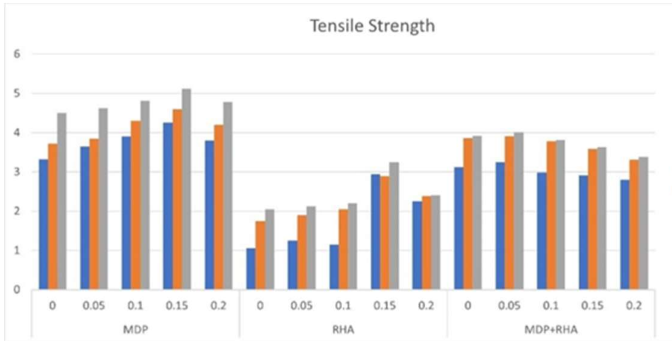
TestresultofTensilestrengthof7,14,28aysofMDP+RHA

Unit = N/mm²

MDP +RHA	**TensileStrength(7days)**	**TensileStrength(14days)**	**TensileStrength(28days)**
0%	3.12	3.86	3.92
5+5%	3.25	3.91	4.01
10+10%	2.98	3.78	3.81
15+15%	2.91	3.59	3.63
20+20%	2.80	3.31	3.38

Table 4.III.III

The split tensilestrengthof concrete increasesupto5+ 5%replacementofcementbyMDP+RHA & furtherincreasingofpercentageleadstodecreaseinsplittensilestrengthofconcrete.



5. CONCLUSION

The focus of this study was on the potential of MDP and RHA to substitute cement in construction projects. Researchers looked at how MDP and RHA interacted with concrete's workability, compressive, and tensile strengths. Results from the testing indicate that a replacement percentage of (5+5%) with MDP and RHA combined yields the highest compressive strength, while a percentage of (10+10%) yields the highest tensile strength. Cement alternatives like MDP (MDP) and RHA (RHA) are viable replacements for traditional portland cement (OPC). Partial substitution of cement with MDP and RHA demonstrated their ability to create concrete with the necessary Fresh and Hardened qualities. Based on the outcomes of the tests, it was determined that RHA and MDP could effectively replace 10% of cement. Cement, a common binding element in concrete, has a major detrimental effect on the environment despite its widespread usage. As a result, it's important to find ways to replenish or supplement the cement without compromising the fresh or hardened qualities of the concrete. Using MDP and RHA may lessen the toll on the environment, and the materials recovered from their disposal can be put to good use.

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