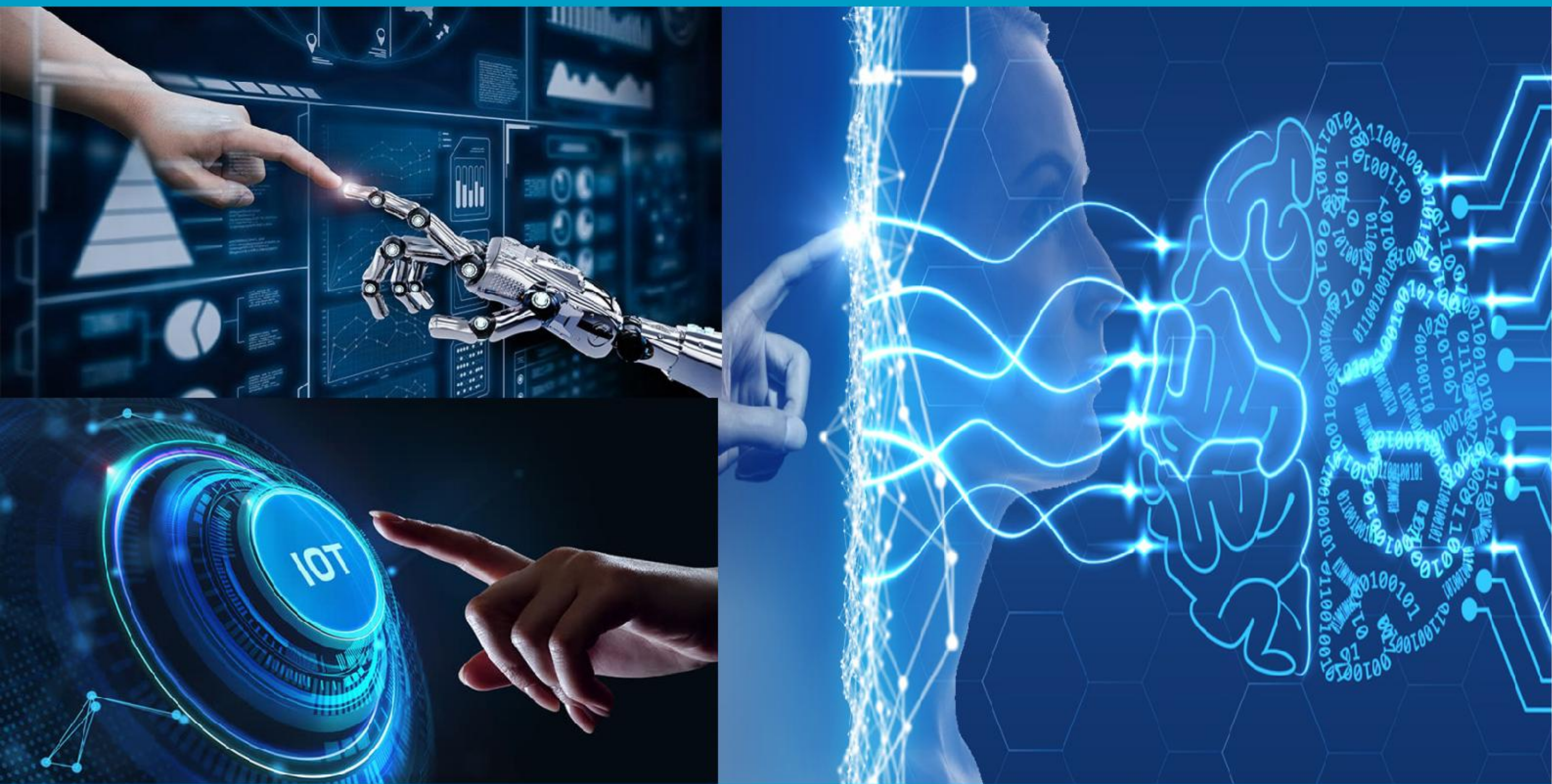
IJMRSETM

e-ISSN: 2395 - 7639




# INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

Volume 9, Issue 6, June 2022

INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.580

+91 99405 72462 +9163819 07438 ijmrsetm@gmail.com www.ijmrsetm.com

International Journal of Multidisciplinary Research in Science, Engineering, Technology & Management (IJMRSETM)

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

| Volume 9, Issue 6, June 2022 |

| DOI: 10.15680/IJMRSETM.2022.0906037 |

# To Investigate and Study of Strength and Capacity for the Different Proportions of RHA and WPSA Affect the Behaviour of Concrete

**PANKAJ, ABHISHEK SHARMA**

Structural Engineering, CBS Group of Institutions, Haryana, India

**ABSTRACT:** In addition to the limited quantity of raw resources and the ever-increasing cost of electricity, the rising demand for construction materials is pushing up the total price of those items. By using these extra cementing chemicals, it may be possible to reduce the amount of energy that is used (during the production of cement), so saving money, improving engineering qualities, and helping the environment by lowering waste deposits. These are only some of the many advantages that come with engaging in such behaviour, and there are many more. The physical, chemical, and mineralogical properties of materials, in addition to their permeability, are all linked to a material's capacity to withstand wear and tear over time. Any improvement in these characteristics will almost probably be beneficial to the product's lifetime. When individuals refer to pozzolanic material, which is sometimes referred to as pozzolan, they are referring to a substance that is siliceous and aluminous in nature. The findings of the research indicated that the early strength of RHA, WPSA, and Mix (RHA+WPSA) concrete was found to be lower, and that the strength rose with age. It has been discovered that an increase in replacements results in a deterioration in the workability of RHA, WPSA, and Mix (RHA+WPSA) concrete. It is convenient to declare, based on the findings of the Split Tensile Strength test, that there is a major increase in tensile strength owing to the inclusion of RHA, WPSA, and Mix (RHA+WPSA). This conclusion is supported by the fact that there is a significant rise in tensile strength.

**KEYWORDS:** RHA, WPSA, Concrete, Rice Husk Ash, Pozzolanic Material

## I. INTRODUCTION

The growing demand for building materials, along with the limited supply of raw resources and the rising cost of energy, is driving up the overall price of those products. Incorporating these supplemental cementing ingredients may save on energy consumption (during the manufacturing of cement), save money, enhance engineering characteristics, and help the environment by reducing waste deposits. These are just some of the benefits that can be gained by doing so. The physical, chemical, and mineralogical qualities of materials, as well as their permeability, are all connected to a material's durability. Any increase in these attributes will very certainly help the product's longevity. A siliceous and aluminous substance is what people mean when they talk about pozzolanic material, also known as pozzolan. It has a chemical reaction with calcium hydroxide (lime) when it is at an ordinary temperature and there is moisture present. The products of this reaction are compounds that have cementitious characteristics. The physical processes that are connected with the particle size and shape of pozzolans are what affect the concrete mix percentage and the rheological behavior of plastic concrete. Pozzolanic and cementitious processes are responsible for the majority of the effects that are associated with hardened concrete, including its strength and permeability. A significant amount of garbage has been produced as a direct consequence of the brisk pace of industrialization. The majority of the wastes are not put to any beneficial use and, in addition to taking up enormous areas of precious cultivable land, they also contribute to a variety of environmental and ecological issues. This is because the disposal of these wastes contributes to the pollution of the environment. A decrease in the cost of producing cement and a fall in the amount of greenhouse gas emissions generated per ton of cement produced are two additional advantages to the cement business. Because of this, cement businesses could also be able to reap the advantages of carbon trading.

### RICE HUSK ASH

Rice husk ash, often known as RHA, is a by-product that is created when rice husk is burned. As a result of the extensive rice cultivation that takes place in East and South-East Asia, rice husk may be found in quite high quantities in these two regions. These Asian nations make the most of the fertile terrain and warm climate, which together provide the ideal circumstances for rice cultivation. Before rice can be sold or eaten, the husk must first be removed from the grain during the growing process. After that, the ash from the rice husk is added to cement either as a replacement or an

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

| Volume 9, Issue 6, June 2022 |

| DOI: 10.15680/IJMRSETM.2022.0906037 |

additive. As a result, the complete rice product is used, which results in a strategy that is both effective and kind to the environment. This can potentially contribute to the pollution of both the air and the water. Ash from rice husks is a natural pozzolan, which is a term for a substance that, when combined with lime, may exhibit qualities similar to those of a cement. RHA may contain no carbon, very little or no crystalline Si02, and no hazardous compounds, as is the case with off-white rice husk ash. Additionally, RHA may be carbon neutral. Rice husk ash may be converted into RHA using a burning process. Paddy is grown in India on an annual basis to the tune of approximately 122 million tons.

**Properties of RHA**

The pozzolanic quality of rice husk ash is what determines whether or not rice husk may be used as a cementation material in the production of cement and concrete. The kind of silica that is present in the ash as well as the amount of carbon in it are both intimately connected to the pozzolanic reactivity of the ash. Because the temperature and the length of time that silica is subjected to thermal treatment have a significant impact on its physical and chemical properties.

**RHA Production**

About two hundred kilograms, or twenty percent, of husk is generated for every one thousand kilograms of milled rice. About fifty kilograms, or twenty-five percent of the total RHA, will be produced after this husk has been entirely burned. Around fifty percent of the husk is made up of cellulose, twenty-five to thirty percent lignin, and fifteen to twenty percent silica. Silica ash is what's left after cellulose and lignin have been eliminated during the burning process.

**Advantages of using rice husk ash in concrete**

The incorporation of RHAhas been shown to be connected with the following vital advantages:

- Strengthening in both the compressive and flexural directions.
- A more impermeable exterior
- Enhanced resilience to the effects of chemical assault.
- Increased resistance to wear and tear.
- A lessening of the consequences of the alkali-silica reaction.
- Less shrinkage as a result of increased particle packing, which results in denser concrete.
- An improvement in the workability of concrete
- A decrease in the amount of heat that enters a building via its walls.
- Decreased overall concentration of super plasticizer
- A lower probability of efflorescence as a result of less calcium hydracids in the solution.

## II. MATERIALS AND METHODS

This part provides some basic info on the materials and procedures that are utilised in the work that is being done for the thesis.

Cement is a substance that is often found in powder form and may be transformed into a paste by the addition of water. This paste, after it has been poured, will harden into a solid mass. Cements are a broad category that include a wide variety of organic chemicals that may be employed to adhere or secure objects. Cement is a kind of binder that has capabilities of both adhesive and cohesiveness. Concrete is created from cement, coarse aggregate, fine aggregate, and water when all of those ingredients are combined together. There is a vast selection of different types of cement, each of which is used in the construction and building sectors, as well as in the field of specialty engineering, to varying degrees. Although the chemical makeup of these cements may vary quite a little, Portland cements are employed in the production of the vast majority of the concrete used in construction today. The production of Portland cement is, in theory, a fairly straightforward process that requires just a plentiful supply of the necessary raw ingredients. A kiln is heated to temperatures between 1400 and 1600 degrees Celsius (2550 and 2900 degrees Fahrenheit), which is the temperature range in which the two materials interact chemically to form calcium silicates. It is possible to see that the amounts do not add up to a total of one hundred percent, with impurities being responsible for the missing percentages. Portland cement is the kind of cement that is used the most. In order to produce Portland cement, calcareous (limestone, chalk, marl, etc.) and argillaceous (shale or clay) elements are ground together in an approximate ratio of 2:1, along with various silica, alumina, or iron oxide carrying components.

International Journal of Multidisciplinary Research in Science, Engineering, Technology & Management (IJMRSETM)

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

| Volume 9, Issue 6, June 2022 |

| DOI: 10.15680/IJMRSETM.2022.0906037 |


**Fig. 1:Cement**

**Table 1: Typical composition of OPC**

| Name of Compound | Formula | Abbreviated Formula | % Content |
|---|---|---|---|
| Tricalcium Silicate | $3CaO.SiO_2$ | $C_3S$ | 40-55 |
| Diacalcium Silicate | $2CaO.SiO_2$ | $C_2S$ | 15-30 |
| Tricalcium aluminate | $3CaOAl2O_3$ | $C_3A$ | 8-11 |
| Tetracalcium aluminoferrite | $4CaOAl_2O3Fe2O_3$ | $C_4AF$ | 13-17 |

When Portland cement is combined with water, the component compounds of the cement go through a sequence of chemical processes that ultimately lead to the hardening of the concrete. These reactions are responsible for the final product. Hydration is the name given to chemical reactions that include the presence of water, and the new solids that are produced as a result of hydration are referred to collectively as hydration products.

**AGGREGATES**

In most cases, aggregates make up between 70 and 80 percent of the volume of concrete and have a significant amount of influence on the characteristics of the material. They are particulate substances that are produced mostly from natural rock (crushed stone or natural gravels) and sands. In addition to their usage as a cost-effective filler, aggregates often confer improved dimensional stability and wear resistance onto the concrete they are mixed into. Rock that is soft and porous may restrict the strength and wear resistance of the material, and it can also break down during the mixing process, which can have a negative impact on the workability of the material by growing the number of fines.

## III. EXPERIMENTAL WORK AND METHODOLOGY

The characteristics of the materials that are used for creating concrete mixis are determined in the laboratory in accordance with the appropriate rules of practise. This chapter discusses such qualities.

**ORDINARY PORTLAND CEMENT**

Throughout the whole of the inquiry, provides a listing of the numerous tests that were conducted to evaluate the cement's physical characteristics.

International Journal of Multidisciplinary Research in Science, Engineering, Technology & Management (IJMRSETM)

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

| Volume 9, Issue 6, June 2022 |

| DOI: 10.15680/IJMRSETM.2022.0906037 |

**Table 2:** Properties of OPC 53 Grades

| Sr. No. | Characteristics | Values Obtained Experimentally | Values Specified By IS 12269:1987 |
|---|---|---|---|
| 1. | Specific Gravity | 3.10 | 3.10-3.15 |
| 2. | Standard Consistency | 31% | 30-35 |
| 3. | Initial Setting Time | 115 minutes | 30min(minimum) |
| 4. | Final Setting Time | 283 minutes | 600min(maximum) |
| 5. | Compressive Strength($N/mm^2$)<br>7 days<br>28 days | <br><br>38.49 $N/mm^2$<br>52.31 $N/mm^2$ | <br><br>37 $N/mm^2$<br>53 $N/mm^2$ |

## AGGREGATES

The majority of a realcombination is composed of aggregates, which also provide the material with dimensional stability. The aggregates are responsible for about 75% of the body of the concrete; as a result, their effect is of the utmost significance.

### Fine Aggregates

**Table 3: Sieve analysis of fine Aggregate**

| Weight of sample taken =1000 gm | | | | | |
|---|---|---|---|---|---|
| **Sr. No** | **IS-Sieve (mm)** | **Mass Retained (gm)** | **Cumulative mass Retained** | **Cumulative %age mass Retained** | **Cumulative %mass passing through** |
| 1 | 4.74 | 1 | 1 | 0.1 | 99.9 |
| 2 | 2.36 | 22 | 23 | 2.3 | 97.7 |
| 3 | 1.18 | 77 | 100 | 10 | 90 |
| 5 | 600µ | 153 | 253 | 25.3 | 74.7 |
| 6 | 300µ | 264 | 517 | 51.7 | 48.3 |
| 7 | 150 µ | 425 | 942 | 94.2 | 5.8 |
| 8 | Below150µ | 58 | 1000 | 100 | 0 |
| | **Total** | | | **Σ283.6** | |

FM of fine aggregate = 283.6/100=2.836

**Table 4: Physical properties of fine aggregate**

| Characteristics | Value |
|---|---|
| Specific gravity | 2.63 |
| Bulk density | 5% |
| Fineness modulus | 2.83 |

### Coarse Aggregates

This work made use of coarse material that was readily accessible in the area and had a maximum size of 20 millimetres.

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

| Volume 9, Issue 6, June 2022 |

| DOI: 10.15680/IJMRSETM.2022.0906037 |

**Table 5: Sieve analysis of Coarse Aggregate**

| Weight of sample taken =2000 gm | | | | | |
|---|---|---|---|---|---|
| **Sr. No** | **IS-Sieve (mm)** | **Mass Retained (gm)** | **Cumulative mass Retained** | **Cumulative %age mass Retained** | **Cumulative % mass passing through** |
| 1 | 40 | 0 | 0 | 0 | 100 |
| 2 | 20 | 145 | 145 | 7.25 | 92.75 |
| 3 | 10 | 1829 | 1974 | 98.7 | 1.3 |
| 5 | 4.74 | 124 | 1998 | 99.9 | 0.1 |
| 6 | 2.36 | 0 | 1998 | 99.9 | 0.1 |
| 7 | 1.18 | 0 | 1998 | 99.9 | 0.1 |
| 8 | 600µ | 0 | 1998 | 99.9 | 0.1 |
| 9 | 300µ | 0 | 1998 | 99.9 | 0.1 |
| 10 | 150 µ | 0 | 1998 | 99.9 | 0.1 |
| 11 | Below150µ | 2 | 2000 | 100 | 0 |
| | **Total** | | | **Σ805.35** | |

FM of Coarse aggregate = 805.35/100=8.0535

**RHA**

Rice Husk for study came from R. K. Enterprises in Bhangrotu (Mandi), which is located in the Indian state of Himachal Pradesh. After being washed in portable water, the rice husk is then dried in the sunlight. Following that, the rice husk was allowed to burn in the open air, which caused it to turn into ASH.

**Table 6. Physical Properties of Rice Husk Ash**

| | |
|---|---|
| Appearance | Fine powder |
| Particle Size | Sieved through 90 micron sieve |
| Specific gravity | 2.21 |
| Color | Light grey |

## IV. DISCUSSION AND EXPERIMENT

This chapter provides a concise description of the findings that were derived from the laboratory examinations that were carried out on the specimen. The components as well as additional and cured concrete, were subjected to a battery of tests.

**FRESH CONCRETE**

**Slump Test**

**Table 7: Slump Tests Results**

| **Mix** | **Percentage** | **SlumpValue** |
|---|---|---|
| **Control** | 0% | 90mm |
| **RHA** | 5% | 65mm |
| | 10% | 55mm |
| | 15% | 25mm |
| | 20% | 20mm |
| **WPSA** | 5% | 60mm |
| | 10% | 55mm |
| | 15% | 50mm |
| | 20% | 20mm |
| **Mix (RHA+WPSA)** | 5% | 30mm |
| | 10% | 20mm |
| | 15% | 15mm |
| | 20% | 7mm |

In Fig 5.1.1, the slump value in comparison to the percentage of replacement was shown. When a greater quantity or a combination of the two (RHA+WPSA) was mixed into the concrete, the slump was reduced.

International Journal of Multidisciplinary Research in Science, Engineering, Technology & Management (IJMRSETM)
| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|
| Volume 9, Issue 6, June 2022 |
| DOI: 10.15680/IJMRSETM.2022.0906037 |

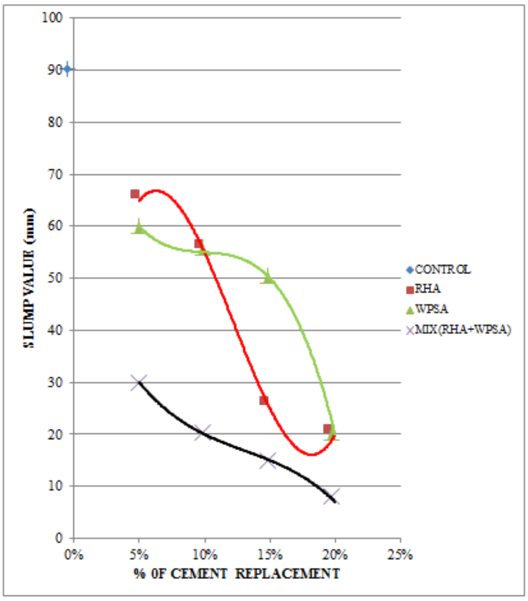


**Fig. 2: Slump Value**

## Compaction Reason Test

**Table 8: Compaction Reason Results**

| Mix | Percentage | Compaction Factor |
|---|---|---|
| CONTROL | 0% | 0.93 |
| RHA | 5% | 0.90 |
| | 10% | 0.87 |
| | 15% | 0.83 |
| | 20% | 0.82 |
| WPSA | 5% | 0.92 |
| | 10% | 0.90 |
| | 15% | 0.85 |
| | 20% | 0.81 |
| MIX (RHA+WPSA) | 5% | 0.84 |
| | 10% | 0.83 |
| | 15% | 0.80 |
| | 20% | 0.78 |

The importance of the controller concrete's corresponding compaction factor is 0.93. The value of the compaction factor will fall from 0.92 to 0.82 as we increase the percentage of substitution of cement with RHA from 5% to 20%. In the instance of WPSA, the value of the compaction factor steadily drops from 0.92 to 0.81 throughout the course of the analysis.

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

| Volume 9, Issue 6, June 2022 |

| DOI: 10.15680/IJMRSETM.2022.0906037 |

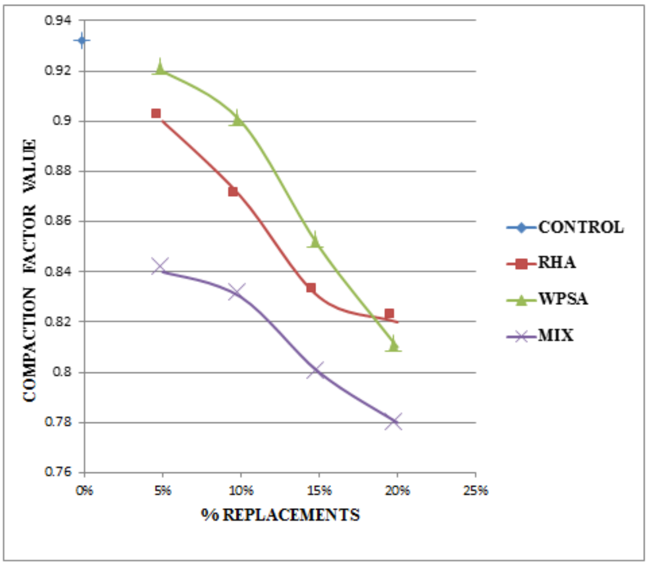



**Fig. 3: Compaction Value**

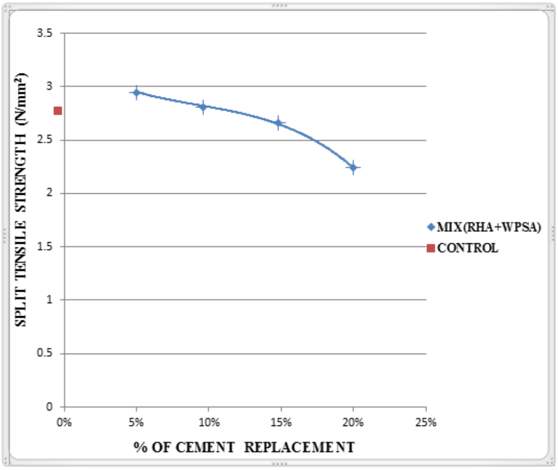



**Fig. 4: Split Tensile Strength Mix (RHA+WPSA) at 28 Days**

## IV. CONCLUSIONS

The purpose of these experiments was to determine whether or not it would be possible to successfully substitute cement in concrete with RHA, WPSA, or MIX (RHA+WPSA), depending on which combination was used.

1. The findings of the research indicated that the early strength of RHA, WPSA, and Mix (RHA+WPSA) concrete was found to be lower, and that the strength rose with age.
2. It has been discovered that an increase in replacements results in a deterioration in the workability of RHA, WPSA, and Mix(RHA+WPSA) concrete.
3. It is convenient to declare, based on the findings of the Split Tensile Strength test, that there is a major increase in tensile strength owing to the inclusion of RHA, WPSA, and Mix (RHA+WPSA). This conclusion is supported by the fact that there is a significant rise in tensile strength.
4. The use of waste paper sludge ash, rice husk ash, and mix (RHA+WPSA) in concrete may prove to be cost-effective given that the trash in question is non-useful and free of charge.
5. The use of waste paper sludge ash in concrete will preserve natural resources that are used for the production of cement, and as a result, the concrete construction industry will become sustainable. Waste paper sludge can be used as fuel prior to using its ash in concrete for partial cement replacement, and the disposal problem for paper industries regarding this waste material has been completely resolved.

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

| Volume 9, Issue 6, June 2022 |

| DOI: 10.15680/IJMRSETM.2022.0906037 |

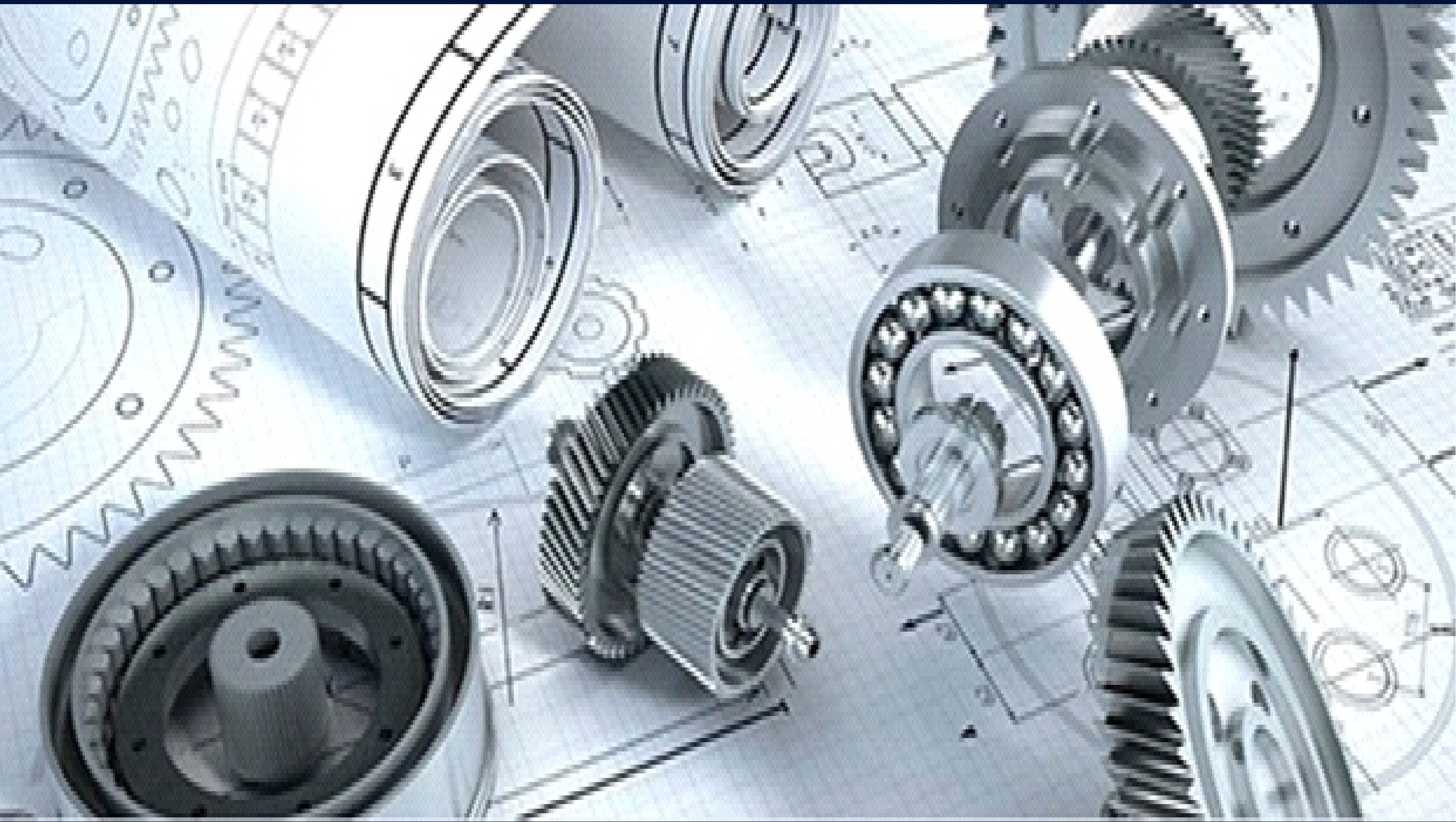
## V.FUTURE SCOPE

Ash from rice husks and waste paper sludge have both been proved to be suitable for use in concrete, according to a study. There are several different areas in which further work may be done, including the following:

1. The research might be expanded further to investigate the behaviour of concrete and determine whether or not it is suited for pumping purposes. Modern technology is engaged in RMC, which involves pumping concrete to great heights, therefore this is an important question to answer.
2. Additional study is required to determine the durability of concrete over a lengthy period of time when it contains mineral admixtures. Additional study is required to be conducted on the microstructural characteristics of concrete.
3. Studies may be conducted to determine the properties and strengths of concrete by using RHA and WPSA that have been appropriately ground and burned at a regulated temperature.

## REFERENCES

1. Ahmad S, Malik M.I., Wani M.B., Ahmad R. (2013). "Study of Concrete Involving Use of Waste Paper Sludge Ash As Partial Replacement of Cement." IOSR Journal of Engineering (IOSRJEN), Vol. 3, Issue 11, pp. 6-15.
2. Alwash J.J.H., "Use of Rice Husk Ash in cement mortar."
3. Balwik S.A., Raut S.P. "Utilization of Waste paper Pulp by Partial Replacement of Cement in Concrete." Int. Journal of Engineering Research and Applications (IJERA), Vol. 1, Issue 2, pp. 300-309.
4. Chun Y.M., Naik T.R., Kraus R.N. (2005). "Durable concrete through use of pulp and paper mill residuals." Composites in Construction, pp. 1-8.
5. Hossain T., Sarker S.K., Basak B.C. (2011). "Utilization potential of Rice Husk Ash as a construction material in rural areas." Journal of Civil Engineering (IEB), pp. 175-188.
6. IS: 10262-1982 (Reaffirmed 1999). "Recommended guidelines for Concrete Mix Design." Bureau of Indian Standards, New Delhi (India).
7. IS: 2386 (Part IV)-1963 (Reaffirmed 1997). "Methods of test for aggregates for concrete." Bureau of Indian Standards, New Delhi (India).
8. IS: 383-1970 (Reaffirmed 2002)." Specification for coarse and fine aggregates from natural sources for concrete." Bureau of Indian Standards, New Delhi (India).
9. IS: 4031 (Part 11)-1988. "Methods of physical tests for hydraulic cement." Bureau of Indian Standards, New Delhi (India).
10. IS: 4031 (Part 15)-1991 (Reaffirmed 2005). "Methods of physical tests for hydraulic cement." Bureau of Indian Standards, New Delhi (India).
11. IS: 456-2000 (Reaffirmed 2005). "Plain and reinforced concrete-Code of practice." Bureau of Indian Standards, New Delhi (India).
12. IS:1199-1959 (Reaffirmed 1999). "Methods of sampling and analysis of concrete." Bureau of Indian Standards, New Delhi (India).
13. Ishimoto B.H, Origuchi T., Yasuda M. (2000) "Use of Papermaking Sludge As New Material." Journal of Material in Civil Engineering, Vol. 12, pp. 310-312.
14. Kartini. K (2011). "Rice Husk Ash-Pozzolanic material for sustainability." Int. Journal of Applied Science and Technology, Vol. 1 No.6, pp. 169-178.
15. Kene S.D., Domke P.V., Deshmuh S.D., Deotale R.S. "Assessment of concrete strength using Fly Ash and Rice Husk Ash." Int. Journal of Engineering Research and Applications (IJERA), Vol. 1, Issue. 3, pp. 524-534.
16. Khassaf S.I., Jasim A.T., Mahdi F.K. (2014). "Investigation the properties of concrete containing Rich Husk Ash to reduction the seepage in canals." Int. Journal of Scientific and Technology Resaearch, Vol. 3, Issue 4, pp. 348-354.
17. Kumar Sathish (2012). "Experimental study on the properties of concrete made with alternate construction materials" Int. Journal of Modern Engineering Research (IJMER), Vol. 2, Issue. 5, pp. 3006-3012.




INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor:
7.580

doi crossref

निस्केयर
NISCAIR

INTERNATIONAL JOURNAL
OF MULTIDISCIPLINARY RESEARCH
IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

+91 99405 72462 +91 63819 07438 ijmrsetm@gmail.com

www.ijmrsetm.com