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# EXPERIMENTAL STUDIES ON ORDINARY PORTLAND 53 GRADE CEMENT &SPECIAL CEMENTS WITH MINERAL ADMIXTURES (FLY ASH &RICE HUSK ASH)

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**Abstract:** Concrete is major part of the constructions. Growing industrial waste has discovered the need to dispose industrial waste. The waste that have to be disposed can be kept to use in some manner. A large volume of production of cement leads to emission of many harmful gases like Green House gases in to atmosphere, which leads to global warming. Hence, the researchers are currently focusing on waste material having cementing properties, which can be added as partial replacement of cement which reduces cement production then the Green House gasses emission is also reduced. It aids in sustain-able management of the industrial waste. The concrete industry is constantly looking for supplementary cementations material with the objective of reducing the solid waste disposal problem. Fly ash, Rice husk ash (RHA) is among the solid wastes generated by industry. This research is carried out in three phase, in first phase mix of M50 grade concrete with OPC 53 with replacement of 0%,15%,30%,45%,60% of mineral admixtures (fly ash& Rice husk ash )in second phase mix of M50 grade concrete with Special cements of OPC 53 S with replacement of 0%,15%,30%,45%,60% of mineral admixtures (Fly ash& Rice Husk Ash). In phase three the comparison of strength obtained from above two phases.Finally30% of fly ash and rice husk ash are replaced in the OPC 53 grade cement and OPC 53S special cements. Among that OPC 53 S special cement is used in the construction of railway sleepers which gives more compressive strength compared to OPC cement .This special cements is finer than ordinary cements. The research work have been extensively executed in almost all areas of testing like compressive, spilt tensile, and flexural strength, and also various primary tests like specific gravity, granular gradation etc. Keywords: Admixture, Cement, Fly ash, Rice husk ash (RHA).

## 1.0 INTRODUCTION

**Cement:** Cement is a material with adhesive and cohesive properties. It is a binder material in concrete, when it is mixed with aggregates and water it turns the particles into a whole compound. Cement is a most important and costliest ingredient of concrete. It is obtained by burning a mixture of the siliceous, argillaceous and calcareous material in definite proportions.

**TYPES OF CEMENT:** By altering the proportions of the ingredients of cement, by adding other ingredients or by changing the intensity of grinding, different types of cement useful for particular situations can be manufactured.

IS 456-2000 has recognized the following types of cements for construction purpose.

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I) Ordinary port land cement confirming to
   a) 33 grade (**IS 269**)
   b) 43 grade (**IS 8112**)
   c) 53 grade (**IS 12269**)

II) Rapid Hardening Cement (**Indianstranded :8041**)

III) Portland Slag Cement (**Indianstranded :455**)

IV) Hydrophobic Cement (**Indianstranded : 8043**)

V) Portland Pozzolona Cement (**Indianstranded :1489**)

VI) Low heat Portland Cement (**Indianstranded :8042**)

VII) Sulphate Resisting Portland Cement (**Indian stranded :1233**)

VIII) White Portland Cement (**Indian stranded :8042**)

IX) High Alumina Cement (**Indian stranded :6452**)

In our project the Ordinary Portland Cement of 53 grade cement and Ordinary Portland Special cement of OPC 53 S cements are used

**Special Cements (OPC S):** The Special Cements are a special type of cements which are used for the specified requirements. Among its OPC 53 S is the special type of cements which are used for construction of sleepers. OPC represents Ordinary Portland Cement, 53 represent the compressive strength of cement after 28 days curing, and S represents the special cements. The main differences between Ordinary Portland Cement and Ordinary Portland Special cements is the

- Min Fineness - 225$m^2$ /kg for OPC53 & 370$m^2$/kg for OPC 53 S as per IS4031 ( part -2)
- Chemical composition -
- Maximum Tricalcium aluminate content, is10.0 % by mass,
- Maximum Tricalcium silicate, 45.0%by mass

It is a specialty cement as per specifications which is manufacturing, concrete obtained by the Indian Railways vide their specification No.IRST-40 for manufacturing concrete sleepers. Where there was an amendment(No.6) to I.S 12269, IRST-40 cement and then, this was considered under the ambit of BIS. It isthen designated as 53-S Ordinary Portland cements and conforms to BIS specification Indian standard: 12269-1987. 53-S OPC's which has negligible chloride content protects it against corrosion. High fineness enhances workability and high early strength enables improved mass production cycle of Railway Sleepers.

## 2. LITERATURE REVIEW:

### 2.1 S. Arivalagan- studies on concrete having GGBS as a replacement material in cement

- This research work is an extinguished to develop a greenery concrete by using several industrial waste material
- In this report the M 35 mix design is used the GGBS replacement level is up to 40 % cement replacement, the maximum strength was obtained at

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the 20 % replacement at the age of 28 days.

- In this report the split tensile and flexure strength are also discussed at the replacement level of up to 40 % replacement and mechanical properties are compared with normal plain concrete.

**2.2 Sonali k. Gadpalliwar, R.S. Deotale, AbhijeetR.Narde.(2014)**

- In this report for M 40 mix design the mechanical properties are compared by adding quarry dust and GGBS.
- They concluded that the compressive strength increasers with percentage increase of quarry sand for certain limit.

## 3. WORKING METHODOLGY

**Collections of materials Cement:** the cement of OPC 53 S is used in project it is collected from the railway sleeper plant, OPC 53 OF JPJ cement is used.

**Fine aggregate**: the sand used for our investigation is collected form Godavari river sand which is conforming to Zone III as per Indian Specification 383-1970 codal provisions.

**Coarse aggregate:** the coarse aggregate of max20mm size with an angular shape which is well graded.

**Fly ash** is collected from RIN (Visakhapatnam Steel Plant )

**Rice husk Ash** is collected from the locally available mills

**Special cements:** OPC 53-S is a special type of cement. It is an example for Portland pozzolona cement. It is generally used in construction of railway sleeper and marine structures. It is a specialty cement, manufactured as per specifications originally formulated by the Indian Railways vide their specification No.IRS T-40 for manufacturing concrete sleepers. However, there was, IS 12269, IRS T-40 cement and then, this was brought under the ambit of BIS. It is now designated as 53-S Ordinary Portland cements and conforms to Misspecification IS: 12269-1987. 53-S OPC's negligible chloride content, protects it against corrosion. High fineness enhances workability, and high early strength enables improved mass production cycle of Railway Sleepers.

Table-1 physical properties of OPC-53grade and OPC-53-S grade cements

| PROPERTITES | OPC 53 | OPC 53-S |
|---|---|---|
| Fineness of cement | 8% | 1% |
| Standard consistency | 32% | 35% |
| Specific gravity | 3.15 | 3.15 |
| Initial setting time | 40 minute | 22 min |
| Final setting time | 330 minute | 150 min |
| Soundness | 2mm | 2mm |

**Fine Aggregate:**The sand which is used is comes under Zone –III as per IS 383-1970. The physical properties like zoning of sand, bulk density, specific gravity are determined according to the codal provisions

Table -2 physical properties of fine aggregate:

| Properties | Test results |
|---|---|
| Specific gravity | 2.52 |
| Fineness modulus | 2.2 |
| Bulk density | 1.69 |

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**Coarse Aggregate:**The coarse aggregate used is from well-established quarry, satisfying the code IS 383:1970. The mixture of coarse aggregates is used of only 20 mm .the material is of uniform color and has good angular shape. The physical properties like fineness- modulus, specific-gravity bulk-density, water-absorption, aggregate-impact, and crushing value.

Table -3 determined physical compositions of coarse aggregate

| Properties | Test values |
|---|---|
| Specific gravity | 2.73 |
| Bulk density | 1.67 |
| Water absorption | 0.5 |
| Fineness modulus | 6.6 |
| Aggregate impact value | 24% |

**Rice Husk Ash**: Rice Husk Ash is a Pozzolanic material. It is having different physical & chemical properties. The product obtained from R.H.A. is identified by trade name Silpoz which is much finer than cement. A residual RHA obtained from open field burning. The material was carefully homogenized and prepared in two conditions: Natural RHA (NRHA): the ash was only dried, homogenized, and packed to enhance the transport to the laboratory. Grinded RHA (GRHA): after drying and homogenization process the RHA was ground in a laboratory ball mill by one hour for optimization.

Table-4 Properties of Rice husk ash

| Sr. No. | Particulars | Proportion |
|---|---|---|
| 1 | Silicon dioxide | 86.94% |
| 2 | Aluminum oxide | 0.2% |
| 3 | Iron oxide | 0.1% |
| 4 | Calcium Oxide | 03.-2.2% |
| 5 | Magnesium Oxide | 0.2- 0.6% |
| 6 | Sodium Oxide | 0.1- 0.8% |
| 7 | Potassium Oxide | 2.15-2.30% |
| 8 | Ignition Loss | 3.15-4.4% |

**MIX DESIGN: The quantities of M50 [1:1.26:2.5] mix for 1 meter cube is given below.**

Cement = 465 kg

Fine aggregate = 589 kg

Coarse aggregate = 1188.5 kg

Water = 186 lit, W/C = 0.4

## 5. RESULTS AND DISCUSSIONS

**COMPRESSIVE STRENGTH:**

Result representing the compressive strength values from 3 days curing to 90 days curing at various replacement levels i.e. at 0 % to 40 % replacement of Fly ash& Rice Hush Ash in both OPC 53 and OPC 53 S cements.

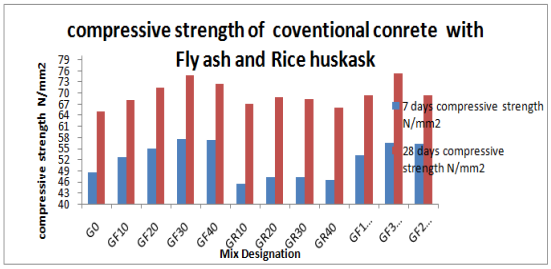


Fig: 1 shows compressive strength of conventional concrete verses various proportions of fly ash and rice husk ash Mix for 7days and 28 days

Note :G0is the conventional concrete ,Gf10 is the 0% of cement Replacement with fly ashGF20 is the 20% replacement of Fly ash with cement,GF30,GF40 is the 30,40% replacement of fly ash in the same the GR10,GR20,GR30,GR40 are the rice husk

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ash replacement for both special cement and 53 grade cement is done

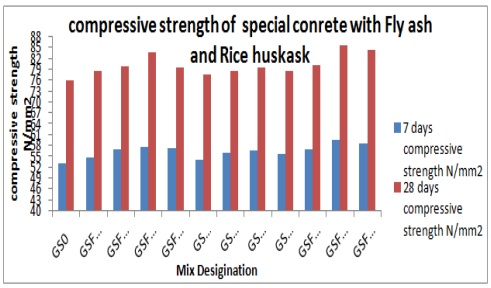


Fig: 2 shows compressive strength of special concrete verses various proportions of fly ash and rice husk ash Mix for 7days and 28 days

Note :GS0is the conventional concrete with special cements ,GSf10 is the 10% of special cement Replacement with fly ashGSF20 is the 20% replacement of Fly ash with special cement,GSF30,GSF40 is the 30,40% replacement of fly ash in the same the GSR10,GSR20,GSR30,GSR40 are the special cement replacement with rice husk ash.

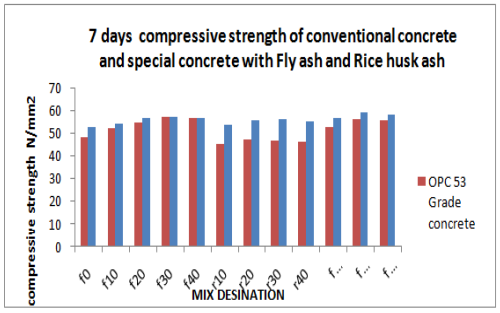


Fig: 3 shows compressive strength of conventional concrete and special concrete verses various proportions of fl ash and ricehusk ash Mix for 7days

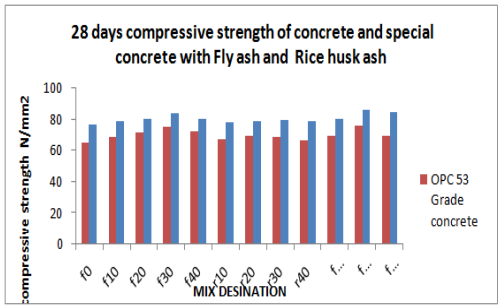


Fig:4 shows compressive strength of conventional concrete special concrete verses various proportions of fly and rice husk ash Mix for 28days.

Note :GS0is the conventional concrete with special cements ,GSf10 is the 10% of special cement Replacement with fly ashGSF20 is the 20% replacement of Fly ash with special cement,GSF30,GSF40 is the 30,40% replacement of fly ash in the same the GSR10,GSR20,GSR30,GSR40 are the special cement replacement with rice husk ash.

**SPLIT TENSILE STRENGTH RESULT:**

The standard size of cylinders of 300mm long and 150 mm diameter, cylinders are casted with the designed mix proportions in both OPC 53 and OPC 53 S ,and they are tested the specimens after 28 days curing in normal w

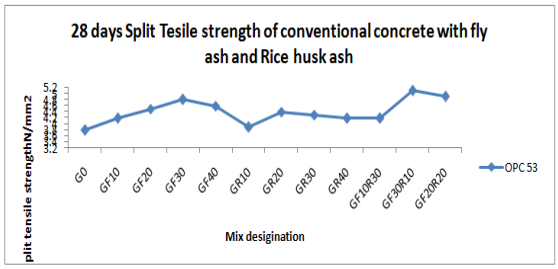


Fig: 5 shows split tensile strength of conventional concrete verses various proportions of fly ash and rice husk ash Mix for 28days

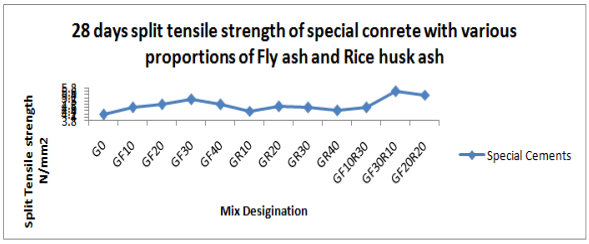


Fig: 6 shows split tensile strength of special concrete verses various proportions of fly ash and rice husk ash Mix for 28days

Note :GS0is the conventional concrete with special cements ,GSf10 is the 10% of special cement Replacement with fly ashGSF20 is the 20% replacement of Fly ash with special cement,GSF30,GSF40 is the 30,40% replacement of fly ash in the same the GSR10,GSR20,GSR30,GSR40 are the special cement replacement with rice husk ash

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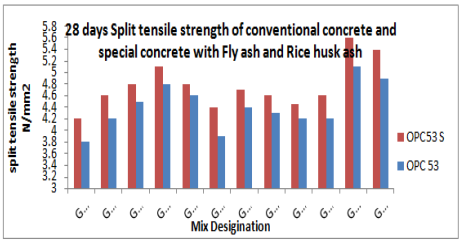


Fig: 5.7 shows split tensile strength of conventional concrete and special concrete verses various proportions of fly ash and rice husk ash Mix for 28days

**FLEXURE STRENGTH:** The standard size of prisms of 500mm*100mm*100mm .prisms are casted with the designed mix proportions in both OPC 53 and OPC 53 S, and they are tested the specimens after 28 days curing in normal water.

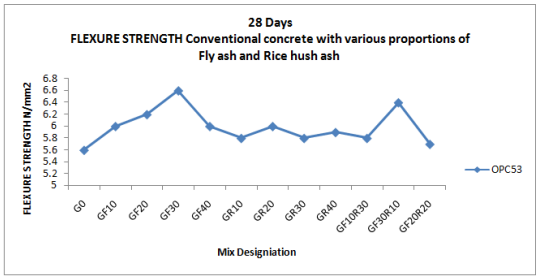


Fig: 5.8 shows flexural strength of conventional concrete verses various proportions of fly ash and rice husk ash Mix for 28days

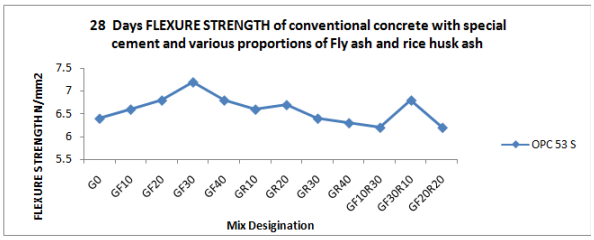


Fig: 9 shows flexural strength of special concrete verses various proportions of fly ash and rice husk ash Mix fo 28days

Note :GS0is the conventional concrete with special cements ,GSf10 is the 10% of special cement Replacement with fly ashGSF20 is the 20% replacement of Fly ashwith special cement,GSF30,GSF40 is the 30,40% replacement of fly ashin the same the GSR10,GSR20,GSR30,GSR40 are the special cement replacement with rice husk ash.

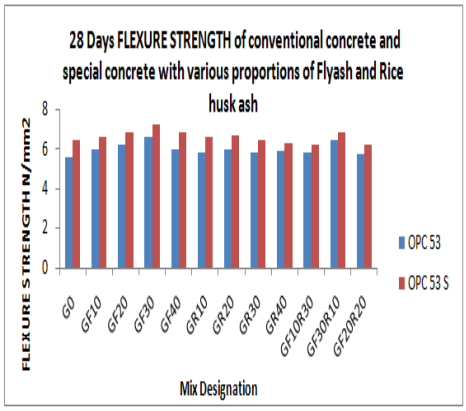


Fig: 10 shows split tensile strength of conventional concrete and special concrete verses various proportions of fly ash and rice husk ash Mix for 28days

## CONCLUSIONS:

1. The compressive strength result of concrete when replaced up to 30 % OF fly ashis more than conventional aggregate concrete at the end of 28 days for normal curing
2. The split tensile, flexure strength result of when replaced up to 30 % of Fly ashis more than the conventional aggregate concrete at the end of 28 days for normal curing.
3. The degree of workability is normal in special concrete is same up to 40 % level of replacement.
4. An increase of around 16.3 %, compressive strength for OPC 53 cement concrete when replaced with 30% of Fly ash OPC 53 cement at the of 28, 56 90 days normal curing.
5. An increase of around 20.2 %,of compressive strength is observed for OPC 53S cement concrete when replaced with 30% of Fly ash& 10% Rice Hush Ash(MF30R10)
6. An increase of about 3.1 % of split tensile strength at 30 % replacement level after 28 days normal curing

when the Fly ash is replaced with OPC 53

7. An increase of about 3.9 % of split tensile strength at 30 % replacement of Fly ash& 10% Rice Hush Ash after 28 days normal curing when the is replaced with OPC 53 S
8. An increase of about 5.15 % of flexure strength at 10 % replacement level after 28 days normal curing when the Fly ashRice Hush Ash is replaced with OPC 53 grade cement
9. An increase of about 3.12 % of flexure strength at30% Fly ash& 10 % of Rice Husk Ash replacement level after 28 days normal curing when the Fly ash& Rice Husk Ashis replaced with OPC 53 S grade cement
10. Among all the mixes the 30% of Fly Ash&10% Rice Hush Ash as the more compressive strength

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