**Review on Strength Properties of Concrete by the Partial Replacement of Cement with Metakaolin and Rice Husk Ash with Recycled Aggregate**

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# *Abstract-* The specimens prepared with the partial supplant of cement with 5% Metakaolin and Rice husk ash of 9%, 12%, 15% by weight of cement are tested for 7days, 28days and 90days by conducting various tests like compression, tensile and flexural quality tests and acid attack tests (H2SO4, HCL) and compared with conventional mix prepared with 100% cement, 0% Metakaolin and 0% rice husk ash. Values obtained for different mix proportions of MK and RHA are analyzed and compared with the strength properties of conventional mix. The result is given in the information tables mentioned. By this, we can know the strength properties of different mixes. Conventional mix has greater strength than that of strength properties obtained for different mixes using MK and RHA. By the increase in RHA content, even though it has pozzolonic properties, the compressive, tensile and flexural qualities of specimens decrease. The main purpose is cost reduction and usage of waste material. So, it can be used where there is no need of higher strength constructions and it is very much useful for a common man to decrease the overall cost of construction. In our project we are finding the Mechanical properties (like Strength, Ductility, Wear resistance, etc.) of concrete using M20 grade by partial supplant of cement with Metakaolin with 0%, and 5% and Rice husk ash with 9%, 12%, 15% by the weight of cement with recycled aggregate by weight of cement is done and checked for compressive, tensile, and flexural strengths and acid curing (HCl, H2SO4) for 7 and 28days.

***Key words: split tensile strength, compressive strength, flexural strength, Rice husk ash, Metakaolin.***

Earlier, a study of compression, split tensile, and flexural properties and Acid curing by using H2SO4 & HCL tests was undertaken to use Rice husk Ash, Metakaolin, as Admixtures of partial supplant for binder in concrete has done. Following are the related studies.

### *[1].Narmatha and Dr.T.Felixkala:*

Analyzed about the partial cement replacement in concrete with metakoalin. HPC is the latest development in concrete. Metakaolin is a propitious cementitious supplementary substance for maximum performance concrete. Concrete features with metakaolin are majorly preferred the corresponding additives in maximum performance concrete. A feasible lower cost, due to vast availability in our country itself may be advantages to metakaolin utilize in HPC. The substitution ratio of metakaolin was to be utilized with 5, 10, 15, and 20% percentages by the weight of corresponding cement. To make cube sand and cylinders to discover the strength and durability of concrete. There results indicate that the substituting mix upto till final percent has to measured and noted and effect on strength in comparing with mixer without metakaolin. After 28days the compressive strength for MK5% enhancing in 4.36%, and when compared to majorly control specimen the Flexural strength for MK5% increases 4.76%. So MK 15% is the best ratio for add in cement.

### *[2].Farah Alwani Wan Chik, Badorul Hisham Abu Bakar, Megat Azmi Megat Johari & Ramadhansyah Putra Jaya:*

Examined the partial substitution of binder with rice husk based ash and confers a laboratory analysis of gases incinerating rice husk based ash (GIRHA) on behavior of prepared moulds. Compaction behavior, moisture movement, water immersion capacity, and Young’s modulus are examined by physical experiments of the immediate readily blend was also mainly carried out. 390mm x 190mm x 100mm dimensional blocks are cast and compressed by a KANGO hammer for 7days, 14days, 28days and 60 days at 0, 10, 15 and 20% substitution stages. In overview, great effective functioning of blocks can be developed utilizing rice husk based ash (RHA) as cement substitution material. The compression related strength of the OPC and RHA moulds develops with age at curing and reducing as the percentages of corresponding RHA portion was increased.

*[3].Ehsan Mohseni , Mohammad Ali Yazdi , Bahareh Mehdizadeh Miyandehi , Mehdi Zadshir and Malek Mohammad Ranjbar :*

Examination sustained to examine the major efficacy of the implemented application of metakaolin and rice husk based ash considered as a partial substitution part for binder and polypropylene considered as an substance, on multiple mechanical related and water based immersion characteristics of adhesive. Adhesive was manufactured utilizing multiple substitution proportions of metakaolin those are varying from 5 - 15% percentage, and of rice husk based ash are majorly varying from 10 - 30% percentage, by corresponding weight of cement. The PP fiber based content was taken as constant at a rate of 0.3%. Compaction related and convolution related strength, water based immersion capacity, ultrasonic related pulse velocity and also the scanning electron based microscopy analysis are noted & reported. Outcomes betrayed that the mixture of rice husk based ash, metakaolin, and PP produces affirmative changes on the mechanical based functionalities of adhesive. The samples substitutions of cement with a mixture of 10% percentage of MK, 10% percentage of RHA, and 0.3% percentage of PP fiber gives greater mechanical functionalities than the other adhesive sample ratios. In terms of water related immersion capacity, incorporation of PP fiber minimized the permeability when these are contrasted with the combinations of 15% percentage MK and 10–30% percentages of RHA, and outcomes represented a optimal absorption in contrasted with the adhesive having 5–10%MK.

*[4]. Ashok Kumar Yadav, Dhaval S. Shah, Dhaval N. Amlani, Saureen R. Naik, Tej J. Patel, Devang M.Maratha :*

It summarizes the comparative analysis of Rice Husk based Ash (RHA) and Metakaolin when used as partial substitution for Ordinary Portland Cement (OPC) in concrete. OPC was substituted with mineral based admixtures at 5, 10 and 15% percentages by weight. 0% percent substitution was majorly served as the control. Compaction strength experiments was sustained on hardened 150mm concrete cubes after at 1, 3, 7, 28, 45 & 56 days curing in room temperature water. Molded based cubes test were cured properly and experimented as per compaction test procedures in digital compaction testing machine of having 3000 KN capacity. At all cement substitution stages of Rice husk based ash, the level of enhancement of compaction strength considered up to 28 days is obtuse as contrasted with that of corresponding concrete in RHA content is measured as zero, while the rate of progress of strength moderately enhances after 28 days - 56 days in instance of RHA blended concrete. The compaction strength of concrete attaining 10% substitution was identified to be higher than the other stages of substitutions. (i.e., 0, 5, &15% percentages).



 Fig.1 Compressive Strength at 5% and 10% replacement in MPa

Fig.2: Compaction Strength at 5 and 10% percentage substitutions in MPa in graphical representation

### *[5]. Mahendrakar Kiran Kumar and C.Rajamallu :*

This study is the application of Metakaolin in concrete. The researchers also vague on the potentiality of hybrid mix with Metakaolin and rice husk based ash. Substitution ratios has to be differenciated to that end and multiple accounts of blending water need to be considered. Strength must be recorded at initial age and in the more mature state of material. This paper represents the outcomes of an experimental based enhanced examinations helpful to perceive the suitability of Metakaolin (MK) only and Metakaolin with and without rice husk based ash (RHA) in manufacture of concrete. In this exploratory study the effect of MK and RHA on strength of the concrete was studied, the referral based concrete M30 was prepared by utilizing 53 Grade OPC and other blends are made by substituting part of corresponding OPC with MK and MK with RHA. The substitution levels are 10, 12.5, 15, 17.5 up to 20% percentages (by weight) for Metakaolin. Test outcomes indicate that use of substituting cement by Metakaolin in concrete has enhance the performance of corresponding concrete up to 15% to20%.

### *[6]. Irfan Ishaq Shah1, Rajesh Goyal2, Pooja Sharma :*

In this research work the Rice Husk Ash and Metakaolin are used. The Metakaolin is acquired by calcinations of particular pure or cultivated kaolin clay at a temperature in the range of 650°C and 850°C, followed by grinding to attain a fineness of 700 m2/kg to 900m2/kg. By adding rice husk ash and metakoalin with concrete, not only replaces the cement content but also increases the strength of corresponding concrete like compaction, flexural & split tensile related strength etc. These two materials RSH & Metakaolin were incorporated with concrete with varying percentages of 2%, 4%, 8%, & 10%. The proper codal precautions were followed during the manufacturing the cubes of 150 X 150 X 150 mm and the cylinders of 150 mm X 300 mm casted with differencing percentage of corresponding RHA & Metakaolin. The complete number of specimen which were prepared 36 cubes were casted with proper curing . It was concluded that the strength of concrete enhanced by incorporated the Rice Husk Ash &Metakaolin.

### *[7]. K.Madhu1, T.Divya Bhavana2 and Syed Eashan Adil2.*

In this exploration the exploratory examinations completed in three stage M30 grade concrete is utilized with RHA in ratios of 0,5,10,15 and 20% percentages .In second phase the metakalon in multiple proportions of 2.5% and 5% and in third combination of metakaolin and RHA were experimented. From this corresponding research the outcomes are much greater as compare to conventional concrete.

Out of the all cementitious materials mentioned in above, rice husk based ash and metakaοlin are choosen to carry the corresponding experimental examination on split tensile based strength of the corresponding concrete with partial substitution of cement. The experiments are conducted after 7days and also after 28 days curing and the results were published. From the above compaction strength outcomes, it is mainly observed that rice husk based ash concretes have gain an improving in strength for 10% percentage substitution of the cement and 5% percentage substitution of cement by metakaolin and mix 10% of the RHA and 5% of the metakaolin at the age of 28 days when compared to convolution concrete. From the given above split based tensile strength outcomes, it is mainly observed that rice husk based ash concretes have gains an improving in strength for 10% percentage of substitution of cement and 5% percentage substitution of cement by metakaolin and mix 10% percentage of RHA and 5% percentage of metakaolin at the age of 28 days when compared to convolution concrete. From the experimental investigation rice husk based ash (RHA) can be utilized as instead substance to cement up to a range of 10 ,20 and metakaolin 2.5 percentages and 5% percentage mix effect of RHA and metakaolin are given outcome at 10% percentage of RHA and 5%metakaolin.

|  |  |  |
| --- | --- | --- |
| S. No | Metakaolin content | Slump |
| 1 | 0% | 96 |
| 2 | 2.5% | 97 |
| 3 | 5% | 98 |

|  |  |  |
| --- | --- | --- |
| S. No | RHA content | Slump |
| 1 | 0% | 96 |
| 2 | 5% | 90 |
| 3 | 10% | 85 |
| 4 | 15% | 75 |
| 5 | 20% | 70 |

Fig.3 Workability of RHA and Metakaolin content

### *[8]. Dr. Mohammed Mansour Kadhum*

This investigation represents the effect of incorporation of operated Metakaolin and fly based ash on the mechanical related characteristics of self compressing concrete type for a variable related water/binder proportion along with hot water was curing at a rate of 80±2 °C is applied. Based on outcomes, it was majorly observed that 40kg/m3 substitution from Metakaolin or fly ash was the best content related to compacting strength. Compaction strength of 59.3 MPa was accomplished at 40 kg/m3 substitution through Metakaolin only. Splitting tensile based strength, convention related behavior and elastic based modulus numeric as well as majorly followed the correspondings. The investigation has been the local Metakaolin and Fly ash has the potential to deliver SSC. Expected 28 days strength of developed concrete from the proper accelerated curing experiments was identified to be on a conservancy side was compared to specific control of concrete. The achieved results of elasticity at next ages are won’t affected by the corresponding curing related temperature as it is specifically noticed at the early ages. The condition of corresponding curing regime won’t play an effective role in next ages. The enhanced level of replacement of metakaolin was 40kg/m3, which gave the maximum compressive based strength while comparison with the other substitution stages; this is due to the major dilution effect of partial cement substitution. SC concretes exhibited a 28 - day tension of the corresponding order of 5.15 % of their compaction strength and represented relatively maximum values of modulus of the elasticity. Splitting based tensile & Young’s modulus outcomes have also followed corresponding trend to that of compaction quality outcomes representing maximum values at 40kg/m3 metakaolin substitution.

### *[9]. Vandana P. Pandya, Iliyas U. Rasool bhai (2015)*

They adopted M25 grade mix proportion 1:1:2 is for casting and testing of cubes for compressive strengths at 7 and 28 days. The metakaolin contents substituted in cement are 0%, 3%and5% by weight of specific cement. The water cement proportion of 0.45 is constant. Minimum 10% of MK is to be used to completely achieve the requirements. By maximizing the percentages of MK the compaction strength increases drastically.

### *[10]. CH Jyothi Nikhila & J D Charan Kumar*

They studied that the metakaolin (MK) is a supplementary cement related material or not. The computational work majorly carried out as partial substitution of cement with MK in M70grade of concrete at 0, 10, 15, 20, 25, and 30% of substitutions. The mix design was made making the use of “Entropy empirical shack lock’s method”. Cubes are experimented for durability based studies with H2SO4 and HCL of 0.5percent and 1percent concentrations respectively. Cylinders, Cubes, Prisms are experimented for temperature at 15% substitution. The specimens were heated to different temperature of 100o, 200 o, 300 o, 400 o and 500 o C of three different durations. The results are conclude that the utilization of Metakaolin based concrete (MKC) has enhanced the performance of concrete under distinct conditions.

###  *[11]. Bindu Biju, Imran H (2016)*

This study is deliberated to conceive a high performance concrete (HPC) blend for M70 class and to perceive the best partial substitution of cement with corresponding metakaolin from chosen particular dosages. The compaction strength at 28day so curing is 78.65N/mm2. The strength was found to increase by 6% when 10% by weight of cement was substituted with metakaolin. They concluded that the strength increase is due to the presence of silicon and aluminates that increases the cementing capacity. The workability was reduced while adding Metakaolin which was rectified with use of super plasticizers.

|  |  |
| --- | --- |
| **Trial Mix** | **Compressive Strength (N/mm2)** |
|  | **Day 7** | **Day 14** | **Day 28** |
| MHPC 2.5 | 62 | 70.66 | 72 |
| MHPC 5 | 66 | 76 | 78.66 |
| MHPC 7.5 | 67 | 76.22 | 79 |
| MHPC 10 | 70 | 79.11 | 84 |
| MHPC 12.5 | 60 | 73.33 | 77.7 |

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