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A STUDY ON STRENGTH CHARACTERSTICS OF FIBER REINFORCED CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT WITH METAKAOLIN

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ABSTRACT: Ordinary Portland cement (OPC) is one of the main ingredients used for the production of concrete and has no alternative in civil construction industry. But, production of cement involves emission of large amount of carbon dioxide gas into the atmosphere which results into a global warming. So it is advisable to search for another material or partly replace it by other material that should lead to lowest environmental impact. The present study deals with the strength characteristics of fiber reinforced concrete with partial replacement of metakaolin with cement. In this study "Recron 3S" is a polypropylene monofilament, discrete, discontinuous short fiber that can be used in concrete to control and arrest cracks. During the present study, an attempt is made to study a partial replacement of metakaolin with cement. The variable factors considered in this study were M30 grade of concrete cubes and cylinders are prepared by using cubes of size (150 X 150 X 150) mm and cylinders of size 150mm(Dia) X 300mm (Depth) that were casted and cured in potable water for a period of 28 days. The specimens were then tested for split tensile strength , compression strength and flexural strength of the conventional concrete and high performance concrete at 7,14 & 28 days.

KEYWORDS: Metakaolin, Recron 3S, monofilament

1. INTRODUCTION: Concrete though not is refractory material, is incombustible and has good fire resistant properties. fire resistant of concrete structure is determined by three main factors-the capacity concrete itself to withstand heat and the subsequent action of water without losing strength unduly, without cracking or spalling, the conductivity of concrete to heat and coefficient of thermal expansion of concrete. In the force of reinforced concrete, the fire resistant is not only dependent upon the type of concrete but also on the thickness of the cover to reinforcement. The fire introduces high temperature gradients and as a result of it, the surface layer tends to separate and

spall of from the cooler interior. The heating of reinforcement aggravates the expansion both laterally and longitudinally of the reinforcement bars resulting in loss of bond and loss of strength reinforcement. Workability, Strength and Durability are three basic properties of concrete. Amount of useful internal work necessary to overcome the internal friction to produce full compaction is termed as Workability. Size, Shape, Surface, Texture and grading of aggregates, water-cement ratio, use of admixtures and mix proportion are important factors affecting workability. Strength is to bear the desired stresses within the permissible factor of safety in expected exposure condition. The Compressive strength of concrete is one of the most important and useful properties of concrete. In most structural applications concrete is employed primarily to resist compressive stresses.

2.LITERATURE REVIEW:

Gorpade and rao (2011) conducted the investigation on high performance concrete(hpc) produced with locally available aggregates and metakaolin as the mineral admixture. various metakaolin based hpc mixes were attained by absolute volume method. cubes of 150 x 150 x 150 mm size were cast and cured for 28 days and then tested for compressive \strength. chloride ion permeability test was conducted on various hpc mixes to measure the permeability values of hpc produced with metakaolin. it was concluded from experimental results that metakaolin has the ability to considerably reduce the permeability of high performance concrete.

Justs et al (2011) investigated the comparison of pozzolanic additives for normal and high strength concrete. Results for dehydroxilated illite clay, microsilica and Centrillit NC at the age of 7 days were very similar: 30.2 MPa, 32.2 MPa and 31.4 MPa accordingly. At the age of 28 days the highest compressive strength of 59.3 MPa was obtained for metakaolin thus proving its high pozzolanic reactivity. The difference in compressive strength compared to the reference mix was as high as 54%. The lowest strength increase (4.9% compared to the reference mix) was for the dehydroxilated illite clay. Testing of samples at the age of 155 days showed that compressive strength increased from 12.6% for metakaolin mix to 58.7% for the reference mix showing that metakaolin tends to use most of its potential in the shorter term. The final 155 day strength varied from 61.1 MPa for the reference mix to 67.4 MPa for Centr illit NC. Microsilica with the indicator 63.8 MPa demonstrated the second result after the reference mix, which proved that it is not possible to fully use its potential without good particle dispersion in the mix and that a high range super plasticizer should be used to obtain good micro silica particle dispersion.

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3. EXPERIMENTAL STUDY:

Cement: [IS: 8112-1989]: Ordinary Portland cement is used for general constructions. The raw materials required for manufacture of Portland cement are calcareous materials, such as limestone or chalk and argillaceous materials such as shale or clay. The manufacture of cement consists of grinding the raw materials, mixing them intimately in certain proportions depending upon their purity and composition and product formed by using the procedure is a "Portland cement".

Aggregate [IS: 383-1970]: Aggregate properties greatly influence the behavior of concrete, since they occupy about 80% of the total volume of concrete. The aggregates are classified as

1) Fine aggregate
2) Coarse aggregate

1) **Fine aggregate [IS: 383-1970]:**The size of the fine aggregate is below 4.75mm.Fine aggregates can be natural or manufactured. The grade must be throughout the work. The moisture content or absorption characteristics must be closely monitored. The fine aggregate used is natural sand obtained from the river Godavari conforming to grading zone-II of table 3 of IS: 10262-2009.

Coarse aggregate [IS: 383-1970]: Crushed angular granite aggregate conforming to IS: 383-1970 is used for preparation of concrete. Coarse aggregate of size 20mm, having the specific gravity of 2.74 is used. It is free from impurities such as dust, clay particles and organic matter etc. The coarse aggregate is also tested for its various properties.

RECRON 3S FIBER: Recron-3s is a polypropylene monofilament, discrete, discontinuous short fiber that can be used in concrete to control and arrest cracks. Recron 3s fiber was used as a secondary reinforcement material. It arrests shrinkage cracks and increases resistance to water penetration, abrasion and impact. It makes concrete homogenous and also improves the compressive strength, ductility and flexural strength together with improving the ability to absorb more energy. Use of uniformly dispersed Recron 3s fibers reduces segregation and bleeding, resulting in a more homogeneous mix. This leads to better strength and reduced permeability which improves the durability.

Metakaolin: The reactivity of metakaolin is based on chemical composition and reactive surface. Highly reactive metakaolin has become available as a considerably reactive pozzolanic material in concrete. This type of material is not like other admixtures for example fly ash, blast furnace slag, and silica fumes in terms of production because it is produced from high purity kaolin clay by calcinations at temperatures ranging from 700 to 800 ^{o} C. The average size of highly reactive metakaolin particle, which is smaller than cement particles, is ranging

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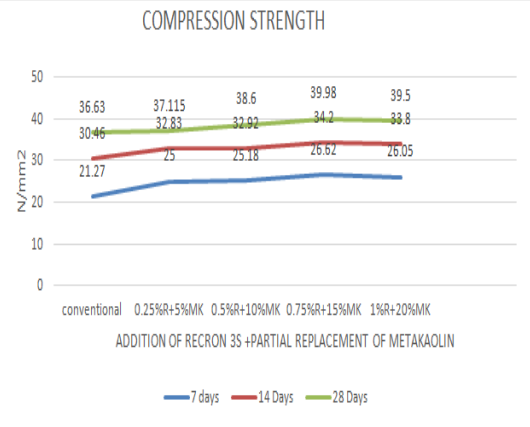
from 1 to 2 and it is white in colour which in return influences the r of the final product. Specific gravity of highly reactive metakaolin is 2.5

Water [IS: 3025-1984]: This is the least expensive but most important ingredient of concrete. The quantity and quality of water is required to be looked in to very carefully. In practice very often great control on the properties of all other ingredients is exercised, but the control on the quality of the water is often neglected. Since quality of the water effects strength, it is necessary for us to go in to the purity and quality of water.

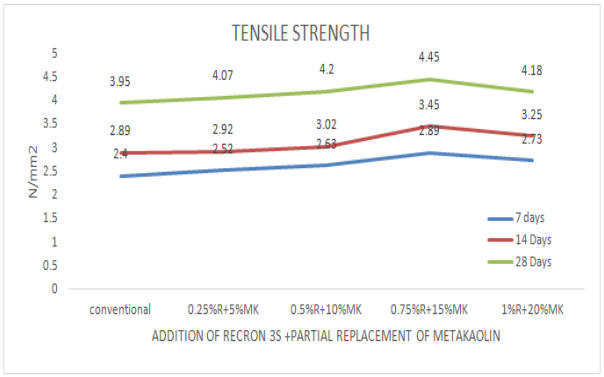
4. RESULTS AND DISCUSSION:

COMPRESSION STRENGTH



From the above experimental results, it is clear that the strength of concrete increases when the recron fiber is added and partial replacement of metakaolin with cement .It is found that the strength of concrete increases gradually from 0.25% to 0.75% and 5% to 15% of recron and metakaolin respectively At 1% and 20% of recron and metakaolin, the concrete strength is decreases. So at that position of 0.75% and 15% the concrete gives maximum strength.

Tensile strength



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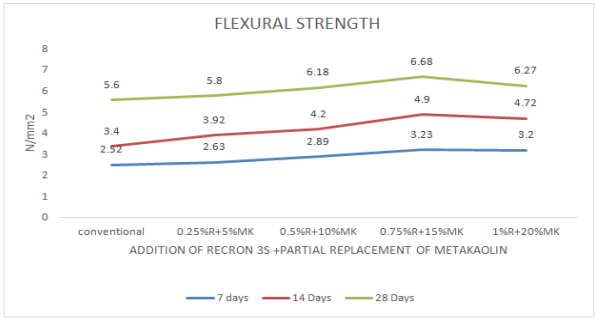
FLEXURAL STRENGTH



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5. CONCLUSIONS

- From the above experimental results, it is clear that the strength of concrete increases when the recron fiber is added and partial replacement of metakaolin with cement .
- It is found that the strength of concrete increases gradually from 0.25% to 0.75% and 5% to 15% of recron and metakaolin respectively
- At 1% and 20% of recron and metakaolin ,the concrete strength is decreases
- So at that position of 0.75% and 15% the concrete gives maximum strength
- These results are same in tensile and flexure test
- The strength is maximum at 0.75% and 15% of recron and metakaolin respectively
- Usage of recron 3s fibers will reduce the cost maintenance by reducing the microcracks and permeability
- The durability will increases
- It is found that use of recron 3s fibers reduces the segregation
- Due to use of metakaolin reduces the shrinkage and creep failures of concrete ,so then increases the durability of concrete
- So then this project is so useful for constructions of high rise buildings and heavy structures

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