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REVIEW ARTICLES

TO CHECK THE SUITABILITY OF ALUMINIUM POWDER AND KHANGAR IN CONCRETE

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ABSTRACT

In this study an experiment is conducted to determine the properties of M40 concrete such as compressive strength, split tensile strength etc. after which a chemical called aluminium powder is introduced to enhance these properties. This powder is used in different percentages in the concrete. Khangar, a coarse aggregate is also used in making of concrete. Impact test is performed to determine the exact percentage of khangar to be used. Casting of cubes and cylinders of the concrete with Aluminium powder and Khangar individually is performed to determine the above mentioned properties. A mixture of aluminium powder, khangar and super plasticizer which is an admixture is also used to cast cube and cylinder. Finally, it leads to the conclusion that addition of aluminium powder individually results in enhancement of the properties of M40 concrete while the addition of khangar individually and the mixture of aluminium powder plus khangar results in depreciation of the properties of M40 concrete.

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INTRODUCTION

Concrete is a complex material composed of coarse aggregate bonded together with a fluid cement that hardens over time. The majority of concrete used are lime-based concretes such as Portland cement concrete or concretes prepared with other hydraulic cements. However usage of asphalt concrete on rigid pavement, is also a type of concrete, where the cement is used as a binder material in place of bitumen. When aggregate is mixed together with dry Portland cement and water, the mixture forms a fluid slurry that is with no trouble poured and moulded into shape. The cement reacts chemically with the water and other ingredients to form a hard matrix that bind the materials together into a durable stone-like material that can be used for various application. Frequently, additives (such as superplasticizers) are integrated in the mixture to get better physical properties of the wet mix or the complete material.

Composition of concrete

Unit weight of concrete

The unit weight of concrete varies from 23 to 26KN/m^2 depending upon the percentage of reinforcement, type of aggregates and amount of voids.

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The unit weight value of plain and reinforced concrete as specified by IS: 456 is 24 and 25KN/m^3 respectively.

Objectives

- To evaluate the effect of aluminium powder and khangar on compressive strength of concrete.
- To evaluate the effect of aluminium powder and khangar on split tensile strength of concrete.
- To investigate the use of aluminium powder and khangar in concrete.

LITERATURE REVIEW

Dr. N. Arunachalam, (2012) carried out study on lightweight concrete (LWC) of density 1700 kg/m^3 to 1800 kg/m^3 with different aluminium powder content. Aluminium powder was added at 0.2% to 0.8% by weight of cement. The ultimate strength of LWC thus obtained was of the range between 3N/mm^2 – 10.5N/mm^2 for different aluminium powder content. Addition of more than 0.2% of aluminium powder reduced the compressive strength drastically. Indu Susan Raj (2014) carried out a study to produce a light weight concrete for developing masonry block. Six dosages of aluminum powder (0.1, 0.2, 0.5, 1, 2 and 5%) by weight of cement were used to produce aerated (gas) concrete. The wet and dry densities were observed. Addition of more than 5% aluminium powder reduced the compressive strength and densities drastically.

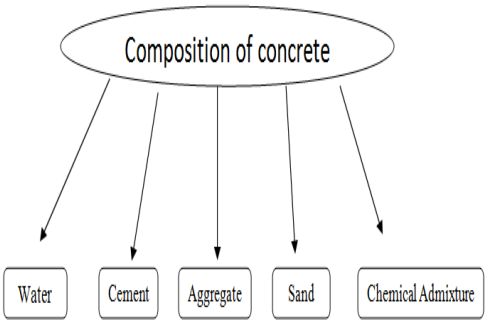
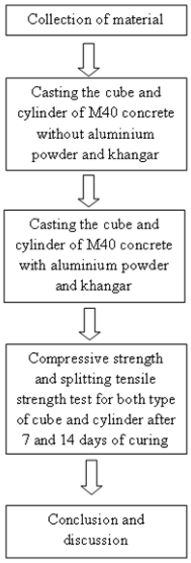


Fig 1. Composition of concrete

Selvaraj (2015) carried out a study on gas concrete which falls under the category of light weight concrete. Aluminium powder (0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1% and 1.1%) by weight of cement was mixed in cement mortar 1:3 at certain rations with and without alkali solutions to study volume and void increase in mortar, the optimum percentage is concluded as 1% of aluminium powder by weight of cement. Balaji B and Sathyakumar N (2016) carried out a study on high strength light weight concrete compared to the normal light weight concrete. Five dosages of aluminium powder (0%, 0.25%, 0.50%, 0.75%, and 1%) by weight of cement were used to produce light weight concrete. Revathy .S and Josina Thomas (2016) carried out a study by combining the advantages of LWC and SCC. The characteristics of three types of LWSCC, which were produced using fine pumice stone powder in one mix, aluminium powder in second mix and for third mix containing both pumice and aluminium powder was studied. Results concluded that aluminium powder met the requirements for structural applications.

METHODOLOGY

The flow chart for the methodology is shown below:



EXPERIMENTAL WORK

List of experiments conducted on concrete

- Impact test
- Slump test
- Compressive strength test
- Tensile split strength test

Materials used in concrete

Fig 2: Materials used for making concrete

Aluminium Powder

Aluminum powder shown in fig. 3 is powdered aluminum. This is originally produced by mechanical means using a stamp mill to create flakes. Subsequently, a process of spraying molten aluminum to create a powder of droplets is developed by E. J. Hall in the 1920s. The resulting powder might then be processed further in a ball mill to flatten it into flakes for use as a coating or pigment.

Fig. 3. Aluminium Powder

Physical and Chemical Properties of Aluminium Powder

Molecular Formula: Al

Form: Powder
Color: Silver
Melting point: 660^{o} C (1220^{o} F)
Boiling point: 2467^{o} C (4473^{o} F)
Density: 2.7g/ml at 25^{o} C (77^{o} F)
Ignition Temperature: 760^{o} C (1400^{o} F)
Auto Ignition Temperature: Catches fire spontaneously if exposed to air.
Odour: Odourless

Khangar

Khangar is waste product of fire insulated bricks. Materials in the khangar are fly ash, cement, sodium phosphate and air entraining agent. The khangar can be used in side walls, partition walls, roof, floor and also as filling material.

Fig. 4 Khangar Blocks

Grade and water-cement ratio used for concrete

Grade of concrete

In this study mix design of M40 grade of concrete is done using IS 10262(2009) that gives mix proportion of 1:1.15:2.5 with water cement ratio 0.43.

Slump test

Fig. 5. Slump cone of concrete

Compressive strength test

Fig. 6. Cube mould with concrete

Fig. 7. Cubes and cylinder remoulded after one day

Split Tensile Strength Test

Fig.8. Cylinder mould

Fig.9. Concrete cylinder with crack

RESULTS OF EXPERIMENTS

Result of impact test

A.For 60% khangar and 40% aggregate, impact value = 71.87%
B.For 50% khangar and 50% aggregate, impact value = 62.5%
C.For 40% khangar and 60% aggregate, impact value = 39.37%
D.For 30% khangar and 70% aggregate, impact value = 27.5%
30% khangar and 70% aggregate is used for the study because this would give satisfactory result.

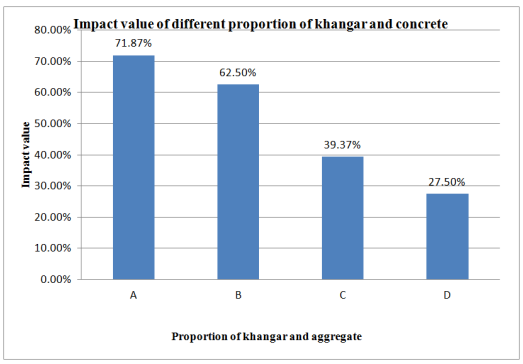


Fig 10 : Graph for impact value of different proportion of khangar and concrete

Result of slump test

- Slump of M40 concrete = 24 cm
- Slump of M40 concrete with 0.11% aluminium powder = 25 cm

- Slump of M40 concrete with 0.05% of aluminium powder = 22 cm
- Slump of M40 concrete with 0.02% aluminium powder = 22 cm
- Slump of M40 concrete with 30% khangar and 70% aggregate = 23 cm
- Slump of M40 concrete with 30% khangar and 70% aggregate and with 0.05% aluminium powder = 22 cm

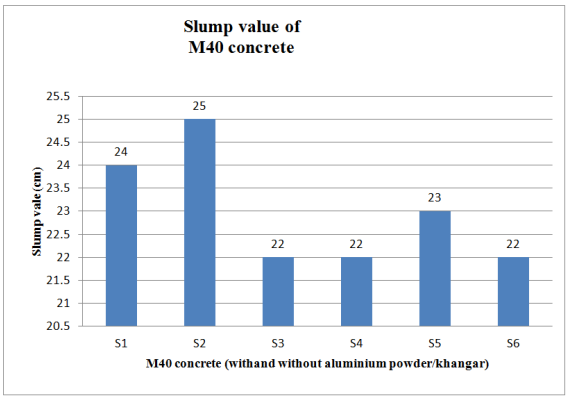


Fig. 11. Graph for slump values of M40 concrete

Where;

S1 = Slump of M40 concrete
S2 = Slump of M40 concrete with 0.11% aluminium powder
S3 = Slump of M40 concrete with 0.05% of aluminium powder
S4 = Slump of M40 concrete with 0.02% aluminium powder
S5 = Slump of M40 concrete with 30% khangar and 70% aggregate
S6 = Slump of M40 concrete with 30% khangar and 70% aggregate and with 0.05% aluminium powder

COMPARISON BETWEEN RESULTS

Comparison between compressive strength of different M40 concrete (with and without aluminium powder/khangar)

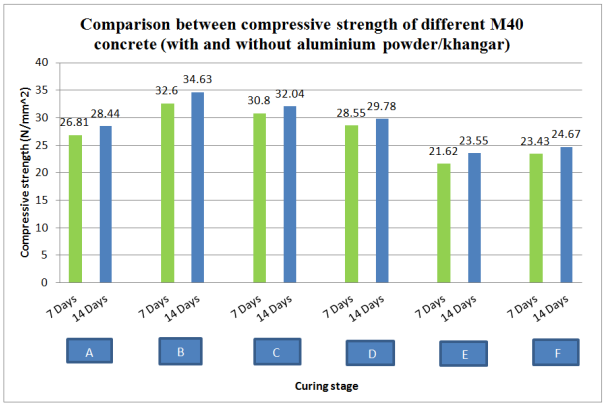


Fig. 12. Graph for comparison between compressive strength of different M40 concrete (with and without aluminium powder/khangar)

Where;
A = Compressive strength of M-40 concrete after 7 and 14 days of curing
B = Compressive strength of M-40 concrete with 0.11% of aluminium powder after 7 and 14 days of curing
C = Compressive strength of M-40 concrete with 0.05% of aluminium powder after 7 and 14 days of curing
D = Compressive strength of M-40 concrete with 0.02% of aluminium powder after 7 and 14 days of curing
E = Compressive strength of M-40 concrete with 30% khangar and 70% aggregate after 7 and 14 days of curing
F = Compressive strength of M-40 concrete with 30% khangar and 70% aggregate and with 0.05% 0f aluminium powder after 7 and 14 days of curing

Comparison between splitting tensile strength of different M40 concrete (with and without aluminium powder/ khangar)

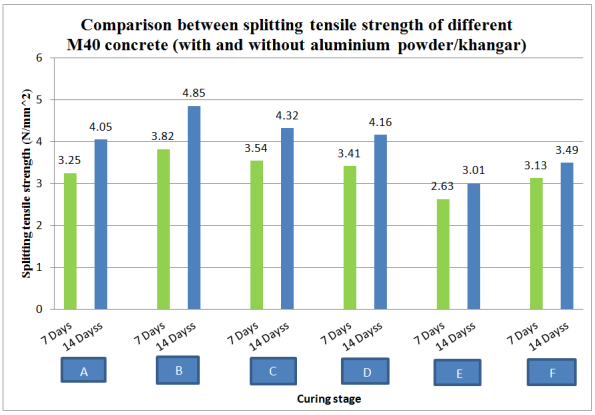


Fig.13. Graph for comparison between splitting tensile strength of different M40 concrete (with and without aluminium powder/khangar)

Where;

A = Splitting tensile strength of M-40 concrete after 7 and 14 days of curing
B = Splitting tensile strength of M-40 concrete with 0.11% of aluminium powder after 7 and 14 days of curing
C = Splitting tensile strength of M-40 concrete with 0.05% of aluminium powder after 7 and 14 days of curing
D = Splitting tensile strength of M-40 concrete with 0.02% of aluminium powder after 7 and 14 days of curing
E = Splitting tensile strength of M-40 concrete with 30% khangar and 70% aggregate after 7 and 14 days of curing
F = Splitting tensile strength of M-40 concrete with 30% khangar and 70% aggregate and with 0.05% 0f aluminium powder after 7 and 14 days of curing

CONCLUSION AND DISCUSSION

On the basis of above results (Fig. 12 & 13) it can be concluded that with increase in the percentage of aluminium powder in concrete the compressive and split tensile strength of concrete increases but using 30% khangar in concrete the compressive and split tensile strength of concrete is not affected. Using 30% khangar with 0.05% of aluminium powder the compressive and split tensile strength is affected but very little. Overall it can be concluded that as the percentage of aluminium powder increases the compressive strength and split tensile strength also increases but khangar alone is not able to affect the compressive and split tensile strength of concrete. Using khangar with some percentage of aluminium powder will affect the compressive and split tensile strength of concrete.

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