STUDIES ON THE MECHANICAL STRENGTH PROPERTIES OF THE METAKAOLIN CONCRETE

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ABSTRACT:- The utilization of industrial waste products released by industrial processes has been the focus of waste reduction research for economic and technical reasons. In coal fired power plants, flyash is generally captured by electrostatic precipitators. Burning pulverized coal in electric power generating plants flyash is a by-product. It can be used as a cement replacement material. In this study dealing with concrete incorporating flyash and metakaolin and fibre replacing ordinary Portland cement in concrete with various percentages of flyash and constant percentage of metakaolin. Tests were conducted to study the strength of hardened concrete such as compressive strength, flexural strength, split tensile strength. Test results indicated that the use of flyash and metakaolin as partial replacement of cement resulted in improvement in mechanical strength and can be effectively used in structural concrete. Conventional concrete which possess strain capacity 0.1% where fibre concrete reinforced micromechanically designed fibres [2] selecting a type of fibre polyvinyl alcohol fibre was low cost and high performance hence it is also a eco-friendly cement reinforced material[4].

Keywords: Flyash (FA), metakaolin (MK), Fibre.

1. INTRODUCTION

Fibre reinforced concrete can keep on resisting much amount of loads even at deflection. The characteristics and behaviour of fibre reinforced concrete depends on matrix properties such as material, fibre concentration, fibre geometry, fibre orientation, fibre distribution [1]. The new additives flyash and fibres which is practised in recent times was found to be satisfactory. Flyash is the pozzolanic property called as coal ash or fuel ash it is grey in colour. Flyash is the by-product from the coal industry these waste disposal flyash plays a significant role in reducing the pollution in the environment. Class f flyash is manufactured by burning harder with bituminous coal [3]. Cement based materials have been widely used for various type of structures, includes bridges, dams, and skyscrapers. Strain, stress, crack and damage be detected by measuring the electrical signals of cement based composite [5]. The design of the cement matrix with special ingredients to make it perfect compatibility with the fibres and to increase flexibility [6]. Recron 3s improves homogeneity of the concrete by decreasing the segregation of aggregates [7]. AR glass fibre which is low in volume fraction which possess extensive strain hardening [8]. Fibre reinforced concrete which is also engineered cementitious concrete is a class of ultra-ductile fibre reinforced cementitious composites [9]

2. MATERIALS

2.1 Course aggregate

The crushed granite stone aggregates used were 20mm nominal size and are tested as per Indian standards and results are within permissible limits. The specific gravity of course aggregate is 2.67

2.2 Fine aggregate

Manufacture sand namely m-sand is an excellent substitute of river sand for concrete construction. Manufacturing sand is produced by crushing hard granite stone crushing. The cleaned fine aggregate was tested for various properties such as specific gravity, fineness modules and sieve analysis and are conforming to standard specification. The sand used conform to grading zone II of IS 383:1970

2.3 Cement

Ordinary Portland cement of grade 53 confirming to IS 8112:1989 was used. The specific gravity of cement is 3.15.

2.4 Flyash

Class F type flyash used which is grey in colour and it is one of the waste materials released from the power plants can be used as a replacement for fillers and available in low cost.

2.5 Metakaolin

Metakaolin is off-white and it is manufactured amorphous alumina-silicate with excellent physical, chemical and pozzolanic properties. The specific gravity of metakaolin is 2.5. Metakaolin (air entraining admixture). It improves compressive and flexural strength and decreases bleeding and it is also eco-friendly because of less carbon dioxide emission.

2.6 Water

Water available in the college campus conforming to the requirements of water for concreting and curing as per as IS: 456-2009.

2.7 Recron fibre

Recron fibre offers millions of fibres which support concrete in all direction. The cut length of recron fibre is 12mm and having approximate 320 as aspect ratio. The diameter of recron fibre as per seller provided is 0.4mm and circular in shape .use of uniformly dispersed recron 3s fibres reduces segregation and bleeding, resulting in a more homogeneous mix

3. MIX PROPORTIONS

Mix proportions for M30 grade concrete

Water cement ratio 0.40

Mix designation	Conventional Concrete	Metakaolin, flyash	Metakaolin, flyash	Metakaolin, flyash	Metakaolin, flyash
Metakaolin %	0	5	5	5	5
Flyash %	0	0	10	15	20
Fibre %	1	1	1	1	1
Cement (kg/m³)	360	342	306	288	270
Metakaolin (kg/m³)	0	18	18	18	18
Flyash (kg/m³)	0	0	36	54	72
Fine aggregate (kg/m³)	629	629	629	629	629
Course aggregate (kg/m³)	1223	1223	1223	1223	1223
Water (kg/m³)	144	144	144	144	144
Fibre (kg/m³)	3.6	3.6	3.6	3.6	3.6

4. CASTING OF SPECIMEN

For compressive strength of concrete, cubes were casted in the size of 150*150*150mm. for tensile strength of the concrete; cylinder was casted in the size of 30cm in length and 7.5cm in dia. For flexural strength of the concrete, prism were casted in the size of 100*100*500mm.

Test on concrete

4.1 Compressive strength

The compressive strength testing was done as per as IS 516:1959 by using 150mmx150mm cube specimen. For each mix; specimens were tested for compressive strength at 28 days respectively.

4.2 Tensile strength

Tensile test involves compressing a cylinder on its side until a crack forms down the middle, causing failure of the specimen. The split tensile strength tests were done on cylindrical specimens of size 75mmx150mm for each mix; specimens were tested for split tensile strength at 28 days respectively.

5. RESULTS AND DISCUSSION

Table 5.1

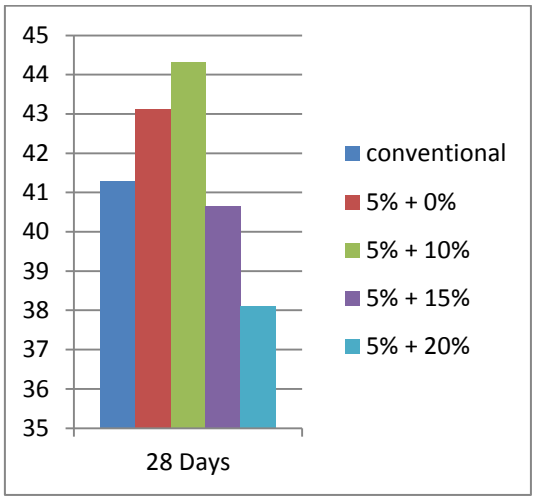
mix	28 days compressive strength (MPa)
Normal concrete	41.28
Metakaolin-5%, flyash-0%	43.12
Metakaolin-5%, flyash-10%	44.31
Metakaolin-5%,flyash-15%	40.16
Metkaolin-5%,flyash-20%	38.12

Table 5.2

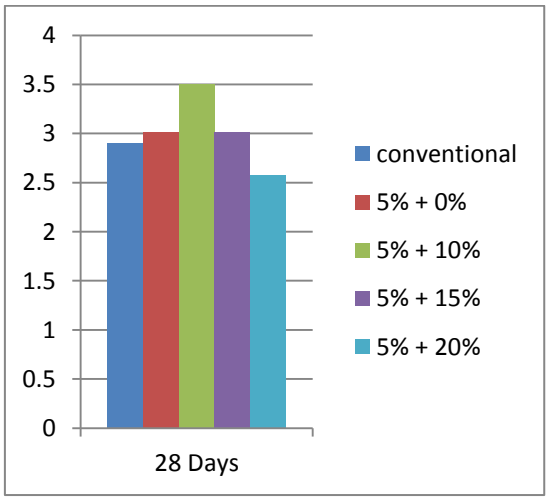
mix	28 days tensile strength (MPa)
Normal concrete	2.9
Metakaolin-5%, flyash-0%	3.01
Metakaolin-5%, flyash-10%	3.5
Metakaolin-5%,flyash-15%	3.2
Metkaolin-5%,flyash-20%	2.57

From graph 5.3and 5.4 it was observed that the compressive strength and tensile strength increases as the flyash percentage is increased up to 10% replacement. After replacement of 10% compressive strength is gradually decreased. Hence we conclude that the increasing more than 10% decreases the strength properties of the concrete.

5.3 COMPARISON OF COMPRESSIVE STRENGTH TEST RESULTS



5.4 COMPARISON OF TENSILE STRENGTH TEST RESULTS



6. CONCLUSIONS

- The test results show that the workability of the modified concrete with flyash 10% when metakaolin percentage is kept constant. So the use of superplasticizer is not essential
- The replacement of cement with flyash and metakaolin increases the compressive strength and split tensile strength up to 15%
- The workability aspect of recron fibre concrete is an appreciable issue as satisfactory workability is observed without use of any superplasticizer
- Usage of fibre will reduce the cost of maintenance by reducing the microcracks and it also reduces the segregation
- Addition of recron fibre to the fresh concrete significantly increases the tensile strength hardened properties of the concrete.

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