AN EXPERIMENTAL INVESTIGATION ON PROPERTIES OF CONCRETE BY ADDITION OF FLYASH

S.Venkada Priya[1], S.Aishwarya[2]

[1]*Assistant Professor, Department of Civil Engineering, Velammal College of Engineering and Technology, Madurai, Tamil Nadu, India*
[2]*P.G. Student, Department of Structural Engineering, Vickram College of Engineering and Technology, Madurai, Tamil Nadu, India*

Abstract:
This experimental investigation on mixture of concrete with admixture and fly ash by reducing the volume of cement and water content with fly ash admixture respectively. This experiment presents the effect of mixture of fly ash and mono vinyl alcohol admixture on various properties of concrete such as compressive strength, tensile strength, workability and fracture properties with various contents of fiber (0%, 0.5%, 1.0%, 1.5%).The result of this investigation indicates that by adding of mono vinyl alcohol and fly ash shows maximum compressive and tensile strength.

Key words: ***mono vinyl alcohol M30concrete, addition of poly carboxyl ether, maximum strength, increasing post cracking response, improves energy absorption.***

1. INTRODUCTION

Concrete has better resistance in compression while steel has more resistance in tension. Conventional concrete has limited ductility, low impact and abrasion resistance and little resistance to cracking. A good concrete must possess high strength and low permeability. Hence, alternative composite materials are gaining popularity because of ductility and strain hardening. To improve the post cracking behavior, short discontinuous and discrete alcohol are added to the plain concrete. Addition of alcohol improves the post peak ductility performance, pre- cast tensile strength, fracture strength, toughness, impact resistance, flexural strength resistance, fatigue performance etc.

For many years, steel in the form or bars or mesh (also known as "re-bar") has been used as reinforcement for concrete slabs that are designed to experience some form of loading, whether that loading would be carrying traffic, spanning a void or bearing another structure such as a wall. In many slabs, steel mesh has been used a crude (and often ineffective) method of crack control. Latest developments in concrete technology now include reinforcement in the form of alcohol, notably polymeric alcohol, as well as steel or glass alcohol 1-5. Fiber-reinforcement is predominantly used for crack control and not structural strengthening. Although the concept of reinforcing brittle materials with alcohol is quite old, the recent interest in reinforcing cement-based materials with randomly distributed alcohol is quite old; the recent interest in reinforcing cement based materials with randomly distributed alcohol is based on research starting in the 1960's. Since then, there have been substantial research and development activities throughout the world.

2. MATERIALS

2.1 CEMENT

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel together. Cement mixed with fine aggregate produces mortar for masonry, or withsand and gravel, produces concrete. Cement is the most widely used material in existence and is only behind water as the planet's most-consumed resource.
Cements used in construction are usually inorganic, often lime or calcium silicate based, and can be characterized as either hydraulic or non-hydraulic, depending on the ability of the cement to set in the presence of water.

2.2 FINE AGGREGATE

The fine aggregate sample taken for study and physical properties of fine aggregate. Both river sand and crushed stones may be used. Coarser sand may be preferred as finer sand increases the water demand of concrete and very fine sand may not be essential in High Performance Concrete as it usually has larger content of fine particles in the form of cement and mineral admixtures such as fly ash, etc. The sand particles should also pack to give minimum void ratio as the test results show that higher void content leads to requirement of more mixing water.

2.3 COURSE AGGREGATE:

Coarse aggregates are components found in many areas of the construction industry. They have structural uses such as a base layer or drainage layer below pavements and in mixtures like asphalt and concrete. This lesson explores the various types of coarse aggregates.

The coarse aggregate sample taken for study and the physical properties of coarse aggregate. For coarse aggregate, crushed 12mm normal size graded aggregate was used. The specific gravity and water absorption of coarse aggregate were found to be 2.68 and 1.0%, respectively. The grading of coarse aggregate conforms to the requirement as per IS: 383 – 1970.The coarse aggregate is the strongest and least porous component of concrete. Coarse aggregate in cement concrete contributes to the heterogeneity of the cement concrete and there is weak interface between cement matrix and aggregate surface in cement concrete. By usage of mineral admixtures, the cement concrete becomes more homogeneous and there is marked enhancement in the strength properties as well as durability characteristics of concrete. The strength of High Performance Concrete may be controlled by the strength of the coarse aggregate, which is not normally the case with the conventional cement concrete.

2.4 WATER

Water is an important ingredient of concrete as it actively participates in the chemical reactions with cement. The strength of cement concrete comes mainly from the binding action of the hydrated cement gel. The requirement of water should be reduced to that required for chemical reaction of unhydrated cement as the excess water would end up in only formation of undesirable voids in the hardened cement paste in concrete. From High Performance Concrete mix design considerations, it is important to have the compatibility between the given cement and the chemical/mineral admixtures along with the water used for mixing.

2.5 MONO VINYL ALCOHOL

A micro fluidic platform was used to fabricate continuous and non-rounded mono vinyl alcohol (MVA) microalcohol. We showed that the size and cross-section of the MVA fibres can be controlled by changing the MVA concentration in dimethyl sulfoxide (DMSO) and flow rate ratio between the core and sheath fluids. The MVA concentration was varied from 6% to 12%, and the sheath-to-core flow rate ratio used for this study was in the range of 500 : 5 to 500 : 20. The aspect ratio of the fibres became larger when the MVA concentration increased and the flow rate ratio decreased. Additionally, we simulated the micro fluidic fibre fabrication process and the results were consistent with the experimental results. The dissolution of the MVA fibres fabricated with different characteristics was also studied. It was shown that increasing the MVA concentration and decreasing the flow rate ratio increased the dissolution time of the alcohol in DI water. A tensile test was conducted to obtain the stress–strain curves for different types of alcohol. The results showed that a wide range of mechanical properties can be achieved by changing the PVA concentration and the flow rate ratio. The increase of MVA concentration from 6% to 12% enhanced the tensile stress at break and Young's modulus by a factor of 4.9 and 2.02, respectively. The mechanical strength of the alcohol was shown to drop when the flow rate ratio decreased. The 3rd generation can even be used with no slump concrete (0.29 – 0.31 w/c), and the slump is increased to more than 250 mm. Concrete possessing slump above 225 – 250 mm is called 'rheoplastic'. Super plasticizing admixtures are prone to slump retention problems. The efficient dispersion of cement and reduced surface tension of water leads to hydration of cement, which in turn causes the diminishing of the electrostatic charge, and flocculation occurs.

Fig-1: MONO VINYL ALCOHOL

2.6 NEED FOR MONO VINYL ALCOHOL:

Concrete develops micro cracks with curing and these cracks propagate rapidly under applied stress resulting in low tensile strength of concrete. Hence addition of alcohol improves the strength of concrete and these problems can be overcome by use of Polypropylene alcohol in concrete.

Application of Mono vinyl alcohol provides strength to the concrete while the matrix protects the alcohol. The primary role of fibres in a cementitious composite is to control cracks, increase the tensile strength, toughness and to improve the deformation characteristics of the composite. The performance depends on the type of the alcohol used. Inclusion of Mono vinyl alcohol reduces the water permeability, increases the flexural strength due to its high modulus of elasticity. In the post cracking stage, as the alcohol are pulled out, energy is absorbed and cracking is reduced.

Mono vinyl alcohol are versatile and widely used in many industrial applications such as ropes, furnishing products, packaging materials etc.

3. MIX DESIGN FOR M25 GRADE CONCRETE

Table-1: MATERIALS REQUIRED AS PER IS METHOD OF DESIGN

Quantity of material (kg/m³)					
Flyash	Cement	Fine aggregate	Coarse aggregate	Water	Chemical admixture
1.05	5.87	12.61	19.28	2.52	0.069

The properties of materials used are

- Specific gravity of cement =2.87
- Specific gravity of fine aggregate =2.63
- Specific gravity of coarse aggregate =2.70

3.1 EXPERIMENTAL PROGRAMME

The following tests were made after 28 days curing:

- Workability test
- Compressive strength test
- Split tensile strength test,

3.1.1 Workability test

3.1.1.1 Slump cone test

The concrete slump test is an empirical test that measures workability of fresh concrete. The test measures consistency of concrete in that specific batch. It is performed to check consistency of freshly made concrete. Consistency refers to the case with test is popular due to the simplicity of apparatus used and simple procedure. Unfortunately, the simplicity of the test often allows a wide variability in the manner in which the test is performed. The slump test is used to ensure uniformly for different batches of concrete under field conditions, and to ascertain the effects of plasticizers on their introduction. Metal mould, in the shape of the frustum of a cone, open at both ends, and provided with the handle, top internal diameter 100mm, and bottom internal diameter 200mm with a height of 300mm.

Fig- 2: Slump test

The slumped concrete takes various shapes, and according to the profile of slumped concrete, the slump is termed as the true slump, shear slump or collapse slump is achieved, a fresh sample should be taken and the test repeated. A collapse slump is an indicated of too wet a mix or that it is a high workability mix, for which the slump test is not appropriate. Very dry mixes having 10 -40mm are used for foundation with light reinforcement, medium workability mixes, 50 – 90 mm for normal reinforcement concrete placed with vibration , high workability concrete > 100mm.

3.1.2 Compressive strength test

This test method covers the deformation of cube compressive strength concrete specimen. The specimen is prepared by pouring freshly mixed concrete into lubricated cube moulds. Consolidation is done extremely over vibrating table for 1-2 minutes. After vibration and finishing, the moulds are kept at normal atmosphere conditions for 231/2 ± ½ hours after which demoulding is done. The specimen are then cured in water tank.

Fig -3: Compressive Strength Testing Arrangement

The test is conducted at surface dry condition. The specimen is tested at the age for 28 days of curing under the compression testing machine.

$$\text{Compressive strength} = \frac{\text{Maximum load at failure X1000}}{\text{Loaded surface area}}$$

The tests were carried out on a set of triplicate specimen and the average compressive strength values were taken.

3.1.3 Split tensile strength test

Splitting tensile strength test was conducted on concrete cylinders to determine the tensile nature of carbon black concrete. The wet specimen was taken from water after 28 days of curing. The surface of specimen was wiped out. The weight and dimensions of the specimen was noted. The cylinder specimen was placed on compression testing machine. The load was applied. The test consist of applying a compressive line load along the opposite generators of a concrete cylinder placed with its axis horizontal between the compressive plates. Due to the compression loading a fairly uniform tensile stress is

developed over nearly 2/3 of the loaded diameter as obtained from an elastic analysis.

Split tensile strength =2P /(Πdl)

Table 4: SPLIT TENSILE STRENGTH AT 28 DAYS

% of Polypropylene Fiber	Sample 1	Sample 2	Sample 3	Average
0%	2.82	2.97	3.04	2.94
0.5%	3.11	2.97	3.18	3.08
1%	3.25	3.32	3.11	3.23
1.5%	3.39	3.53	3.46	3.46
2%	3.53	3.61	3.67	3.60

Fig -4: Split Tensile Strength Testing Arrangement

4. RESULT AND DISCUSSION

Table 1: COMPRESSIVE STRENGTH AT 7 DAYS

% of Polypropylene Fiber	Sample 1	Sample 2	Sample 3	Average
0%	15.56	15.11	15.33	15.33
0.5%	19.78	19.55	19.11	19.48
1%	22.67	23.11	22	22.59
1.5%	24	24.22	23.55	23.92
2%	25.78	24.89	25.11	25.26

Table 2: COMPRESSIVE STRENGTH AT 28 DAYS

% of Polypropylene Fiber	Sample 1	Sample 2	Sample 3	Average
0%	28.89	28.44	29.11	28.8
0.5%	30.22	30.44	29.77	30.14
1%	33.33	32.89	33.55	33.25
1.5%	34.67	34.89	33.78	34.45
2%	36.44	36.67	36.44	36.52

Table3: SPLIT TENSILE STRENGTH AT 7 DAYS

% of Polypropylene Fiber	Sample 1	Sample 2	Sample 3	Average
0%	1.69	1.83	1.62	1.71
0.5%	1.84	1.69	1.76	1.76
1%	1.91	1.98	2.05	1.98
1.5%	2.12	2.19	1.98	2.09
2%	2.3	2.41	2.26	2.32

5. CONCLUSIONS

Based on the experimental investigation, the following findings are observed.

- Adding of polypropylene fiber 2% gives the maximum value
- 2% of polypropylene fiber improves the compressive strength values up to 21% when compared with the conventional concrete.
- 2% of polypropylene fiber improves the split tensile strength values up to 18% when compared with the conventional concrete.
- It shows the effective results so it reduces the cost of steel in construction

- From these results use of polypropylene fiber in low cost composites for civil infrastructure provide good mechanical properties at lower cost of polypropylene fiber.

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BIOGRAPHIES

S.VENKADA PRIYA M.E.,
Assistant Professor,
Department of Civil Engineering,
Velammal College of Engineering and
Technology, Madurai, Tamil Nadu.

S.AISHWARYA.M.E.,
PG Scholar of Structural Engineering,
Department of Civil Engineering,
Vickram College of Engineering,
Madurai, Tamil Nadu.