HIGH PERFORMANCE CONCRETE (M50 GRADE) USING ORGANIC MIXTURE

MIYAPURAM PRAVEEN KUMAR
14C71D2015, M.Tech (Civil - Structural Engineering), Ellenki College of Engineering & Technology

SOUNDHARYA
Assistant Professor
Ellenki College of Engineering & Technology

ABSTRACT

Long term performance of structures has become vital to the economics of all nations. Concrete has been the major instrument for providing stable, reliable infrastructures. Deterioration, long term poor performance and inadequate resistance to hostile environment coupled with greater demands for more sophisticated architectural form, led to research into the micro structures of cements and concretes and more elaborate codes and standards. Modification in cement concrete to improve its strength and durability is need of the hour. Drawbacks of cement concrete such as low tensile strength, susceptibility to chemical attack, corrosion of reinforcement and low durability have to be overcome.

The use of blended cement is becoming common in these days owing to attempts made by the researchers in the direction of utilization of materials, which are available in nature abundantly. The new admixture 'fenugreek' is one such organic material, which is tried in recent times found to be satisfactory. While, there is much to be done in order to standardize the properties of the admixture. An attempt is made in the present work to investigate the influence of this admixture on the compressive strength of concrete. The experimental study of this investigation consists of concrete mix for target mean strength. The mix was worked out giving certain proportions by keeping the obtained water-cement ratio constant. The mix is obtained with water-cement ratio 0.3. For this mix the different percentages of admixtures was added i.e., 0%, 0.1%, 0.2%, 0.3%, 0.4%, 0.5% by weight of cement. These percentages were added in cement mortar 1:3 ratio, specimens were tested up to failure to study the behavior in compression.

INTRODUCTION

Advances in cement and concrete research are continuous and ongoing. Despite advances in the production of accelerated-setting and high-strength cement, the development of Portland cement with varying controlled setting times and high compressive strength and higher rate of strength development would be highly beneficial to the cement and the construction industries, especially in the area of new materials, admixtures, reduced usage of cement, self-curing concrete, self-compacting concrete, economical production of concrete. For example producing ready mix concrete transportable to longer distance, enhancing initial setting time beyond thirty minutes, will revolutionize construction industry, enabling quality construction practices in inaccessible places. Reduced usage of water in concrete preparation and curing could be yet another far reaching global research effort. While achieving the above objectives, concrete durability and strength requires to be enhanced.

The performance of concrete both short and long term is being in greater research in the recent years. In these conditions, ordinary concrete may fail to exit the required quality or desirability. In such cases admixtures are used to modify the

properties of ordinary concrete so as to make it more suitable as per the requirements.

A performance enhanced concrete or high performance concrete is a specialized series of concrete designed to provide several benefits in the construction of concrete structures that cannot always be achieved routinely using conventional constituents, normal mixing and curing practices. In other words a high performance concrete is a concrete in which certain characteristics are developed for a particular application and environment, so that it will give excellent performance in the structure in which it will be placed, in the environment to which it will be exposed, and with the loads to which it will be subjected during its design life. It includes concrete that provides either substantially improved resistance to environmental influences (durability in service) or substantially increased structural capacity while maintaining adequate durability. It may also include concrete, which significantly reduces construction without compromising long term serviceability. It is, therefore, not possible to provide a unique definition of high performance concrete without considering the performance requirements of the intended use of the concrete. Examples of characteristics that may be considered critical in an application requiring performance enhancement are, ease of placement and compaction without segregation, early age strength, long-term mechanical properties, permeability, density, heat of hydration, toughness, volume stability and long life in severe environments, i.e. durability. Concretes possessing many of these characteristics often achieve higher strength. High performance concrete usually contains additional ingredients such as mineral and chemical admixtures as compared to conventional concrete. Thus, in practical applications of this type of concrete, the emphasis has in many cases gradually shifted from compressive strength to the other properties of the materials, such as high tensile strength, high modulus of elasticity, high density, low permeability and high resistance to some forms of attacks. The cost and other benefits derived may include less material, light weight and fewer structural elements, reduced maintenance, extended life cycle and aesthetics.

An admixture is defined as a chemical product, which is added to the concrete mix in quantities no larger than 5% by weight of cement .It is added to the batch immediately before or during mix for the purpose of achieving a specific modification, or modifications to the normal properties of concrete .Admixtures may be organic or inorganic in composition but their chemical character is an essential feature.

A concrete structure is built so as to last and give maintenance free service as far as possible during the life of structure. Long term behavior under service conditions and environmental effects has also become an important consideration in evaluating performance. The major

prescription for making durable concrete is to achieve and ensure good quality control at the material selection stage and also at the stage of concrete production. Accordingly, a number of parameters related to mix proportion of concrete properties of concrete such as permeability, air entrainment, water-cement ratio, workability, etc., become very important. In few situations, the cement characteristics have also got an influence on the durability of structure. Making concrete water tight i.e., impermeable to great extent is a primary requirement for durability of concrete.

Certain organic compounds (admixtures) are used in the concrete as workability agents. A new admixture called 'Fenugreek' comes under this category is used as workability agent to the mix designed with different percentages of admixture.

REVIEW OF LITERATURE

M.E. Prior and A.B. Adams in their paper, 'Introduction to producer's papers on water-reducing admixtures and set-retarding admixtures for concrete', have mentioned that the active components of admixtures are surface-active agents. There are substances, which are concentrated at the interface between two immiscible phases, and alter the physico-chemical forces acting at these interfaces. The substances are adsorbed on the cement particles giving them negative charge, which leads to repulsion between the particles and results in stabilizing their dispersion. Air bubbles are also repelled and cannot attach to the cement particles. In addition, the charges causes the development around each particle of a sheath of oriented water molecules, which prevent a close approach of the particles to one another .The particles therefore have a greater mobility and water freed from restraining influence of the flocculated system becomes available to lubricate the mixes, that the workability is increased.

R.E. Davis in his paper, 'A review of pozzalanic materials, and their use in concretes, symposium on use of pozzalanic materials in mortars and concrete', published in A.S.T.M special technical publication No. 99, PP 3-15 (1950) have mentioned that the influence of admixture on concrete as strength varies considerably with the composition of cement, the greatest increase in strength is occurring when the cement of low alkali or low Tri-Calcium Aluminate content are used. Some water reducing admixtures are more effective when used in mixes containing pozzolonas than in plain mixes.

Foster B. has studied the effect of water reducing and set-retarding admixtures on properties of concrete. He has mentioned that the reduction in the quantity of mixing water, that is possible owing to the use of admixtures, varies between 5% and 15 %. The actual decrease in the mixing water depends on the cement content, type of aggregates used, and presence of air entraining agents of pozzolonas.

S. Gopala Krishnan in his notes (Feb. 2000) mentions that the supplementary cementious materials (available in India) could be used in concrete mixtures to improve the permeation characteristics of concrete thereby enhancing its durability. Though judicious choice of water-binder ratio and use of supplementary cementious materials confirming to standards, it is possible to produce durable concrete having desired rate of strength development. High performance concrete is concrete, which meets special performance and uniformity requirements that cannot always be achieved using only the conventional materials and normal mixing, placing and curing practices. The performance requirements may involve enhancement of placement and compaction without segregation long term mechanical properties, early age strength, toughness, volume stability and service life. A high performance concrete element is that which is designed to give optimized performance characteristics for a given set of load, usage and exposure conditions consistent with requirement of cost, service life and durability. High performance concrete has high resistance to chemical attack.

Manoj K. Jain and S.C. Pal in their paper titled, 'Utilization of industrial slag in making high performance concrete composites', has given investigations on compressive strength development and corrosion resistance properties of high volume Ground Granulated Blast Furnace Slag (hereby referred to as 'GGBFS') concrete composites. They found that for water-cement ratio 0.25, the initial setting time shows an increase from 80 minutes for pure OPC to about 240 minutes for 70 percent GGBFS. Their results revealed that as far as strength is concerned 50 percent cement replacement by GGBFS showed best results, (10 to 15 percent more) even superior to the pure OPC concrete, but as far as durability is concerned 70 percent cement replacement by slag have given best results.

EXPERIMENTAL PROGRAMME

The investigation was carried on M_{50} grade concrete .The design mix has been done according to IS Code: 10262 - 1982. Required quantities of materials were calculated. Cement, sand, coarse aggregate and admixture were thoroughly mixed in dry state. Then the required percentage of water was added and mixed. The moulds were cleaned and all care was taken to avoid any irregular dimensions. The joints between the sections of mould were coated with mould oil and a similar coating of mould oil was applied between the contact surfaces of the bottom of the moulds and the base plate in order to ensure that no water escaped during the filling. The interior surfaces of the assembled moulds were thinly coated with mould oil to prevent adhesion of the concrete and for easy removal of the moulds after casting. Then the moulds were arranged on the vibrator platform for casting. The mix was placed in three layers; each layer was compacted using table vibrator to obtain dense concrete.

The samples were air dried for a period of 24 hours and then immersed in water. The specimens were tested for compressive strength on a Universal Testing Machine after 3rd, 7th, 14th and 28th days. The results were tabulated in the following chapter. For each category of concrete mix 12 cubes (150mm x150mm x 150mm) were casted (i.e., a total of 72 cubes).

RESULTS AND CONCLUSION

Compressive Strength Of Concrete For Different Percentages Of Admixtures For M_{50} Grade:

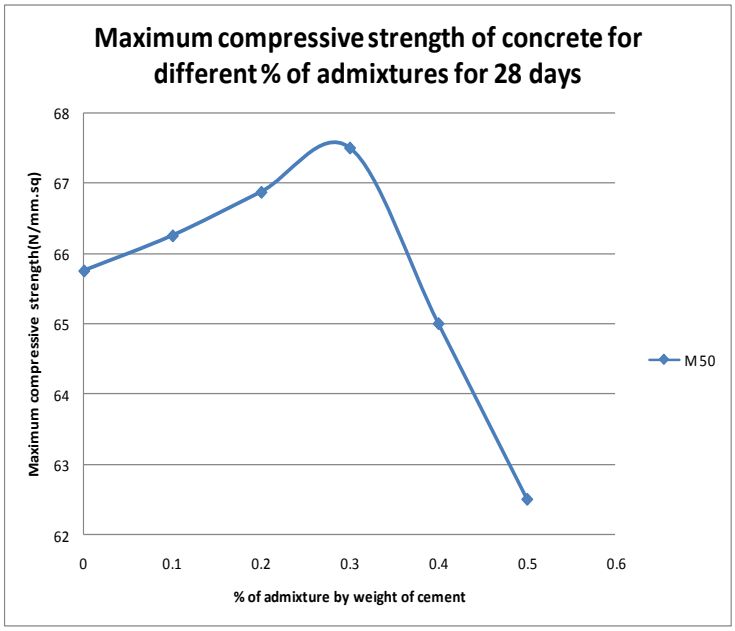
Percentage Of Admixture	3 DAYS N/mm^2	7 DAYS N/mm^2	14 DAYS N/mm^2	28 DAYS N/mm^2
0.0	30.63	34.38	42.34	65.75
0.1	30.00	35.00	47.25	66.25
0.2	30.00	35.25	45.50	66.87
0.3	31.25	35.00	48.65	67.50
0.4	28.25	33.75	46.60	65.00
0.5	27.50	32.50	49.31	62.50

Variation Of 7 Days/ 28 Days Strength For Various % Of Admixture For M_{50}:

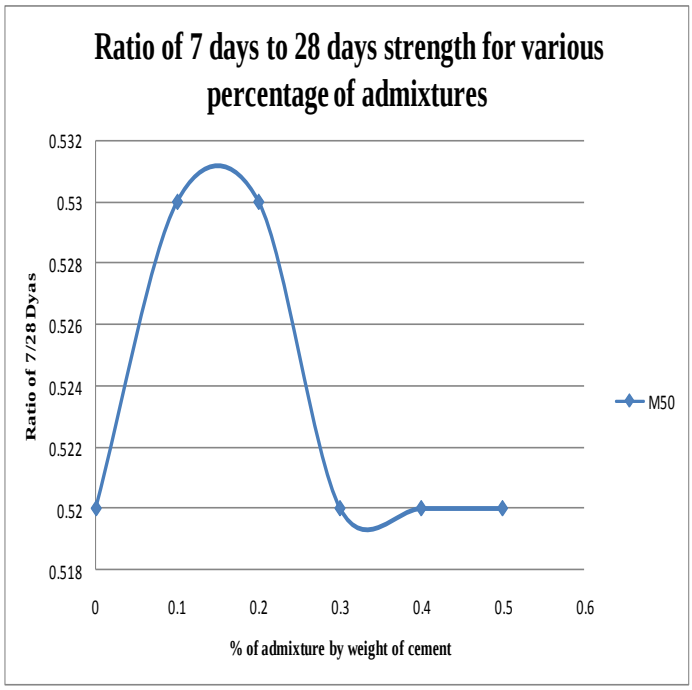
% OF ADMIXTURE	0	0.1	0.2	0.3	0.4	0.5
RATIO OF 7 DAYS/28 DADAYS	0.52	0.53	0.53	0.52	0.52	0.52

M50 cubes prepared with 0.4% admixture

GRAPH: 1



GRAPH: 2



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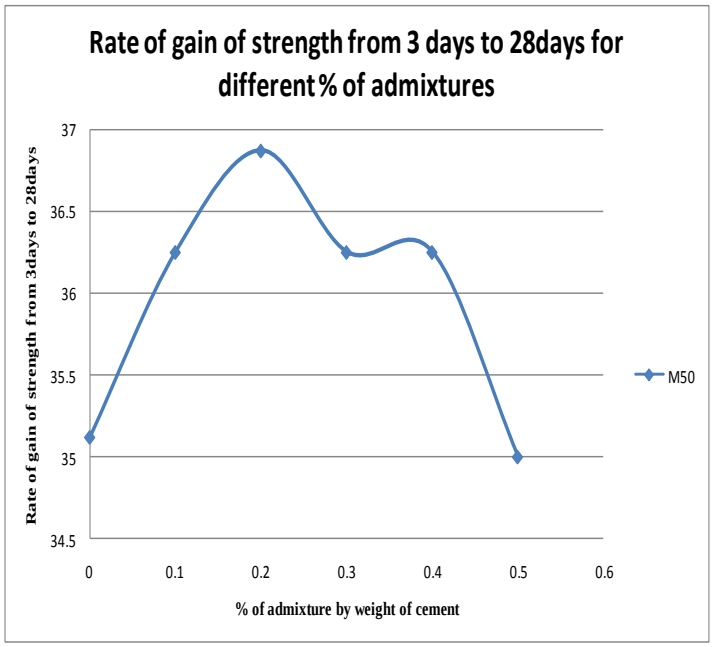

CONCLUSIONS:

- The maximum compressive strength of concrete is achieved at 0.3% of admixture
- The rate of gain of strength is maximum at 0.2% admixture and minimum at 0.5% admixture
- The ratio of 3/28 days' strength increases up to 0.3% of admixture and the decreases

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