



Effect on chemical compounds high-performance-concrete with water on setting time and workability

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Abstract

The strength of concrete is very much dependent upon the hydration reaction just discussed. Water plays a critical role, particularly the amount used. The strength of concrete increases when less water is used to make concrete. Water proofing compounds can be used to improve the pore structure of concrete and hence to reduce the water permeability of concrete. Nowadays, a number of waterproofing products are available in market which works on reduction of permeability of concrete. Few of them are required to be added while mixing the concrete ingredients and few others are applied on the concrete surface. The colour of groundmass changes with addition of micro-silica and it become dark in colour and confirm the increase in binding property of cementitious material. Reaction rim develops in case of cement with micro-silica. Binding material is more uniform in case of concrete with micro-silica than the concrete without micro-silica. The addition of micro-silica gives high strength, more durable and uniformly distributed binders in concrete.

Keywords: chemical compounds, high-performance-concrete, water, setting time

1. Introduction

Water is the key ingredient, which when mixed with cement, forms a paste that binds the aggregate together. The water causes the hardening of concrete through a process called hydration. Hydration is a chemical reaction in which the major compounds in cement form chemical bonds with water molecules and become hydrates or hydration products. Details of the hydration process are explored in the next section. The water needs to be pure in order to prevent side reactions from occurring which may weaken the concrete or otherwise interfere with the hydration process. The role of water is important because the water to cement ratio is the most critical factor in the production of "perfect" concrete. Too much water reduces concrete strength, while too little will make the concrete unworkable. Concrete needs to be workable so that it may be consolidated and shaped into different forms (i.e. walls, domes, etc.). Because concrete must be both strong and workable, a careful balance of the cement to water ratio is required when making concrete.

Aggregates are chemically inert, solid bodies held together by the cement. Aggregates come in various shapes, sizes, and materials ranging from fine particles of sand to large, coarse rocks. Because cement is the most expensive ingredient in making concrete, it is desirable to minimize the amount of cement used. 70 to 80% of the volume of concrete is aggregate keeping the cost of the concrete low. The selection of an aggregate is determined, in part, by the desired characteristics of the concrete. For example, the density of concrete is determined by the density of the aggregate. Soft, porous aggregates can result in weak concrete with low wear resistance, while using hard aggregates can make strong concrete with a high resistance to abrasion.

Concrete has many properties that make it a popular

construction material. The correct proportion of ingredients, placement, and curing are needed in order for these properties to be optimal.

Good-quality concrete has many advantages that add to its popularity. First, it is economical when ingredients are readily available. Concrete's long life and relatively low maintenance requirements increase its economic benefits. Concrete is not as likely to rot, corrode, or decay as other building materials. Concrete has the ability to be molded or cast into almost any desired shape. Building of the molds and casting can occur on the work-site which reduces costs.

Concrete is a non-combustible material which makes it fire-safe and able with stand high temperatures. It is resistant to wind, water, rodents, and insects. Hence, concrete is often used for storm shelters.

Concrete does have some limitations despite its numerous advantages. Concrete has a relatively low tensile strength (compared to other building materials), low ductility, low strength-to-weight ratio, and is susceptible to cracking. Concrete remains the material of choice for many applications regardless of these limitations.

In concrete silica fume acts as damp-proof, provides resistance from electricity and great strength. Due to these properties corrosion related issues can be solved. First properties prevent penetration of water, oxygen and chloride in steel electrode. Ionic conduction is reduced due to resistance of electricity. There are many strength concrete formed by pozzolans, which also contains silica fumes. This concrete is more sensitive as compared to Portland cement. During hot and dry weather when concrete is more exposed to dryness, it expels the moisture which is required for the continuation of pozzolanic reaction that can continue to occur beyond the water curing period. To examine the effect of curing, the strength of the

concrete and its characteristics of concrete skin which prevents the steel reinforcement should be taken into consideration. The objective of this work is to The object of the present work is to distinguish the silica fume concretes with the points of view of heat generation, shrinkage and sensitivity to curing, and to compare their performance with that of concretes made of Portland cement only, which having either the same cement components or the same water to cemented materials proportion.

Amudhavalli & Mathew (2012) [1] scrutinized concrete by mixing silica fume with concrete and examined the output with respect to strength and durability properties of concrete. The study experimented on M35 grade concrete and silica fume is replaced with cement in the percentage of 0, 5, 10, and 15 and by 20%. The study on characteristics of concrete like strength, split tensile strength and compressive strength was carried out for 7 days and 28 days. From the output it is demonstrated the use of silica fume in concrete has upgraded concrete strength and its durability.

Shanmugapriya & Uma (2013) [2] did an experiment on High Performance Concrete by replacing Silica Fume with Cement. The concrete with 60 Mpa target mean strength is used in the experiment. The ratio of water to cement 0.32 with Super Plasticizer named Conplast SP430. The specimens like beams, cubes and cylinders were cast for various doses of percentage and performed test at the age of 7, 14 and 28 days. The experimentation sates that the silica fumes will produce efficient compressive strength, flexure strength and split tensile strength by replacing silica with cement. The silica was used in 7.5% quantity when replaced with cement.

Hanumesh, Varun & Harish (2015) [3] also did research on the Mechanical Properties of Concrete including Silica Fume as Partial Replacement with Cement. The motive of this research is to examine the mechanical properties of M20 grade control concrete and silica fume concrete with four different percentages (5, 10, 15 and 20%) of silica fume as a replacement of cement. The end readings demonstrate that by replacing silica fume upto 10% compressive strength of concrete increases. With 10% the compressive strength and the split tensile strength of concrete declines. The optimal dose of silica fume in the form of percentage in concrete is 10% of the cement for M20 grade of concrete.

Ajileye (2012) [4] For M30 grade of concrete, silica fume up to 10% of cement is good to enhance the compressive strength of concrete. If at the 15% is used it decreases the compressive strength for 3, 7, 14 and 28 days curing period in concrete.

Pradhan and Dutta (2013) [5] analyzed the effects of silica fume on conventional concrete. The optimum compressive strength was gained at 20% cement replacement with silica fume at 24hours, 7days and 28 days. Higher compressive strength concludes that the concrete mixed with silica fume was high strength concrete.

Singh *et al.* (2017) [6] also did research on the Study of High Strength Concrete Using Microsilica. The experiment comprises four levels of silica-fume at the rate of 0%, 5.5%, 8.0%, 9.5% and 11.0% which results high strength concrete.

2. Experimental Investigation

1. **Cement:** Ordinary Portland cement of grade 53 was used. Laboratory test were conducted to determine the

properties of cement. The cement satisfies the requirements as per IS: 456-2000 [7].

2. **Fine aggregate:** Laboratory tests were conducted to determine different physical properties as per IS 3085-1965 [8].
3. **Coarse aggregate:** For proper gradation, combination of 12.5 mm and 20 mm aggregates are used. Laboratory tests were conducted to determine the different physical properties as per IS 3085-1965 [8].
4. **Mixing water:** Potable water used was free from injurious amount of oils, acids, alkalis, salts, organic materials or other substance that may be deleterious to concrete.

Table 1: Mix proportions

Materials	M-1	M-2	M-3
w/c ratio	0.37	0.37	0.37
Cement (kg)	511	485	470
Micro-silica (kg)	0	26	41
Water (kg)	191	191	191
Fine aggregate (kg)	568.32	565.22	563.0
Coarse aggregate (kg)	1175.2	1168.8	1165.6
Superplasticizer (litre)	4.39	6.58	7.68
Slump (mm)	95	100	85

5. **Micro-silica:** Micro-silica following parameters was used

Table 2: Parameters of micro-silica

Parameters	Specification	Analysis
SiO ₂	% Min 85.0	91.6
Moisture Content	% Max 3.0	0.9
Loss ignition	% Max 6.0	1.6
Carbon	% Max 2.5	0.8
Specific Surface	M ² /g Min 15	21.7
Bulk Density	Kg/m ³ 500-700	640

3. Results and Discussion

Following results of compressive strength and water absorption are drawn from the above experimental work.

Table 3: Compressive Strength of Different mix (N/mm²)

Mix Designation	7 Days	28 Days	60 Days	90 Days
M-1	31.66	40.86	44.63	46.23
M-2	32.41	43.32	48.82	52.41
M-3	33.89	45.94	50.10	54.75

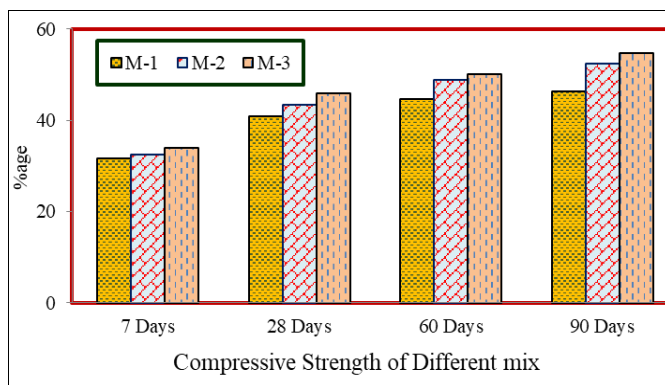
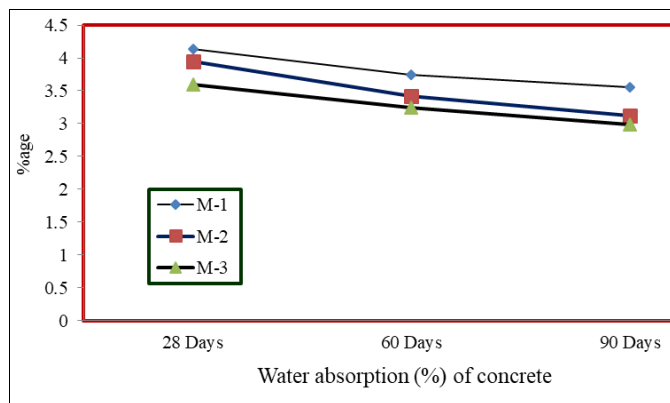


Fig 1

Table 4: Water absorption (%) of concrete

Mix Designation	28 Days	60 Days	90 Days
M-1	4.13	3.75	3.56
M-2	3.95	3.42	3.12
M-3	3.59	3.24	2.99

**Fig 2**

4. Conclusions

The amount of water required for normal consistency of cementations material increases with the increase of micro-silica percentage. Initial and final setting time of cementations material decrease with increase of micro-silica percentage. With the partial replacement of cement by micro-silica, it is found that the strength of cementitious material decreases with increase in content of micro-silica upto 28 days. However this difference reduces with age. The workability of concrete decreases with increase of the content of micro-silica. The compressive strength of concrete increases with increase of micro-silica, but after certain percentage the gain in strength starts decreasing. Water absorption decreases with increase of micro-silica in concrete.

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6. References

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