

EXPERIMENTAL INVESTIGATION ON CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH SILICA FUME

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ABSTRACT

Traditionally, Ordinary Portland cement is used for making the civil structures. Portland cement can be partially replaced by silica fume. Silica fume is non-metallic and non-hazardous waste of industries. It is suitable for concrete mix and improves properties of concrete i.e. compressive strength etc. The main objective of this paper is to determine the optimum replacement percentage which can enhance the compressive strength of concrete with silica fume. In this experiment we will take various percentage of adding micro silica like 10%, 20%, and 30% by weight of cement replacement in concrete and proportion of maximum compressive strength and workability of M25 grade concrete. The properties of concrete (compressive strength) are studied at 7 days, 14 days and 28 days. The test results are increased in the stress at silica fume concrete compared to conventional concrete.

Key words: *Compressive Strength, silica fume, Water cement Ratio*

I. INTRODUCTION

Concrete is a most widely used building material which has on admixture of cement, sand, coarse aggregate and water. It can be used for construction of multistory buildings, dams, road pavement, tanks, offshore structures, canal lining. The process of selecting suitable ingredients of concrete and determining their relative amount with the objective of producing a concrete of the required strength durability and workability as economically as possible is termed the concrete mix design. Engineers and scientists are trying to increase the strength of concrete by adding the some other cheap and waste material as a partial replacement of cement or as a admixture fly ash, micro silica, steel slag etc.

These materials are generally by products from other industries for example fly ash is a waste product from power plants and silica fume is a by product resulting from electric furnace during production of silicon metal or ferrosilicon alloys. Nowadays whole world is facing a major

problem of environmental pollution these micro silica is become pollution reduction material. The incorporation of silica fume in concrete improves the different mechanical properties like concrete strength, modulus of elasticity, durability, corrosion protection, chemical and abrasion resistance. Addition of silica fume to Concrete improves the durability of concrete and also in protecting the embedded steel from corrosion. Benefit of silica fume has been discussed by replacing cement with silica fume at varying percentage and the strength parameters were compared with conventional concrete.

2. EXPERIMENTAL INVESTIGATION

2.1 MATERIALS

2.1.1 CEMENT

Ultratech (OPC) 53 grade cement conforming to IS specifications was used to cast the test specimen. The specific gravity of cement was determined as per BIS: 12269-1987 and found to be 3.14.

2.1.2 FINE AGGREGATE

The fine aggregate used for all the specimens in river sand. The fine aggregate used for casting through IS 4.75 mm sieve. The specific gravity of fine aggregate used for concrete was determined and found to be 2.65.

2.1.3 COARSE AGGREGATE

Crushed granite coarse aggregate of maximum size 20 mm is used. The experiments are carried out to find the property of coarse aggregate. Coarse aggregate was used with 20mm nominal size and specific gravity 2.83 and fineness modulus 8.27 and were tested as per IS Indian Standard Specifications IS : 383-1970.

2.1.4 SILICA FUME

The Silica fume is used as a partial replacement of cement. The chemical composition of silica fume are contains more than 90 percent silicon dioxide. Other constituents are carbon, sulphur and oxides of aluminium, iron, calcium, magnesium, sodium and potassium.

The physical composition of silica fume are diameter is about 0.1 micron to 0.2 micron Surface area about 30,000 m²/kg Density varies from 150 to 700 kg/m³.

2.1.5 WATER

The potable water available in our campus is used for mixing and curing of concrete.

2.2 EXPERIMENTAL PROCEDURES

2.2.1 COMPRESSIVE STRENGTH TEST

Among the normal and high strength concrete specimens, a total of 150x150x150mm were prepared and cured at 7days, 14days and 28days and then tested according to IS: 516- 1959. The material was weighed and the materials were mixed in mixer machine. The water cement ratio adopted was 0.5. The concrete was filled in different layers and each layer was compacted. The specimen was removed from mould after 24hrs, cured in clean water for 7days, 14days and 28days and then tested for compressive strength as per Indian Standard. The materials for each batch of moulds mixed separately using the quantities of dry materials, conforming to the proportions and the quantity of water was determined.

3. RESULTS AND DISCUSSION

3.1. Compressive strength test on conventional concrete

The results of the compressive strength test for all concrete mixes after 7, 14 and 28 days curing were determined. Compressive strength of concrete containing various percentage of silica fume was studied. Conventional concrete strength was compared with the strength of concrete containing 10%, 20% and 30% silica fume that replaced cement of same percentage.

COMPRESSIVE STRENGTH N/mm ²	7 DAYS	14 DAYS	28 DAYS
	17.52	21.26	23.52

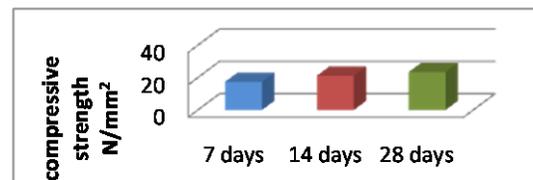


Fig1: compressive strength test on conventional concrete

3.2 Concrete with partially replacement of cement with silica fume in 10%

COMPRESSIVE	7 DAYS	14 DAYS	28 DAYS
STERNGTH			
N/mm ²	18.43	22.24	23.72

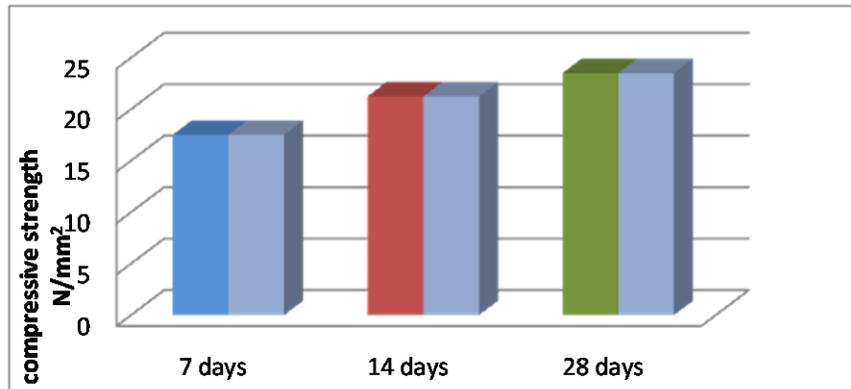


Fig2. Concrete with partially replacement of cement with silica fume in 10%

3.3 Concrete with partially replacement of cement with silica fume in 20%

COMPRESSIVE	7 DAYS	14 DAYS	28 DAYS
STERNGTH			
N/mm ²	19.92	23.36	26.46

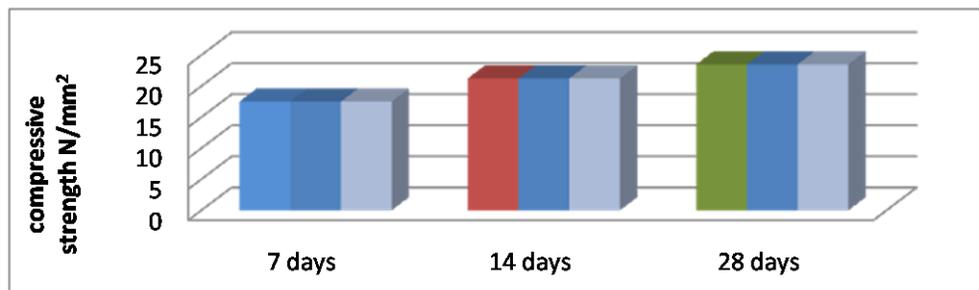


Fig3. Concrete with partially replacement of cement with silica fume in 20%

3.4 Concrete with partially replacement of cement with silica fume in 30%

COMPRESSIVE	7 DAYS	14 DAYS	28 DAYS
STRENGTH			
N/mm ²	26.12	27.00	29.94

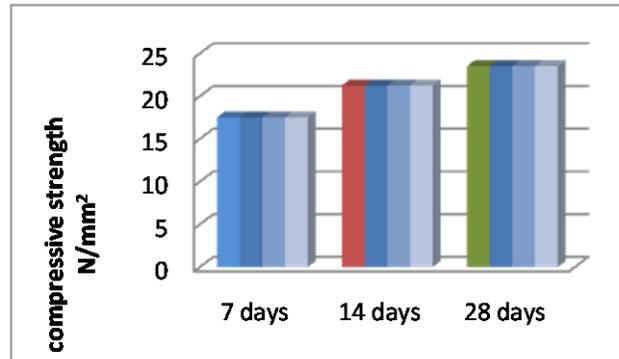


Fig4. Concrete with partially replacement of cement with silica fume in 30%

3.5 Comparison between conventional concrete and silica fume concrete

The strength of silica fume concrete is increased compared to normal (conventional) concrete.

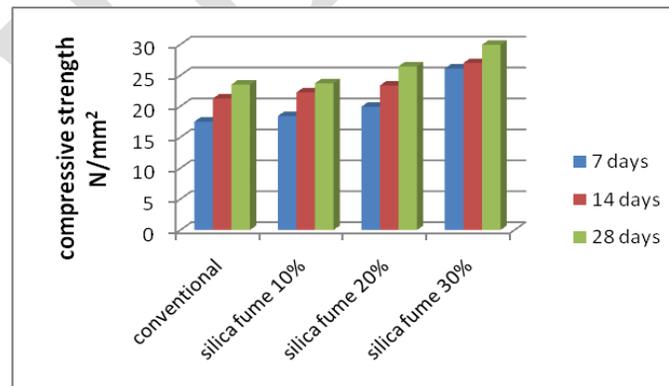


Fig5. Comparison between conventional concrete and silica fume concrete

CONCLUSION

- Results indicates that general superior performance of cement replacement in 10%, 20% and 30% with silica fume compared to conventional concrete it increase the compressive strength.

- The silica fume presented here in as a mineral admixture is employed to produce concrete of special characteristics as silica fume is less expensive than cement.
- The impacts of silica fume in concrete under, compressive strength are achieved as high. It concluded that the 28th day's strength of concrete with silica fume gives a higher strength of compressive strength as compared to conventional concrete.
- Various properties are enhanced such as workability, permeability, durability, bleeding, heat of hydration, sensitivity to curing, acid resistance.

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