Effect of Silica Fume and steel fibre on concrete, A review

Suhail Rashid Dar[1], Ankit Mahajan[2]
[1]PG Student Department of civil engineering, Chandigarh University Mohali Punjab
[2]Assistant Professor Department of civil engineering,Chandigarh University Mohali Punjab

Abstract - Extensively used material in construction industry is concrete this is because of good workability and ability to be moulded to any shape. Ordinary cement concrete possesses very low tensile strength, limited ductility and less resistance to cracking. The concrete shows the brittle behaviour and fails to handle tensile loading hence leads to internal micro cracks which are mainly responsible for brittle failure of concrete. In the recent past, there has been considerable attempts for improving the properties of concrete with respect to strength and durability, especially in aggressive environments. High performance concrete appears to be better choice for a strong and durable structure. A large amount of by-product or wastes such as fly-ash, copper slag, silica fume etc. are generated by industries, which causes environmental as well as health problems due to dumping and disposal. Proper introduction of silica fume in concrete improves both the mechanical and durability characteristics of the concrete. Silica fume, a by-product in the manufacture of ferro-silicon and silicon metal, is a very efficient pozzo anic material. This paper describes its physical, chemical, and poxzolanic properties and its possible applications and limitations in concrete.

Key-words - Silica Fume,steel Fibre,Compressive Strength,Flexural,etc

Objective - To study the effect of silica fume and steel fibre in concrete

Introduction

In recent years, many organizations have become increasingly involved in research aimed at energy conservation in the cement and concrete industry. This, in part, is being accomplished by encouraging the use of less energy intensive cementitious materials such as fly ash, slags, and pozzolans. Lately, some attention has been given to the use of condensed silica fume as a possible partial replacement for cement.

Silica fume is also known as micro silica or condensed silica fume, is used as an artificial pozzlanic admixture. It is a material resulting from reduction of quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy.Chemical composition of silica fume Contains more than 90 percent silicon dioxide Other constituents are carbon, Sulphur and oxides of aluminum, iron, calcium, magnesium, sodium and potassium.The physical composition of silica fume Diameter is about 0.1 micron to 0.2 microns, Surface area about 30,000 m²/kg and Density varies from 150 to 700 kg/m³.FRC is cement- based composite material that has been developed in recent years. It has been successfully used in construction with its excellent flexural-tensile strength, resistance to spitting, impact resistance and excellent permeability and frost resistance. It is an effective way to increase toughness, shock resistance and resistance to plastic shrinkage cracking of the mortar. Fibre is a small piece of reinforcing material possessing certain characteristics properties. They can be circular, triangular or flat in cross-section. The fire is often described by a convenient parameter called ―aspect ratio‖. The aspect ratio of the fibre is the ratio of its length to its diameter. The exact data on the annual output of silica fume in Canada and the U.S. are not available, but estimates are that in 1981 a total of about 15,000 tonnes was available in Canada. The corresponding estimated figure for the U.S. was approximately 300,000 tonnes. Norway is one of the world's largest producers of silica fume with 1981 estimated tonnage of about 120,000 tonnes, and this is expected to double over the next severa1 years. As steel fibres have almost zero cover near the surface of SFRC structural elements, their durability aspects under aggressive environments are of much importance and use of mineral admixtures may help in such situations. Many investigators have studied the mechanical properties and durability characteristics of SFRC with and/or without binary blending of mineral admixtures. However, a few studies have been reported on influence of binary and ternary blends on strength and durability aspects of SFRC under chloride environment.

Materials Used

Silica Fume:- Silica fume is a by-product resulting from the reduction of high purity quartz with coa1 in electric are furnaces in the manufacture of ferro-silicon and silicon metal. The fume, which has a high content of amorphous silicon dioxide and consists of very fine spherical particles, is collected by filtering the gases escaping from the furnaces .

Steel Fibre:- Fibres are generally used as resistance of cracking and strengthening of concrete. In this project, I am going to carry out test on steel fibre reinforced concrete to check the influence of fibres on flexural strength of concrete.

Review Of Literature

Amudhavalli& Mathew (2012) studied the Effect of silica fume on the strength and durability characteristics of concrete.The main parameter investigated in this study is M35 grade concrete with partial replacement of cement by silica fume by 0, 5, 10,15and by 20%. a detailed experimental study in Compressive strength, split tensile strength, flexural strength at age of 7 and28 day was carried out.Results Shows that Silica fume in concrete has improved the performance of concrete in strength as well as in durability aspect.

Abhinav Shyam(2017) The review of earlier studies related to partial replacement of Cement with Silica fume reveals that there is a significant change in the strength properties of concrete such as compressive strength, flexural strength, split tensile strength. These experiments were carried out in various grade concrete to find out the result. From the above literature reviews optimum percentage of Silica Fume varies from 5% to 15%.

Pramod Kawde(2017) concluded that SFRC is being increasingly used to improve static and dynamic tensile strength, energy absorbing capacity and better fatigue. They concluded that the addition of steel fiber increases the ultimate strength and ductility. The plain structure cracks into two pieces when the structure is subjected to the peak tensile load and cannot withstand further load or deformation.

T.H. Sadashiva Murthy(2014) Test results of average of three specimens of SFRC at different ages up to 150 days for all combinations of mixes cured under normal water and NaCl solutions are presented in fig. under normal curing, all ternary blended mixes of SFRC showed higher strengths than that of corresponding binary blended mixes at all ages. However, binary blended mixes showed increased trend of higher strengths than that of control mix at later ages. Similarly, in case of NaCl curing, same trend was observed as that of normal curing with slightly lower strength values in all the mixes at corresponding ages.

Table 3: Spilt tensile strength ratio values of SFRC mixes under NaCl curing.

Mix	compared to normally cured specimens at corresponding ages					compared to 28 day strength of corresponding normally cured specimens				
	28d	60d	90d	120d	150d	28d	60d	90d	120d	150d
A	1.000	1.022	0.981	0.930	0.860	1.000	1.031	0.996	0.959	0.901
B	1.000	1.037	0.978	0.969	0.961	1.000	1.105	1.129	1.150	1.181
C	1.000	1.026	0.975	0.971	0.964	1.000	1.093	1.126	1.155	1.186
D	1.000	1.015	0.948	0.979	0.972	1.000	1.144	1.175	1.235	1.268
E	1.000	1.013	0.995	0.960	0.986	1.000	1.054	1.065	1.074	1.166
F	1.000	1.017	0.990	0.974	0.966	1.000	1.074	1.088	1.105	1.169
G	1.000	1.019	0.984	0.975	0.980	1.000	1.127	1.137	1.160	1.247

Table 2: Spilt tensile strength (MPa) of SFRC mixes at different ages under Normal and NaCl curing.

Mix	Normal curing					NaCl curing				
	28d	60d	90d	120d	150d	28d	60d	90d	120d	150d
SA	5.16	5.21	5.24	5.39	5.48	5.16	5.32	5.14	4.95	4.65
SB	4.63	4.94	5.19	5.50	5.69	4.63	5.12	5.23	5.33	5.47
SC	4.51	4.81	5.08	5.37	5.55	4.51	4.93	5.08	5.21	5.35
SD	4.16	4.49	4.84	5.25	5.43	4.16	4.76	4.89	5.14	5.28
SE	5.34	5.56	5.72	5.98	6.32	5.34	5.63	5.69	5.74	6.23
SF	5.13	5.42	5.64	5.82	6.21	5.13	5.51	5.58	5.67	6.00
SG	4.75	5.17	5.29	5.45	6.04	4.75	5.35	5.40	5.51	5.92

Conclusion

On the basis of existing review of literature it can be concluded c that Replacement of cement with silica fume up to 15% increases the compressive strength, splitting tensile strength, flexural strength and shear strength of concrete. Replacement of cement by 15% with silica fume and natural aggregates by up to 50% shows improved compressive strength, Tensile strength, Flexural strength and Shear strength than the normal concrete.

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