Performance of Microsilica in a Hyposludge Concrete

Selsiadevi S [1]
School of Civil Engineering
SASTRA Deemed University
Thanjavur

Jayasree B [4]
Department of Civil Engineering
St.Joseph College of Engineerng and Technology
Thanjavur

Selescadevi S [2]
Department of Civil Engineering
Parisutham institute of technology and science
Thanjavur

Vivek S [3]
Department of Civil Engineering
Parisutham institute of technology and science
Thanjavur

***Abstract*— This project present the results of experimental investigations carried out to evaluate "THE PERFORMANCE OF MICROSILICA IN HYPOSLUDGE CONCRETE" where cement is replaced with that of hyposludge on various proportions in concrete (0%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%).The basic objective of this study was to identify alternative source of cement and to produce new type of concrete made of hyposludge as a green concrete and to control pollution to the environment. The pollution occurs due to the disposal of hyposludge by burning as well as dumping process. By using these waste materials in concrete we can control cost of materials used in construction. Hyposludge is the waste of industrial product from paper production. It provides great opportunity to utilize it as an alternative to cement due to the silica and magnesium properties. In this study, concrete of M25 (1:1:2) grade was considered for a w/c ratio of 0.5 for the replacements of various percentage of cement by hyposludge. Micro silica is added as a mineral admixture in hypo sludge concrete in order to increase its strength (15% of hypo sludge). The investigation revealed improvement in compressive strength, split tensile strength based on the overall observations. This study investigates the performance of concrete mixtures containing hyposluge in terms of compressive strength at 7, 14 and 28 days. Results show that concrete incorporating hyposludge had higher compressive strength of concretes.**

Keywords*— *hyposludge; micro silica

I. INTRODUCTION

Energy plays a crucial role in growth of developing countries like India. In the context of low availability of non-renewable energy resources coupled with the requirements of large quantities of energy for building materials like cement, the importance of using industrial waste cannot be underestimated. During manufacturing of 1 tonnes (T) of Ordinary Portland Cement (OPC) we need about 1…1⅓ t of earth resources like limestone, etc. Further during manufacturing of 1T of Ordinary Portland cement an equal amount of carbon dioxide are released into the atmosphere. The carbon-di-oxide emissions act as a silent killer in the environment under various forms. In this backdrop, the search for cheaper substitute to OPC is a needful one.

Over 300 million tonnes of industrial wastes are being produced per annum in India. These materials pose problems of disposal and health hazards. This paper mill sludge consumes a large percentage of local landfill space for each and every year. Worse yet, some of the wastes are land spread on cropland as a disposal technique, raising concerns about trace contaminants building up in soil or running off into area lakes and streams. Some companies burn their sludge in incinerators, contributing to our serious air pollution problems. To reduce disposal and pollution problems from these industrial wastes, it is most essential to develop profitable building materials from them. For each tone of recycled paper about 300 kg of paper waste sludge is produced which is comparatively a large volume of sludge produced each day. Keeping this in view, investigations were undertaken to produce low cost concrete by blending various ratios of cement with hypo sludge. Hypo sludge behaves like cement because of silica and magnesium properties. This hypo sludge contains, low calcium and maximum calcium chloride and minimum amount of silica. Concrete, is most widely used man made construction material and is the largest production of all the materials used in construction industry.

Concrete is basically made of cementations materials which have to properly bind themselves together, as well as with other materials to form a solid mass. Concrete or mortar is made up of cement, water and aggregates (Coarse and Fine Aggregate) and sometimes with necessary admixtures. Concrete has attained the status of a major building material in all the branches of modern construction. It is difficult to point out another material of construction which is as variable as concrete. Concrete is the best material of choice where strength, durability, impermeability, fire resistance and absorption resistance are required. Compressive strength is considered as an index to assess the overall quality of concrete and it is generally assumed that an improvement in the compressive strength results in improvement of all other properties. Hence strength investigations are generally centred on compressive strength. Even though concrete mixes are proportioned on the basis of achieving the desired

compressive strength at the specified age, flexural strength often play a vital role in concrete making.

II. MATERIALS

A. Cement

The Portland Pozzalonic cement (PPC) of 53 grade conforming to IS1489 (PART 1) -1991 is being used. Cement is a generic name that can apply to all binders. The chemical composition of the cements can be quite diverse but by far the greatest amount of concrete used today is made with Portland cements. Lime and silica make up about 85% of the mass. Common among the materials used in its manufacture are limestone, shells, and chalk or marl combined with shale, clay, slate or blast furnace slag, silica sand, and iron ore. Lime and silica make up about 85% of the mass. Common among the materials used in its manufacture are limestone, shells, and chalk or marl combined with shale, clay, slate or blast furnace slag, silica sand, and iron ore.

B. Fine aggregate

Those fractions from 4.75 mm to 150 microns (μ) are termed as fine aggregate. The river sand is used as fine aggregate conforming to the requirements of IS: 383 1970. The river sand is washed and screened, to eliminate deleterious materials and oversize particles.

C. Coarse aggregate

The fractions from 80 mm to 4.75 mm are termed as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 1970 is be use. The Flakiness and Elongation Index were maintained well below 15%.

D. Hyposludge

It is the by product of the paper waste. This hypo sludge contains low calcium and minimum amount of silica. Hypo sludge behaves like cement because of silica and magnesium properties. It is usually used in proportion of percent of cement content of the mix.

TABLE 1: Properties of Hyposludge

Chemical Constituents	Percentage (%)
CaO	62.81
SiO 2	19.83
Fe203	5.08
Na2O	0.19
SO3	2.82
Loss on ignition	0.86

E. Mineral admixture

Microsilica is a mineral admixture composed of very fine solid glassy spheres of silicon dioxide (SiO2). The particles are less than 1 micron (0.00004 inch) in, generally 50 to 100 times finer than average cement. As an admixture, microsilica can improve the properties of both fresh and hardened concrete. Microsilica effectiveness as a pozzolan and filler depends largely on its composition and particle size which in turn depend on the design of the furnace and the composition of the raw materials with which the furnace is charged. At present there are no U.S standard specifications for the material or its applications. Dosages of microsilica used in concrete have typically been in the range of 5 to 20 percent by weight of cement, but percentages as high as 40 have been reported.

III. METHODS

F. Methods

In this research hypo sludge is used as replacement of conventional building materials such as cement in partial in various proportions its quantity. The replacements are done for a ratio of 5% 10% 15% 20% 25%30% 35% and 40%. The concrete tested for compressive strength. The grade of concrete mixed is M25 grade with a water cement ratio of 0.5 the grade chosen as per IS 456-2000 for an exposure condition of severe for reinforced concrete. The mix was prepared is non pumping mix with ratio of 1: 1.8: 2.829. The optimum strength obtained at a replacement of 30% of hyposludge by cement with the micro silica (mineral admixture). The material was tested for compressive strength to find out the optimum ratio. The hyposludge concrete made with the optimum strength gained replacements. The strength of the hyposludge concrete at an age of 7 days 14 days and 28 days are more than the conventional concrete.

IV. RESULT AND DISCUSSION

G. Compressive strength

Cube specimen shall be of size not less than four times the maximum size of the course aggregate and not less than 150 mm compressive strength of concrete made with 15cm x 15cm x 15 cm cubes are made with M25 grade of concrete, concrete mixed and cured and tested with reference to Indian standard code specification IS 516 –1959.(TABLE 2, 3 & FIGURE 1)

TABLE 2: Compressive Strength of conventional concrete

Curing periods	Compressive Strength (N/mm^2)		
	Trail-1	Trail-2	Trail-3
7 days	15.35	15.48	15.45
14 days	24.32	24.38	24.30
28 days	24.85	24.88	24.76
average	15.42	24.35	24.89

Table 2. Compressive strength of concrete for replacement of cement (N/mm^2)

Percentage of replacement	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
5%	17.014	25.78	28.68
10%	17.8	26.98	29.97
15%	18.717	28.36	31.47
20%	21.56	32.67	36.26
25%	25.05	37.96	42.13
30%	26.41	40.02	44.42
35%	23.32	35.34	39.22
40%	20.37	30.87	34.26

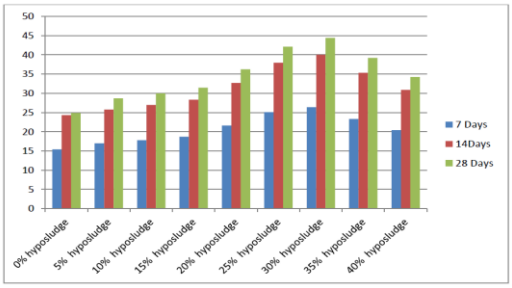

FIGURE.1. Compressive strength of Hyposludge concrete

From the compressive strength obtained by hyposluge concrete, the optimum percentage for the addition of microsilica is 30% above which the strength gets reduced. This was obtained by the partial replacement of cement by the percentage of microsilica. From 5 to 30% the compressive strength gradually increased, which shows addition of micro silica enhance the property of cement.

V. CONCLUSION

The outcome of the project is to increase the strength of hyposludge concrete by using micro silica as mineral admixture and also the project is to control the manufacturing and usage of cement in construction work and enlarge the usage of waste materials (by products) which can replace the cement, by having more or less similar physical and chemical properties. By this research we have proved that the use of hyposludge in part of cement by adding Micro silica (mineral admixture) can improve the compressive strength and split tensile strength of concrete. By the use of cement as part of conventional building materials can help in reduction in disposal problem, we can produce a cost effective concrete, and by controlling usage of conventional building materials, the increase in cost can be controlled, Environmental pollution caused by manufacturing of cement can be controlled. By the test results of replacement in cement we have analyzed that the hyposludge with micro silica can be effectively replaced for 30% of cement even after 30% of replacing of hyposludge the strength of the hyposludge concrete is not fall below the conventional concrete strength , hence the optimum percentage of strength achieved for this percentage and finally hyposludge concrete produced by replacing 30% of cement and strength achieved for 7 days, 14 days & 28 days for compressive strength are 26.4, 40.02, 44.42 (N/mm^2).

REFERENCES

[1] Rushabh a. shah, prof. jayeshkumar pitroda “Effect of Hyposludge as Partial Replacement with Cement in Mortar “ISSN2320 –5083.
[2] Prof .jayeshkumar pitroda, l.b.zala, dr.f.s.umrigar “Innovative Use of Paper Industry Waste” (Hypo Sludge) In Design Mix Concrete E-ISSN 0976.
[3] Jayeshkumar pitroda “Gainful Utilization of Fly Ash And Hyposludge in Concrete”.
[4] Gagan krishna, suresh” Partial Replacement of Cement with Hypo Sludge “ISSN 2348 – 8050.
[5] Mahesh shirur1, yashwanth “An Experimental Study on Economic Feasibility and Strength of Concrete by Partial Replacement of Cement with Hypo Sludge.
[6] Sarma , p.v.rambabu, anil “ Durability Studies on Concrete With Hypo Sludge” as partial replacement of cement ISSN : 2248-9622
[7] Cherian varkey, jefin p john, neema v n, namitha joshy “Study on Utilization of Waste Paper Sludge by Partial Replacement of Cement in Concrete “E-ISSN: 2395 -0056.
[8] Katru sai teja “Hypo Sludge as a Partial Replacement of Cement in Concrete”