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Effect of Characteristic Strength of Concrete by Replacing Cement Partially With Hypo Sludge and Fly Ash

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ABSTRACT: This paper presents the results of study undertaken to investigate the feasibility of using fly ash and hypo sludge as cement in concrete. The effects of replacing cement by fly ash and hypo sludge on the flexural strength of beams (500mm*100 mm*100 mm) are evaluated in this study. Two test groups were constituted with the replacement percentages of 0%, 10%, 20% and 30%. The results showed the effect of fly ash and hypo sludge on concrete beams has a considerable amount of increase of the flexural strength characteristics. To investigate the utilization of Hypo Sludge as Supplementary Cementitious Materials (SCM) and influence of these hypo sludge on the Strength on concretes made with different Cement replacement levels and also compare with fly ash concrete and ordinary concrete. At the place where strength is not of more importance or rather structure is for temporary basis then design mix proportion up to 40% replacement can also be utilized.

KEYWORDS: Flyash, Hypo Suldge, SCM, Mixdesign

I. INTRODUCTION

Fly ash is one of the types of coal combustion by-products. The use of these by-products offers environmental advantages divert the material from the waste stream, reduce the energy used in processing virgin materials, use of virgin materials, and decreases pollution. India is a resourceful country for fly ash generation with an annual output of over 110 million tones, but utilization is still below 20 % in spite of quantum jump in last three to four years. Availability of consistent quality fly ash across the country and awareness of positive effects of using fly ash in concrete are pre requisite for change of perception of fly ash from a 'A waste material' to 'A resource material. Although fly ash offers environmental advantages, it also improves the performance and quality of concrete. Fly ash affects the plastic properties of concrete by improving workability, reducing water demand, reducing segregation and bleeding, and lowering heat of hydration. Fly ash increases strength, reduces permeability, reduces corrosion of reinforcing steel, increases sulphate resistance, and reduces alkali-aggregate reaction. The 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 agricultural land 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 emanating from these industrial wastes, it is most desire to develop profitable materials from them. Keeping this in view, investigations were undertaken to produce low cost concrete by blending various ratios of cement with hypo sludge. So we take hypo sludge and fly ash for compare it with cement.

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II. RELATED WORK

In all countries, the construction industry is rapidly developing based on the invention of different materials and products in engineering fields. Engineers have attempted various types of materials in order to make the task more efficient reducing time, cost, improving durability, quality and performance of structures during their lifetime. The quality of good and durable concrete does not depend only on the quality of raw materials but also on proper mix-design, use of admixtures, placement, vibration and efficient curing. There has been founded and partial replacement are done with hypo sludge and fly ash concrete a worldwide increase in the use of composite materials for strengthening reinforced concrete structures in recent years. All previous work on short hypo sludge, fly ash and iron oxide concrete used, which are the least expensive form of the industrial wastes.

The effects of replacing cement by fly ash and hypo sludge on the flexural strength of beams (500 mm x 100 mm x 100 mm) are evaluated in this study. Two test groups were constituted with the replacement percentages of 0%, 10%, 20% and 30%. The results showed the effect of fly ash and hypo sludge on concrete beams has a considerable amount of increase of the flexural strength characteristics. To investigate the utilization of Hypo Sludge as Supplementary Cementitious Materials (SCM) and influence of these hypo sludge on the Strength on concretes made with different Cement replacement levels and also compare with fly ash concrete and ordinary concrete.

The Concrete is strength and tough material but it is porous material also which interacts with the surrounding environment. The durability of concrete depends largely on the movement of water and gas enters and moves through it. To produce low cost concrete by blending various ratios of cement with hypo sludge & to reduce disposal and pollution problems due to hypo sludge it is most essential to develop profitable building materials from hypo sludge. To make good quality paper limited number of times recycled Paper fibers can be used which produces a large amount of solid waste. The innovative use of hypo sludge in concrete formulations as a supplementary cementations material was tested as an alternative to traditional concrete. These tests were carried out to evaluate the mechanical properties like compressive strength up to 28 days. As a result, the compressive increased up to 10% addition of hypo sludge and further increased in hypo sludge reduces the strengths gradually. This research work is concerned with experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing cement via 5%, 10%, 15%, and 20% of Hypo Sludge. Keeping all this view, the aim of investigation is the behavior of concrete while adding of waste with different proportions of Hypo sludge in concrete by using tests like compression strength and split strength. The mix design was carried out for M25 grade concrete as per IS: 10262-2009.

The use of paper-mill pulp in concrete formulations was investigated as an alternative to landfill disposal. The cement has been replaced by waste paper sludge accordingly in the range of 5% to 20% by weight for M-20 and M-30 mix. By using adequate amount of the waste paper pulp and water, concrete mixtures were produced and compared in terms of slump and strength with the conventional concrete.

III. TEXT INPAINTING

Exemplar based Inpainting technique is used for inpainting of text regions, which takes structure synthesis and texture synthesis together. The inpainting is done in such a manner, that it fills the damaged region or holes in an image, with surrounding colour and texture. The algorithm is based on patch based filling procedure. First find target region using mask image and then find boundary of target region. For all the boundary points it defined patch and find the priority of these patches. It starts filling the target region from the highest priority patch by finding the best match patch. This procedure is repeated until entire target region is inpainted.

The algorithm automatically generates mask image without user interaction that contains only text regions to be inpainted.

IV. EXPERIMENTAL RESULTS

1. DESIGN STIPULATIONS FOR PROPORTIONING

- i. Grade designation : M₂₀
- ii. Type of mix : mix powder (hypo sludge+ fly ash)

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- iii. Maximum nominal size of aggregates: 20 mm
- iv. Minimum mix powder : 320 kg/m³
- v. Maximum water mix ratio : 0.55
- vi. Workability : 23 mm (slump)
- vii. Exposure condition : Mild
- viii. Degree of supervision : Good
- ix. Type of aggregate : Crushed angular aggregate
- x. Maximum mix powder content : 450 kg/m³
- xi. Chemical admixture : Not recommended

2. TEST DATA FOR MATERIALS

- i) Mix used : nil
- ii) Specific gravity of mix : nil
- iii) Specific gravity of Coarse aggregate : 2.68
Fine aggregate : 2.65
- iv) Water absorption
Coarse aggregate : 0.6 percent
Fine aggregate : 1.0 percent
- v) Free (surface) moisture
Coarse aggregate : Nil (absorbed moisture full)
Fine aggregate : Nil
- vi) Sieve analysis
Coarse aggregate : Conforming to Table 2 of IS: 383
Fine aggregate : Conforming to Zone I of IS: 383

3. TARGET STRENGTH FOR MIX PROPORTIONING

$$f'_{ck} = f_{ck} + 1.65 s$$

Where

f'_{ck} = Target average compressive strength at 28 days,

f_{ck} = Characteristic compressive strength at 28 days,

s = Standard deviation

From Table 1 standard deviation, $s = 4 \text{ N/mm}^2$

Therefore target strength = $20 + 1.65 \times 4 = 26.60 \text{ N/mm}^2$

4. SELECTION OF WATER CEMENT RATIO

From Table 5 of IS: 456-2000, maximum water cement ratio = 0.55 (Mild exposure)

Based on experience adopt water cement ratio as 0.50 $0.5 < 0.55$, hence ok

5. SELECTION OF WATER CONTENT

From Table-2, maximum water content = 186 liters (for 25mm – 50mm slump range and for 20 mm aggregates)

Estimated water content for 75 mm slump = $186 + 3/100 \times 186 = 191.6$ liters

6. CALCULATION OF CEMENT CONTENT

Water mix ratio = 0.50

mix content = $191.6/0.5 = 383 \text{ kg/m}^3 > 320 \text{ kg/m}^3$ (given)

From Table 5 of IS: 456, minimum mix content for mild exposure condition = 300 kg/m^3 Hence OK

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7. PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT

From Table 3, volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone I) for water-cement ratio of 0.50 = 0.60

8. MIX CALCULATIONS

The mix calculations per unit volume of concrete shall be as follows

- a) Volume of concrete = 1 m³
 - b) Volume of cement = $[383.16/3.15] \times [1/1000] = 0.122 \text{ m}^3$
 - c) Volume of water = $[192/1] \times [1/1000] = 0.192 \text{ m}^3$
 - d) Volume of all in aggregates (e) = $a - (b + c) = 1 - (0.122 + 0.192) = 0.686 \text{ m}^3$
 - e) Volume of coarse aggregates = $e \times \text{Volume of CA} \times \text{specific gravity of CA} = 0.686 \times 0.6 \times 2.68 \times 1000 = 1103 \text{ kg}$
 - f) Volume of fine aggregates = $e \times \text{Volume of FA} \times \text{specific gravity of FA} = 0.686 \times 0.4 \times 2.65 \times 1000 = 727 \text{ kg}$.
- Aggregates are assumed to be in SSD. Otherwise corrections are to be applied while calculating the water content. Necessary corrections are also required to be made in mass of aggregates.

COMPRESSIVE STRENGTH:

Partial replacement in%		average compressive strength (N/mm ²)	
		7days	28 days
Fly ash	0%	30.24	34.07
	10%	27.85	30.11
	20%	28.45	30.11
	30%	26.6	38.6
	40%	27.43	30.25
Hypo Sludge	0%	30.24	30.24
	10%	33.17	35.26
	20%	27.55	32
	30%	25.51	27.83
	40%	20.91	25.9

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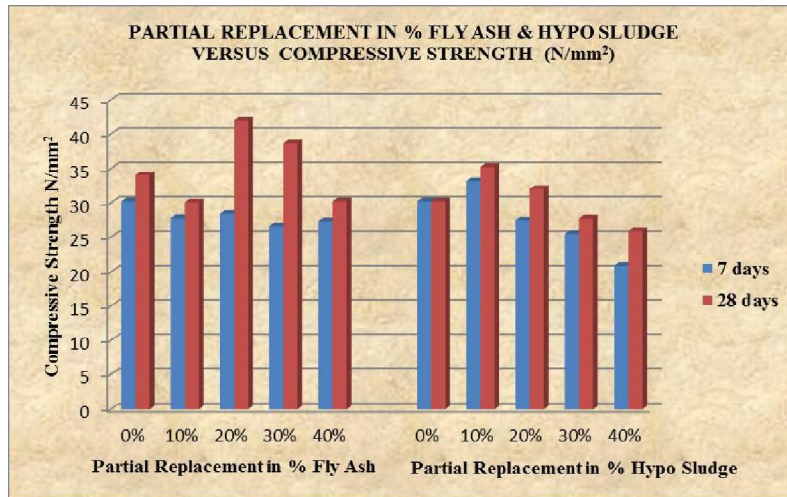


Figure-10: Bar chart of Compressive Strength

Workability reduces at with cement and vice versa it increase with higher replacement of hypo sludge. Compressive strength of the concrete measured after 7 days decreases when the percentage of replacement of increases and 10 % hypo sludge compressive strength increases after 7 days. Compressive strength of the concrete measured after 28 days increases when the percentage of replacement of increases up to 30% and if replacements of 20% hypo sludge compressive strength increases after 28 days.

FLEXURAL STRENGTH OF BEAM FOR FLY ASH AND HYPO SLUDGE @ 0%,10%,20%,30%

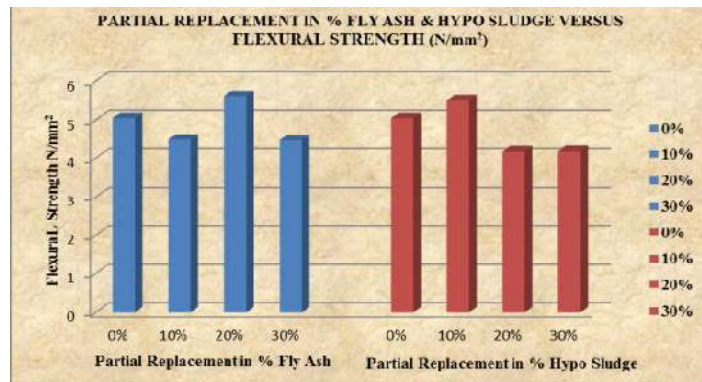
Flexural Strength of Beam for M20 at 28 Days Partial placement in %	Average Flexural Strength of Beam(N/mm ²)	% Change of Flexural Strength of Beam(N/mm ²)
Fly ash 0%	5.05	0
10%	4.48	-11.28
20%	5.61	11.08
30%	4.46	-11.68
Hypo sludge 0%	5.05	0
10%	5.5	8.91
20%	4.17	-17.42
30%	4.18	-17.22

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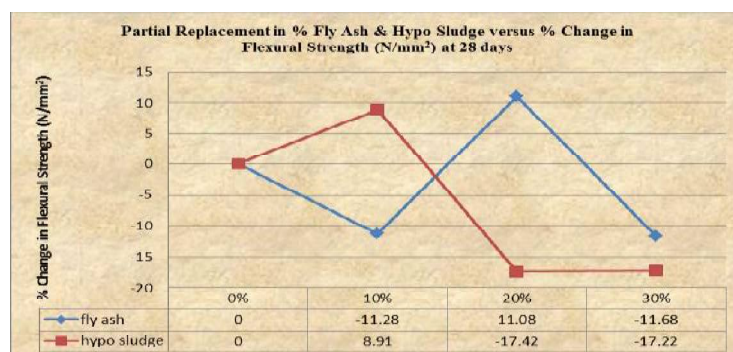
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Partial Replacement in % Fly Ash & Hypo Sludge versus Flexural Strength(N/mm²) at 28days



Partial Replacement in % Fly Ash & Hypo Sludge versus % Change in Flexural Strength (N/mm²) at 28 days

SPLIT TENSILE STRENGTH

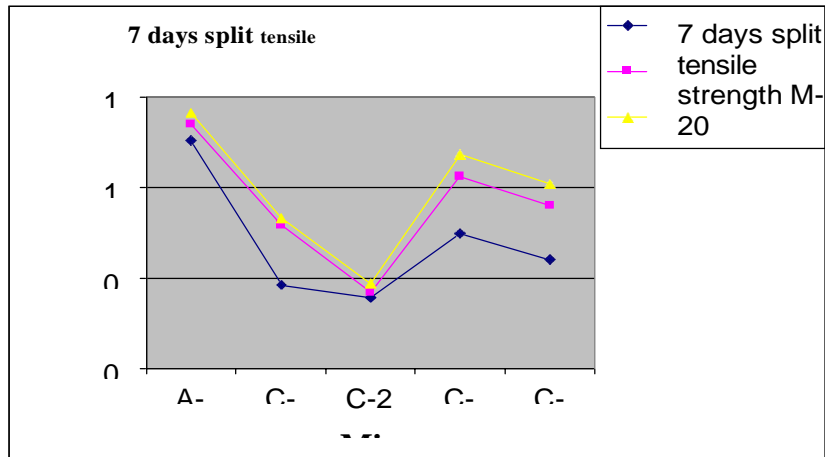
Mix Type	Split Tensile Strength in N/mm ²	
	7 days	28 days
A1-M20	1.26	1.96
C1-M20	0.46	1.37
C2-M20	0.39	1.21
C3-M20	0.75	1.72
C4-M20	0.6	1.58
A2-M25	1.35	2.19
C5-M25	0.79	1.56
C6-M25	0.42	1.47
C7-M25	1.06	1.83
C8-M25	0.9	1.7
A3-M30	1.41	2.5
C9-M30	0.83	1.9
C10-M30	0.47	1.52
C11-M30	1.18	1.91
C12-M30	1.02	1.75

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V. CONCLUSIONS

Based on limited experimental investigation concerning the flexural Strength of concrete, the following observations are made regarding the resistance of partially replaced fly ash and hypo sludge:

1. Flexural strength of the concrete increases when the 20% replacement of cement by fly ash is increased up to 11.08 %.
2. Flexural strength of the concrete increases when the 10% replacement of cement by hypo sludge is increased up to 8.1%.
3. When compare in between flyash and Hypo sludge concrete compressive strength is more upto 20% replacement of cement by Hypo sludge.
4. Use of hypo sludge in concrete can save the paper industry disposal costs and produces a sustainable concrete for construction.
5. Disposal problem of the hypo sludge can be minimized by this project now days it is a big problem of getting the landfill.
6. Workability of the concrete can be increased with the increase in hypo sludge.

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