Experimental and Performance Analysis on Low Cost Concrete Using Industrial Waste as Additional Cementitious Materials

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ABSTRACT - This experimental study on strength of concrete and optimum percentage of the partial replacement by preparing a mix M_{25} grade was designed as per Indian Standard method and the same was used to prepare the test samples. The design mix proportion used were Conventional Concrete, 15%, 25%, 35%, & 50% replacement of cement by industrial waste like fly ash, hypo sludge and rice husk ash. In the test performed, the optimum compressive stress obtained by utilizing paper waste was at 25% replacement. At the place where strength is not of more importance or rather structure is for temporary basis then design mix proportion up to 50% replacement can also be utilized. Test also point towards developing low cost concrete by varying design mix proportion from 15%replacement to 50%replacement. The compared values of cost show gradual decrement in total cost of per cubic meter concrete. To investigate the utilization of hypo sludge, fly ash and rice husk ash as Supplementary Cementations Materials and influence of the Strength of concretes, made with different Cement replacement levels and compare with ordinary concrete. Investigate low cost concrete by using hypo sludge, fly ash and rice husk ash as Supplementary Cementations Material and compare the cost of each per meter cube.

I. INTRODUCTION

Low cost concrete means reduce the cost of making concrete compare to the conventional concrete. This concrete gives the same strength of the conventional concrete. The low cost concrete is very effective for economical weaker section group of people. This system of concrete does not produce environmental effects.

Making of low cost concrete is replace or recycle the concrete ingredient materials such as cement, fine aggregate and coarse aggregate. For the making of low cost concrete first we have to find out the chemical and physical properties of low rate replacement materials. By determining the properties, the material which is economical and capable of giving good strength is selected and used it partially or fully replacement material in concrete. To achieve the good strength in concrete certain amount of admixtures are mixed.

Need for low cost concrete

- Now a day the construction cost is very high, so that the waste materials are used in concrete to reduce the cost of the construction by replacement of concrete ingredient materials.
- Concrete providing is one part of work in construction it is raising the cost of construction. The low cost concrete is used to reduce the cost of construction.

Factors leading to low cost concrete

- The waste material can use an effective in manner.
- Usage of waste materials from the industries we can control pollution.
- By using these waste materials in concrete we can reduce the cost of construction.

Fly Ash Used

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 tonnes, but utilization is still below 20 % in spite of quantum jump in last three to four years. 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. Fly ash reaches its maximum strength more slowly than concrete made with only Portland cement.

Hypo Sludge Used

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. The Hypo sludge in dry powder form is used as an admixture to concrete.

Rice Husk Ash Used

The use of RHA as a partial replacement to cement will provide an economic use of the by-product and consequently produce cheaper materials for low cost construction materials. 22% of the weight of paddy used to produce rice is received as husk. This husk contains about 75% organic volatile matter and the balance 25 % of the weight of this husk is converted into ash during the burning process known as rice husk ash. RHA are very high in silica content but the silica content is depends on the type of rice husk, method of firing and period of combustion [3]. RHA can produced a pozzolanic activity but the pozzolanicity of RHA is depends on its chemical and physical properties. RHA with highly content silica in amorphous phase reported to react with cementations binders to perform pozzolanic activity. So we take hypo sludge, fly ash and rice husk ash for compare it with cement.

Objectives

To investigate the utilization of hypo sludge, fly ash and rice husk ash as Supplementary Cementations Materials and influence of these hypo sludge, fly ash and rice husk ash on the Strength on concretes made with different Cement replacement levels.

In this project the compressive strength of M_{25} grade concrete cube cast with replacement of cement by fly ash, hypo sludge and rice husk ash.

Scope

- Use of fly ash, hypo sludge and rice husk ash as potential partial cement replacement of cement along with 15%, 25%, 35% and 50%.
- Using the industrial waste in useful manner.
- To find the workability of the partial replacement of concrete by slum cone test.
- To find the optimum strength of the partial replacement of concrete.
- To reduce the cost of the construction to analysis Economic feasibility.

Mix design

concrete mixes were designed as per IS: 10262:2000 for M_{25} grade concrete.

Mix Proportion

Partial replacement of cement in %	Replacement materials in %		
	Fly ash	Hypo sludge	Rice husk ash
0	0	0	0
15	5	5	5
25	10	10	5
35	15	15	5
50	20	20	10

Concrete Design Mix Proportions for Partial Replacement of Cement

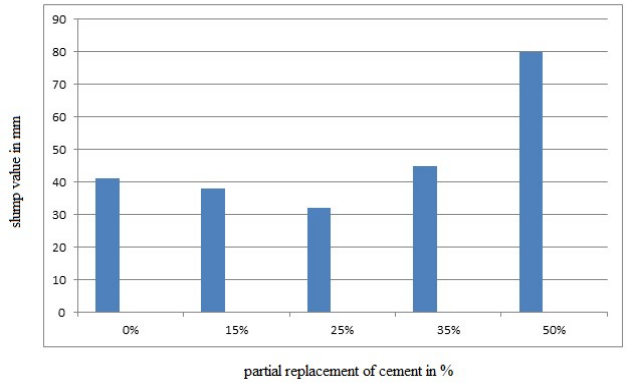
Partial replacement of cement	Concrete design mix proportions for M_{25} grade of concrete						
	W/C ratio	Cement	Fine aggregate	Coarse aggregate	Fly ash	Hypo sludge	Rice husk ash
0%	0.4	1	1.02	2.57	0.00	0.00	0.00
15%	0.4	0.85	1.02	2.57	0.05	0.05	0.05
25%	0.4	0.75	1.02	2.57	0.10	0.10	0.05
35%	0.4	0.65	1.02	2.57	0.15	0.15	0.05
50%	0.4	0.50	1.02	2.57	0.20	0.20	0.10

Results and discussion

Compressive test on concrete cube has been carried out conforming to IS 516-1999. All the concrete cube specimens were tested in a 1000kN capacity compression testing machine. The crushing strength of concrete cube is determined by applying compressive load at the rate of 140kN/min till the specimen fail. After 7days, 14 days and 28 days of curing, the cubes were then allowed to become dry for few hours before testing. Plane surfaces of the specimen were between the platens of compression testing machine and subjective to loading.

Slump Test Result for the Various % Cement Replacement

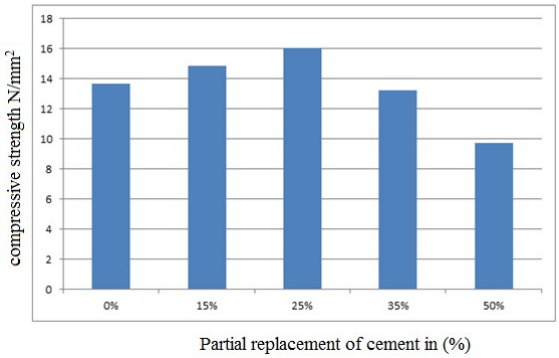
S. No	% Replacement	Slump in (mm)
1	0%	41
2	15%	38
3	25%	32
4	35%	45
5	50%	80



Slump Test Result

Compressive Strength of Cubes for M_{25} at 7 Days

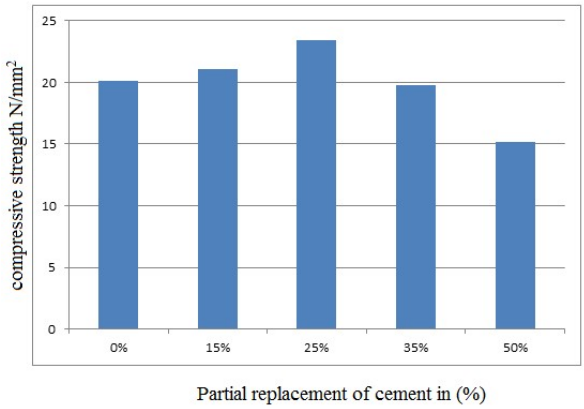
Partial replacement of cement in %				Average ultimate compressive strength (N/mm^2)
	Fly ash	Hypo sludge	Rice husk ash	
0%	-	-	-	13.65
15%	5%	5%	5%	14.83
25%	10%	10%	5%	16.02
35%	15%	15%	5%	13.21
50%	20%	20%	10%	9.73



Compressive Strength Result at 7 Days

Compressive Strength of Cubes for M_{25} at 14 Days

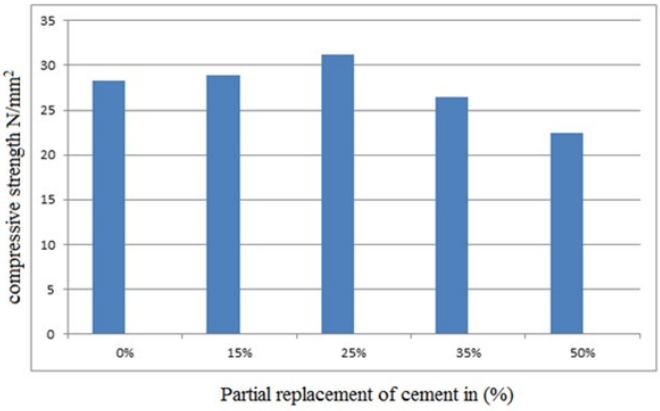
Partial replacement of cement in %				Average ultimate compressive strength N/mm^2
	Fly ash	Hypo sludge	Rice husk ash	
0%	-	-	-	20.11
15%	5%	5%	5%	21.07
25%	10%	10%	5%	23.46
35%	15%	15%	5%	19.81
50%	20%	20%	10%	15.14



Compressive Strength Result at 14 Days

Compressive Strength of Cubes for M_{25} at 28 Days

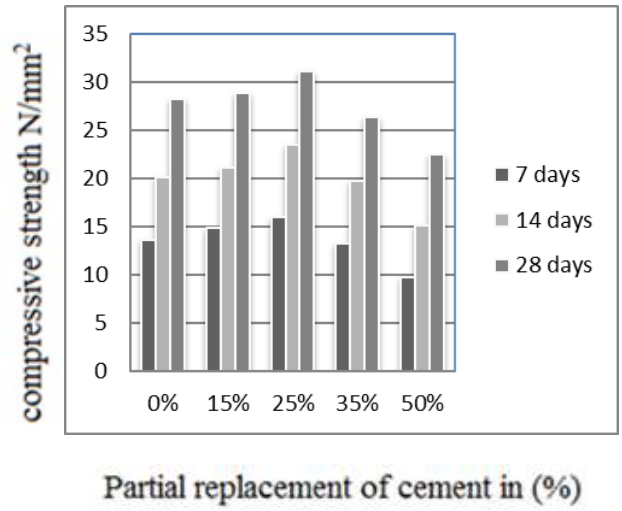
Partial replacement of cement in %				Average ultimate compressive strength N/mm^2
	Fly ash	Hypo sludge	Rice husk ash	
0%	-	-	-	28.32
15%	5%	5%	5%	28.91
25%	10%	10%	5%	31.17
35%	15%	15%	5%	26.42
50%	20%	20%	10%	22.51



Compressive Strength Result at 28 Days

Compressive Strength of Cubes for M_{25} at 7, 14 & 28 Days

Partial replacement of cement in (%)	Average Ultimate Compressive Strength (N/mm^2)		
	7 days	14days	28days
0%	13.65	20.11	28.32
15%	14.83	21.07	28.91
25%	16.02	23.46	31.17
35%	13.21	19.81	26.42
50%	9.73	15.14	22.51



Compressive Strength Result at 7, 14 & 28 Days

The compressive strength of 15% replacement specimen is found to be slightly more than that of control specimen indicating that the addition of 5% fly ash, hypo sludge and rice husk ash. The compressive strength of 25% cement replacement specimen is found to be more than the control specimen and 25% cement replacement specimen. And it also be the highest compressive strength given in all other 15%. 25%. 35%, 50% cement replacement. The result shows that the 25% cement replacement will give the better result. And up to 25% cement replacement the compressive strength wills reduces. ECONOMICAL FEASIBILITY

The change in cost due to adding of fly ash, hypo sludge and rice husk ash replacing cement is worked out in table 6.8. The basic market rates of materials are given table 6.7. Cost decrease due to reduction in cement.

Cost of Materials

S.No	Materials	Rate (Rs/kg)
1	Cement (PPC)	6.6
2	Fly ash	0.65
3	Hypo sludge	0.50
4	Rice husk ash	0.30
5	Fine aggregate	6.4
6	Coarse aggregate	5.4

Cost Variation of Materials for Design Mix M_{25} Concrete

Materials	% Reduction in cement	Material						Total cost (m^3)	% change in cost
		cement kg/m^3	Fine agg kg/m^3	coarse agg kg/m^3	Fly ash kg/m^3	Hypo sludge kg/m^3	Rice husk ash kg/m^3		
Fly ash, hypo sludge & rice husk ash	0	476.16	490.1	1225.3	0	0	0	12895.9	0
	15	404.74	490.1	1225.3	23.81	23.81	23.81	12459.0	3.38
	25	357.12	490.1	1225.3	47.61	47.61	23.81	12172.1	5.61
	35	309.50	490.1	1225.3	71.42	71.42	23.81	11885.2	7.83
	50	238.08	490.1	1225.3	95.23	95.23	47.61	11448.3	11.22

II. CONCLUSION

Based on limited experimental investigation concerning workability and compressive strength of concrete, the following observations are made regarding the resistance of partially replaced hypo sludge, fly ash and rice husk ash.

- Workability reduces at higher replacement of fly ash, hypo sludge and rice husk ash with cement.
- Compressive strength of the concrete after 7, 14 & 28 days the replacement of 25% obtains maximum strength on comparing with other samples of 0%, 15%, 35% and 50% replacement.
- When government implement the projects for temporary shelters for who those affected by natural disaster, this material can be used for economic feasibility.
- Environmental effects from wastes and residual amount of cement manufacturing can be reduced through this low cost concrete.
- The physical and mechanical properties of fly ash, rice husk ash and hypo sludge have been found to be favourable for use in cement concrete as indicates by the compressive strength of concrete specimen tested.

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