A BEHAVIOURAL STUDY OF MANUFACTUED SAND & HYPO SLUDGE IN CEMENT CONCRETE

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Abstract: - *Concrete is today more than 9000 years old and has undergone several changes not only in its composition but also in its performance and applications. From a simple beginning around 7000BC to most complicated design and application in 2013AD, concrete has been used in several structures from housing to various infrastructure projects. Concrete has played a key role in development of our planet earth in developed, developing and under developed countries. Today, development of every type needs concrete, be it in infrastructure, in industry or even in space technology and telecommunication. In the last millennium concrete had demanding requirements both in terms of technical performance and economy and yet greatly varied from architectural masterpieces to the simplest of utilities. Natural sand is excavated from river bed which impacts on environment in many ways. Due to digging of the sand from river bed reduces the water head, so less percolation of rain water in ground, which result in lower ground water level. There is erosion of nearby land due to excess sand lifting as well as it destroys the flora & fauna in surrounding areas. Due to limited supply of natural sand, cost is very high and its consistent supply cannot be guaranteed. Under these circumstances use of alternative of River Sand becomes unavoidable. Also, for sustainable development, it is indeed necessary to utilize various solid waste which leads to environment degradation.*

Over 300 million tons of industrial wastes are being produced per annum by chemical and agricultural process in India. Out of several wastes being produced at present, the use of phosphor-gypsum, flurogypsum, lime sludge, hypo sludge, red mud, and mine tailing is of paramount significance to protect environment.

This research work is concerned with experimental investigation on strength of concrete and partial replacement of cement by 0%, 5%, 10%, 15%, 20 %, 25 %and 30 % of Hypo Sludge while manufactured sand is used as fine aggregate in cement concrete.

In this work, we come to know that 15% of hypo sludge replacement for cement shows maximum strength in all. If we utilize hypo sludge in concrete while manufactured sand is used, it will help us to protect environment from ill effects of extraction of river sand and also from the problem of dumping of hypo sludge.

Key Words: - Hypo sludge, manufacturing sand, Alternative material, Pollution.

1. INTRODUCTION

Concrete is today more than 9000 years old and has undergone several changes not only in its composition but also in its performance and applications. From a simple beginning around 7000BC to most complicated design and application in 2013AD, concrete has been used in several structures from housing to various infrastructure projects. Concrete has played a key role in development of our planet earth in developed, developing and under developed countries. Today, development of every type needs concrete, be it in infrastructure, in industry or even in space technology and telecommunication. In the last millennium concrete had demanding requirements both in terms of technical performance and economy and yet greatly varied from architectural masterpieces to the simplest of utilities.

In the past few years, many research and modification has been done to produce concrete with a view of Sustainability. Sustainability is important to the well-being of our planet, continued growth of a society, and human development.

1.1 Future Challenges for Concrete

India is developing country and we have taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc. To meet the requirements of globalization, in the construction of buildings and other structures, concrete plays the rightful role and a large quantum of concrete is being utilized. Therefore the natural resources which are used to produce concrete, has become highly expensive and also scarce. If we use these natural materials at this speed, it will be scarce or unavailable to future generation. Hence in the backdrop of such a bleak atmosphere, there is large demand for alternative material.

1.2 Why to replace River Sand in Concrete?

- The main cause of concern is the non-renewable nature of natural sand and the corresponding increasing demand of construction industry. Also government have implies restriction to river sand extraction, Therefore looking for an alternative to river sand has become a necessity.

- Natural sand is excavated from river bed which impacts on environment in many ways. Due to digging of the sand from river bed reduces the water head, so less percolation of rain water in ground, which result in lower ground water level. There is erosion of nearby land due to excess sand lifting as well as it destroys the flora & fauna in surrounding areas. Due to limited supply of natural sand, cost is very high and its consistent supply cannot be guaranteed. Under these circumstances use of artificial sand becomes unavoidable. As the supplies of suitable natural sand near the point of consumption are becoming exhausted, the cost of this sand is increasing. Also, the tempering did by dredging sand could damage the fragile ecosystem along the coast. River sand in many parts of the country is not graded properly and has excessive silt and organic impurities.
- In short, the demand of natural sand is quite high in developing countries to satisfy the rapid infrastructure growth, in this situation developing country like India facing shortage in good quality natural sand. Particularly in India, natural sand deposits are being depleted and causing serious threat to environment as well as the society. The main cause of concern is the nonrenewable nature of natural sand and the corresponding increasing demand of construction industry. Therefore looking for an alternative to river sand has become a necessity. The cheapest and easiest alternative to natural sand is manufacturing sand by crushing rocks/stones in desired size and grade by suitable method.
- Scarcity of good quality Natural River sand due to depletion of resources and restriction due to environmental consideration has made concrete manufactures to look for suitable alternative fine aggregate. One such alternative is "Manufactured sand". The Manufacture sand produced by proper machines can be a better substitute to river sand. The Manufactured sand must be of proper gradation and proportion. When fine particles are in proper proportion, the sand will have fewer voids. The cement quantity required will be less. Such sand will be more economical.
- Though manufactured sand has been in use in concrete manufacturing in India, the percentage of its contribution is still very negligible in many parts of the country. Except in Kerala and in some pockets in Southern and Western India, real processed manufacture sand is not available and this makes manufacturing of good quality of concrete very difficult. A well processed manufactured sand as partial or full replacement to river sand is the need of the hour as a long term solution in Indian concrete industry until other suitable alternative fine aggregate are developed.

1.3 Manufacture Sand – An alternative to replace River Sand

- Manufactured sand is crushed aggregates produced from hard stone which is cubically shaped with grounded edges, washed and graded with consistency to be used as a substitute of river sand.
- Manufactured sand is a material of high quality, in contradiction to non-refined surplus from coarse aggregate production. By using the Internet in search for information of this topic it is evident that a variety of terms are used for this or similar product internationally, including: Manufactured stone sand / manufactured fine aggregate, Crushed fine aggregate / Crusher sand, Stone sand / Stone powder, Quarry fines / Quarry sand, Artificial sand

1.4 Hypo sludge

- Hypo sludge produced in a large amount as by product of paper industry and is usually used in concrete production as partial replacement of cement.
- It contains low calcium and minimum amount of silica and it's due to presence of silica and magnesium properties that it behaves like cement.
- Use of hypo sludge in concrete can save the paper industry disposal costs and also produces a sustainable concrete for construction.

1.5 Significance of the study

- Sustainable development is need of time. We must focus for available alternatives in order to protect environment and to conserve natural resources for future generation.
- River sand is scarce natural material. Excess use of river sand leads to environmental degradation. If we find alternative way of using manufactured sand as replacement of river sand, we can not only have new construction material but also protect the Environment.

1.6 Objective of Study:

- To study effect of using Hypo sludge as replacement of Cement while manufactured sand is used as replacement of river sand.
- To determine the optimum replacement level of hypo sludge in Concrete for sustainable development.
- To check cost feasibility by incorporation of these materials.

1.7 Scope of Study:

- Concrete Mix design for M25 will be produced with manufactured sand as reference mix.
- Cement will be replaced partially by Hypo Sludge at 5%,10%,15%,20%,25%,30%
- The scope of present study is limited for Fresh concrete test (Slump cone test) and harden concrete test (compressive strength)
- Hypo sludge and construction debris are environmental concern if we utilize them in concrete production, it will lead to material conservation for sustainable development.

2. REFERENCES

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2.1 Out-come of literature review:

- After carefully reading various literatures, we have concluded following:
- Nowadays the consumption of cement is more. Therefore environment pollution is more also if we use cement at same rate, it will not available for future generation as the raw material (Lime stone) used for production of cement may finish. Therefore an alternative is required to reduce consumption of cement in concrete.
- Hypo sludge is a waste material of Paper industry for which disposal is a environmental problem. However, the properties of hypo sludge helps in replacement of cement.
- River sand is natural sand and the resource is limited, we cannot produce it.Also, extraction of river sand from river causes environmental problems as it causes disturbance to aquatic life. Hence alternative o river sand have to be found.
- Manufacture sand is one of such alternative.
- In this project, we will replace 100% of river sand by manufactured sand and we will partially replace cement by hypo sludge

3. PROPERTIES

3.1 Manufactured sand

Table 3.1: Properties of Manufactured sand

Sr. No.	Test	Result
1	Gradation percentage passing IS Sieve	
	4.75mm	100%
	2.36mm	86%
	1.18mm	67%
	600micron	40%
	300micron	16%
	150 micron	3%
2	Grading zone	II
3	Fineness modulus	2.88
4	Specific gravity	2.69
5	Water absorption (%)	1.63
6	Silt content	0%

3.2 Hypo sludge result:

Table 3.2: Properties of Hypo Sludge

Sr. No.	Test Parameters	Units	Result	Test Method
1	Insoluble reidue	%	0.390	IS 4032:1985
2	Loss on ignition	%	38.06	IS 4032:1985
3	Ratio of % of alumina to that of iron oxide	%	0.360	IS 4032:1985
4	Ratio of % of lime too % of silica,alumina and iron oxide	%	2.86	IS 4032:1985
5	Teotal sulfer content calcukated as sulphuric anhydride	%	0.170	IS 4032:1985
6	Magneia, % by mass	%	1.12	IS 4032:1985
7	Totle alkali content as No2O	%	0.830	IS 4032:1985
8	Chloride as Cl	%	0.450	IS 12423:1988

4. EXPERIMENTAL PROGRAM

4.1 Planning of Experimental Program

In this Experimental Program, we have to cast cubes, beams and cylinders with River sand & Manufacture sand to compare concrete with both materials. We have planned casting schedule as below:

Table no. 4.1 Details of Experimental program

Sr. no.	Description	Id-mark	Test	Specimen
1	Cube	REF	Compressive strength Test	6
2	Cube	5HYP	Compressive strength Test	6
3	Cube	10HYP	Compressive strength Test	6
4	Cube	15HYP	Compressive strength Test	6
5	Cube	20HYP	Compressive strength Test	6
6	Cube	25HYP	Compressive strength Test	6
7	Cube	30HYP	Compressive strength Test	6

Table no. 4.2 Explanation of ID-mark and Casting Schedule

Id-Mark	Description	To be tested for	Casting Date
REF	Cube with 0 % Hypo sludge	Compressive Strength	26/01/20
5HYP	Cube with 5 % Hypo sludge	Compressive Strength	26/01/20
10HYP	Cube with 10 % Hypo sludge	Compressive Strength	26/01/20
15HYP	Cube with 15 % Hypo sludge	Compressive Strength	26/01/20
20HYP	Cube with 20 % Hypo sludge	Compressive Strength	26/01/20
25HYP	Cube with 25 % Hypo sludge	Compressive Strength	26/01/20
30HYP	Cube with 30 % Hypo sludge	Compressive Strength	26/01/20

5. RESULT ANALYSIS

5.1 Test Results of Reference Specimens

Various Specimens casted with river sand to know characteristics of concrete are tested as per Standards and results are as below:

5.1.1 Compressive Strength Test of Concrete

Cubes were casted as per schedule to know Compressive strength of concrete and were tested as per standards as explain ahead. The results obtained **are as below:**

Table No. 5.1 Result for Compressive Strength Test of Concrete at 7 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg.
1	REF	26/01/20	03/02/20	522	22500	23.20	24.18
2				534		23.73	
3				576		25.60	

Table No. 5.2 Result for Compressive Strength Test of Concrete at 28 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg.
1	REF	26/01/20	24/02/20	732	22500	32.53	34.31
2				768		34.13	
3				816		36.27	

Table No. 5.3 Result for Compressive Strength Test of Concrete at 7 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	5hyp	26/01/20	03/02/20	586	22500	26.00	24.58
2				546		24.27	
3				528		23.47	

Table No. 5.4 Result for Compressive Strength Test of Concrete at 28 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	5hyp	26/01/20	24/02/20	768	22500	34.13	**34.57**
2				762		33.86	
3				804		35.73	

Table No. 5.5 Result for Compressive Strength Test of Concrete at 7 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	10hyp	26/01/20	02/02/20	534	22500	23.73	**25.06**
2				558		24.8	
3				600		26.67	

Table No. 5.6 Result for Compressive Strength Test of Concrete at 28 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	10hyp	26/01/20	24/02/20	786	22500	34.93	**35.28**
2				780		34.66	
3				816		36.26	

Table No. 5.7 Result for Compressive Strength Test of Concrete at 7 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	15hyp	26/01/20	03/02/20	576	22500	25.6	**25.15**
2				534		23.73	
3				588		26.13	

Table No. 5.8 Result for Compressive Strength Test of Concrete at 28 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	15hyp	26/01/20	24/02/20	816	22500	36.26	**36.62**
2				828		36.8	
3				828		36.8	

Table No. 5.9 Result for Compressive Strength Test of Concrete at 7 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	20hyp	26/01/20	03/02/20	558	22500	24.8	**23.73**
2				534		23.73	
3				510		22.66	

Table No. 5.10 Result for Compressive Strength Test of Concrete at 28 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	20hyp	26/01/20	24/02/20	780	22500	34.66	**32.70**
2				690		30.66	
3				738		32.80	

Table No. 5.11 Result for Compressive Strength Test of Concrete at 7 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	25hyp	26/01/20	03/02/20	552	22500	24.53	**22.48**
2				462		20.53	
3				504		22.40	

Table No. 5.12 Result for Compressive Strength Test of Concrete at 28 Day

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	25hyp	26/01/20	24/02/20	708	22500	31.46	**31.46**
2				708		31.46	
3				708		31.46	

Table No. 5.13 Result for Compressive Strength Test of Concrete at 7 Days

Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	30hyp	26/01/20	03/02/20	456	22500	20.26	**21.24**
2				498		22.13	
3				480		21.33	

Table No. 5.14 Result for Compressive Strength Test of Concrete at 28 Days

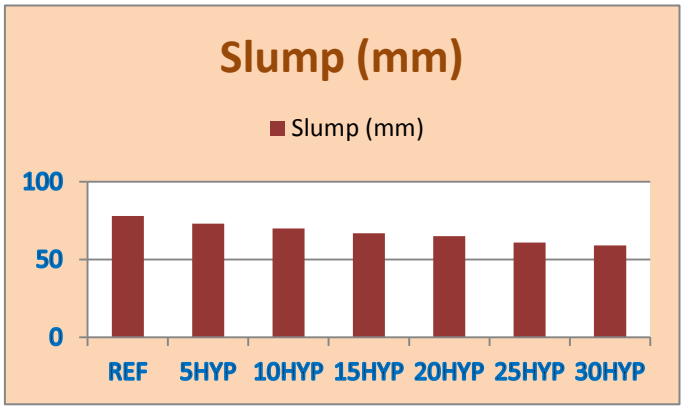
Sr. no.	Id- Mark	Casting Date	Testing Date	Load (KN)	Area of cube (mm2)	Compressive Strength (N/mm2)	Avg. (N/mm2)
1	30hyp	26/01/20	24/02/20	702	22500	31.20	**31.46**
2				720		32.00	
3				702		31.20	

5.2 Slump Cone Test

Concrete with river sand was tested for workability by slump cone test as per IS and it is observed as below:

Table No. 5.15: Result for Slump Test of Concrete

Sr. no.	Id-mark	Slump (mm)
1	REF	78
2	5HYP	73
3	10HYP	70
4	15HYP	67
5	20HYP	65
6	25HYP	61
7	30HYP	59

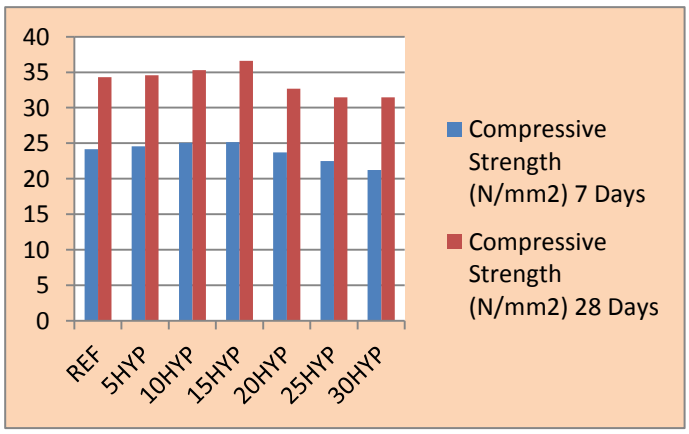


Graph No. 1: Graphical representation of result For Slump Test of Concrete

5.3 Comparison of Compressive strength

Table No. 5.16: Result for Slump Test of Concrete

Sr. no.	Id-mark	Compressive Strength (N/mm2)	
		7 Days	28 Days
1	REF	24.18	34.31
2	5HYP	24.58	34.57
3	10HYP	25.06	35.28
4	15HYP	25.15	36.62
5	20HYP	23.73	32.70
6	25HYP	22.48	31.46
7	30HYP	21.24	31.46



Graph No. 2: Graphical representation of result For Compressive Strength of Concrete

6. Conclusion

The major outcomes of these project work are below:

[1] The objective of our study is to find alternative to reduce cement consumption in concrete and hence to reduce effect of cement production on environment. Also, we are using manufactured sand instead of river sand which facilitates to protect environment from problems associated with extraction of sand from river. Here, 15 % replacement of cement by hypo sludge with manufactured sand is possible which means we can utilize this to protect environment.

[2] The Workability of concrete reduces as percentage of hypo sludge increases in concrete while manufactured sand is used instead of River sand.

[3] The Compressive strength of concrete increases up to 15 % replacement of cement by hypo sludge and then it decreases.

[4] From the result, we can say that 15 % hypo sludge as replacement of cement gives us better strength and desired workability. Hence we can use 15 % hypo sludge as replacement of cement while using manufactured sand as replacement of river sand.