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COMPARATIVE STUDY ON UTILIZATION OF WASTE PAPER SLUDGE AS PARTIAL REPLACEMENT OF CEMENT IN CONCRETE

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Abstract

Paper production industries produce a large amount of solid waste. Many companies burn their sludge in incinerators which leads towards air pollution. This research is aim to evaluate the addition of waste paper to concrete cubes cylinders and beams , to study the effect of waste paper on the strength of concrete, and we also worked on testing of waste paper sludge to find out the amount of chemical compounds are present which is co-related to cement.

In present study work we are going to replacing cement with waste paper sludge at 7%, and 10% respectively. Therefore we have visited Ashapura paper mill at nanireldi near kukma,Bhuj, kutchh to collect sludge disposal and use it with cement in percentage of partial replacement. Material was in dry form when we collect it from paper mill after that we did grinding and convert it into powder form to make it use easily with cement. That powder material passed through 2.36 mm I.S sieve.

We have casted total 27 cubes, 54 cylinders, and 9 beam in which we have included normal cubes, cylinders, and beams and waste paper sludge cubes, cylinders, and beams which is partial replaced with cement. This experimental investigation is carry out on different cubes, cylinders, and beams (such as normal cubes, cylinders, and beams and WPS replaced cubes, cylinders, and beams) which have standard size of cube 15cm x 15cm x 15cm, cylinder 15cm dia. x 30cm, beam 70cm x 15cm x 15cm and compare the results to check compressive strength, Split tensile strength and flexural strength test after 7 days, 14 days & 28 days of curing respectively.

Keywords- *Low Cost Technology, Waste Paper Sludge, WPS moulds, Normal Cement concrete moulds, Compressive Strength, Universal testing machine.*

I. INTRODUCTION

In order to make concrete industry sustainable, the use of waste materials in place of natural resources is one of the best approaches. Industrial waste is produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories, mills and mines.

Some example of industries waste is: Rubber, Plastic, Chemical solvent, Fly ash, Polymer fibers, Waste Paper, leather, glasses, wooden pieces, metals, PVC materials etc.

Recycling of this product is great way to dispose of industrial waste because the waste can be reused to make new product. Material such as glass and aluminum can be recycled and used in manufacturing other products. If there is industrial waste is can't be recycled in our planet anywhere waste seen therefore recycled is best way to make our planet green.

Production of paper all around world is about 8.4 to 11.2 metric tons per annum. Paper producing industries produce a large amount of solid waste. Many companies burn their sludge in incinerators which leads towards air pollution. Paper making generally produces a large amount of solid waste. Paper fibers can be recycled only a limited number of times before they become too short or weak to make high quality paper. It means that the broken, low quality paper fibers are separated out to become waste sludge. Uses of hypo sludge in brick can save the paper industry disposal costs and produce a 'greener' bricks for construction. An innovative supplementary compendious construction material formed through this study.

Figure 1. Waste Paper Sludge

II. MATERIAL SPECIFICATION & BLOCK DIMENSIONS

2.1. Cement

The most common cement used is an ordinary Portland cement. The Ordinary Portland cement of 53 grades conforming to (IS: 12269 1987) is use. Many tests were conducted on cement; some of them are standard consistency tests, Initial Setting Time (43 min) &Final Setting Time (5 h: 4 min). Specific gravity of cement is taken 3.15.

2.2. Sand

Sand used throughout the work comprised of clean river sand size of 0.425mm to 2.0mm. Suitable zone II as per IS383-1970 with specific gravity (G) of 2.6 and Bulk Density is 1588.98 Kg/m^3.

2.3. Coarse aggregate

Aggregates are the important constituents in concrete. The coarse aggregates may be crushed graves or stone obtained by crushing of gravel or hard stone. We are taken normal maximum size of aggregate is 10mm and 20 mm.

2.4. Water

The water used in the manufacture of WPS Blocks is potable water.

2.5. Waste Paper Sludge (WPS)

Waste paper sludge was obtained from Ashapura paper mill at NANIRELDI, DISTRIC KUTCH, Bhuj - 370105, Gujarat, India.

Figure 2: Waste paper sludge

Sludge disposal was in semi liquid form when we were collected it from factory. It is required to put waste paper sludge in sunlight to make it dry. After that it is required to grind dry material to convert it in powder form and checked that from which I.S. sieve this material would pass. It is find out that from 2.36 mm I.S. sieve, this material is passed.

Figure 3: Waste paper sludge in semi liquid form

Figure 4: Waste paper sludge in semi dry form

2.6. Chemical Components Present in WPS

Table 1: Chemical Components Comparison of waste paper sludge and opc cement

Waste Paper Sludge		OPC Cement	
Component	**Mass %**	**Component**	**Mass %**
SiO_2	4.88	SiO_2	19 to 23
SO_3	4.64	SO_3	1.5 to 4.5
Fe_2O_3	2.05	Fe_2O_3	0 to 6
Al_2O_3	3.12	Al_2O_3	2.5 to 6
CaO	83.5	CaO	61 to 67

After performing XRF Analysis on waste paper sludge, it was found that similar chemical components are present in percentage of mass in waste paper sludge and ordinary Portland cement. For that purpose we have used waste paper sludge as partial replacement with cement.

2.7. Size of various types of moulds

1. CUBE: The size of cube is 15cm x 15cm x 15cm so of we casting a normal concrete cubes and partial replacement of waste paper sludge. Here the volume of one cube is 3.375×10^{-3} m^3.

2. CYLINDER: The size of cube is 15cm x 30cm so of we casting a normal concrete cylinders and partial replacement of waste paper sludge. Here the volume of one cylinder is 5.301 x 10^{-3} m^3.

3. BEAM: The size of cube is 70cm x 15cm x 15cm so of we casting a normal concrete beams and partial replacement of waste paper sludge. Here the volume of one beam is 5.301 x 10^{-3} m^3

Figure 5: Various types of moulds

III. QUANTITY OF MATERIALS

3.1. Mix design:

The mix design of concrete as partial replacement with cement in percentage of 0%, 7% and 10% is given in below procedure. We used the Mix Proportions is 1: 1.45: 3.3 for M 20 grade concrete.

3.2. Quantity of materials

Table 2: Quantity of materials for volume of 9 cubes 0.030375 m^3

Waste Paper Sludge replacement with cement in %	Water contain (lit)	Cement (kg)	Sand (kg)	Coarse Aggregate (10mm) (kg)	Coarse Aggregate (20mm) (kg)	Waste Paper Sludge (kg)	Additional water (lit)
0	5.75	11.47	18.50	16.85	27.18	0	0
7	5.33	10.66	12.33	16.85	27.18	0.80	1.5
10	5.16	10.32	12.33	16.85	27.18	1.15	1.85

Table 3: Quantity of materials for volume of 18 cylinders 0.09542 m^3

Waste Paper Sludge replacement with cement in %	Water contain (lit)	Cement (kg)	Sand (kg)	Coarse Aggregate (10mm) (kg)	Coarse Aggregate (20mm) (kg)	Waste Paper Sludge (kg)	Additional water (lit)
0	17.90	35.78	57	52.94	85.40	0	0
7	16.65	33.27	57	52.94	85.40	2.50	2
10	16.10	32.19	57	52.94	85.40	3.60	2.4

Table 4: Quantity of materials for volume of 3 beams 0.04725 m^3

Waste Paper Sludge replacement with cement in %	Water contain (lit)	Cement (kg)	Sand (kg)	Coarse Aggregate (10mm) (kg)	Coarse Aggregate (20mm) (kg)	Waste Paper Sludge (kg)	Additional water (lit)
0	9	18	28.52	26.18	42.24	0	0
7	8.37	16.74	28.52	26.18	42.24	1.26	1.3
10	8.1	16.2	28.52	26.18	42.24	1.8	1.7

3.3. Casting of cubes, cylinders and beams

We have casted total 27 cubes, 54 cylinders and 9 beams. In it included normal cubes, cylinders, beams and waste paper sludge cubes, cylinders, beams.

IV. TEST RESULTS

4.1. Various type of test

- Slump test
- Compressive strength test
- Split tensile strength
- Flexural strength test

4.2. Weight of cubs and cylinders

This comparison is weight of normal concrete moulds and replacement waste paper sludge moulds.

Table 5: Weight comparison for cubes

Sr. No	Waste Paper Sludge replacement with cement in %	Weight of wet cubes (kg)	Weight of dry cubes (kg)
1	Normal concrete cubes	8.92	8.60
2	7(WPS moulds)	8.6	8.55
3	10(WPS moulds)	8.67	8.45

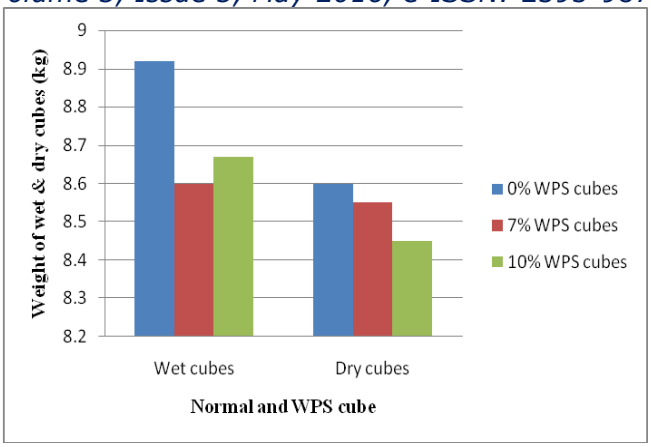

Figure 6: Weight of wet & dry cubes

Table 6: Weight comparison for cylinders

Sr. No	Waste Paper Sludge replacement with cement in %	Weight of wet cylinder (kg)	Weight of dry cylinder (kg)
1	Normal concrete cylinders	13.48	13.38
2	7(WPS moulds)	12.8	12.62
3	10(WPS moulds)	12.85	12.51

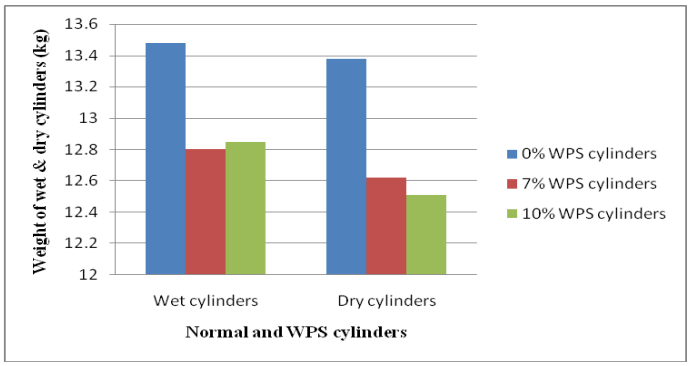

Figure 7: Weight of wet & dry cylinders

4.3. Results

Table 7: Average Compressive Strength of Cubes after 7, 14 and 28 days of curing

Partial replacement of WPS with cement in (%)	Strength of Cube 7 days (N/mm^2)	Strength of Cube 14 days (N/mm^2)	Strength of Cube 28 days (N/mm^2)
0% WPS	15.19	17.60	19.55
7 % WPS	14.66	15.11	17.66
10% WPS	13.66	14.66	15.99

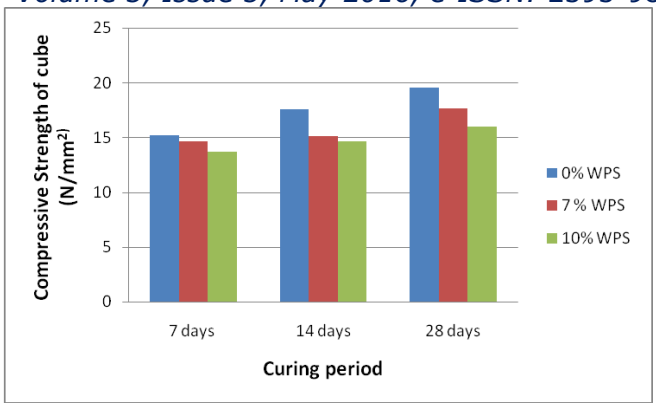

Figure 8: Strength of cubes after 7, 14 and 28 days of curing

Table 8: Average Compressive Strength of Cylinders after 7, 14 and 28 days of curing

Partial replacement of WPS with cement in (%)	Strength of Cylinders 7 days (N/mm^2)	Strength of Cylinders 14 days (N/mm^2)	Strength of Cylinders 28 days (N/mm^2)
0% WPS	18.74	24.70	24.75
7 % WPS	17.68	20.65	22.34
10% WPS	16.26	19.05	21.35

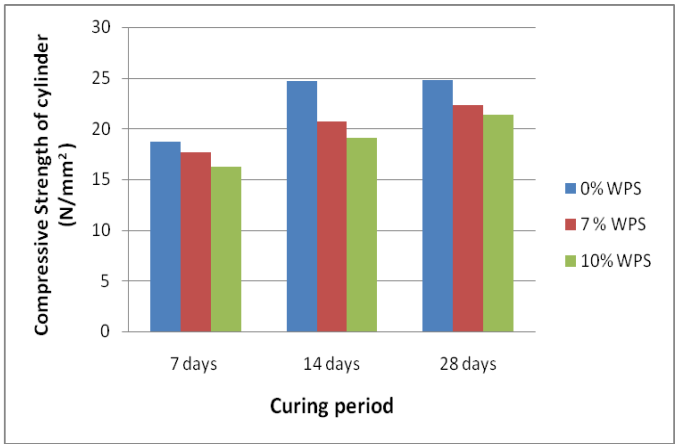

Figure 9: Strength of cylinders after 7, 14 and 28 days of curing

Table 9: Average flexural strength of beam after 28 days of curing

Partial replacement of WPS with cement in (%)	Flexural strength of Beams after 28 days (N/mm^2)
0% WPS	4.03
7 % WPS	2.62
10% WPS	2.23

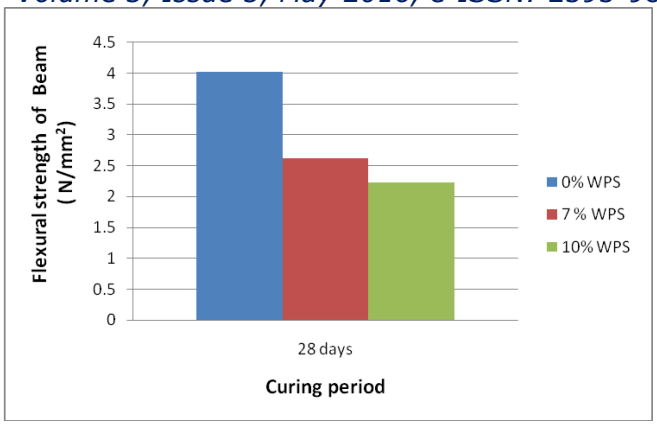

Figure 10: Flexural strength of beam after 28 days of curing period

CONCLUSION

The following conclusions are obtained from above study:

1) During the process of replacement, sludge is the waste material, therefore strength will be not increased with compared to cement.
2) Water absorption capacity of waste paper sludge is more than cement, therefore bonding process of waste paper sludge with concrete is very poor and it is also affect on the strength of concrete.
3) Split tensile strength test results for cylinders are approximately same with results which are required after 28 days curing period.
4) Comparison of compression test results of cubes for normal concrete with 7% WPS replaced concrete is 90.33% similar and between 7% to 10% WPS concrete is 90.54% similar after 28 days curing period.
5) Comparison of compression test results of cylinders for normal concrete with 7% WPS replaced concrete is 92.84% similar and between 7% to 10% WPS concrete is 87.90% similar after 28 days curing period.
6) Flexural test results of beams for normal concrete and WPS concrete is 60 % similar and between 7% to 10% WPS concrete are 85% similar.
7) Waste paper sludge as per like we can used in blocks, partisan wall, boundary wall, boundary poll, inter lock, temporally godown, etc.
8) Waste paper sludge is economical because non useful waste material and available free of cost.

REFERENCES

[1] Mohammad Ismail ,Bala Muhammad, Fabrication of Bricks From Paper Sludge.

[2] Rafiq Ahmad ,Muzaffar Bashir Wani, Study of Concrete Involving Use of Waste Paper Sludge Ash as Partial Replacement of Cement.

[3] MohamadShukeri ,Naser Abdul Ghani, Concrete mix with waste paper.

[4] *MamataRajgor ,JunedPeerzada , ApurvaKulkarni*, A Miniscule Endeavour for Accomplishing Hypo Sludge Brick in Indian Context.

[5] Sumit A Balwaik ,S P Raut, Utilization of Waste Paper Pulp by Partial Replacement of Cement in Concrete.