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Experimental Assessment of the Effect of Paper Waste on Improvement of Concrete Behavior

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ABSTRACT

India is facing a significant challenge in disposing the waste in landfills throughout the country. The landfill disposal is leading to high disposal costs and potential environmental problems. If the current trend continues, waste production will grow by 5% each year, which will ultimately result in a saturated capacity of landfills by 2020. The use of paper industry waste in concrete formulations was investigated as an alternate to landfill disposal. The cement has been replaced by paper sludge accordingly within the range of fifty to fifteen by weight for the M-20 mix. By using an adequate amount of paper and water, concrete mixtures were produced and compared in terms of slump and strength with the traditional concrete. The concrete specimens were tested for compressive strength. These tests were administered to judge the mechanical properties for up to twenty-eight days. As a result, the compressive increased up to 5% addition of paper waste and further increased in waste paper reduces the strengths gradually. The research on the use of paper waste can be further carried out in concrete manufacturing as a new recycled material.

KEYWORDS: *Paper sludge, Cement Concrete, Compressive strength*

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1. INTRODUCTION

Paper waste has been used as a building material for many years, especially in cementation matrices and since then, plenty of research has been done to develop the mechanical properties of the composite like compressive strength. The use of Paper waste in structural concrete could become a cost-effective and profitable substitute to landfills, incinerator, or other useful options. The research on the use of paper waste is often further administered in concrete manufacturing as a replacement recycled material. the utilization of paper waste in concrete formulations was investigated as an alternative to landfill disposal. India is facing a significant challenge in disposing of waste in many landfills throughout the country. The landfill situation is leading to high disposal costs and potential environmental problems.

Paper making generally produces an outsized amount of solid waste. Paper fibers can be recycled only a limited number of times before they become too short or weak to form high-quality paper. It means the broken, low-quality paper fibres are separated intent on become waste sludge. The shiny finish on glossy magazine-type paper is produced employing a fine kaolin clay coating, which also becomes solid waste during recycling. This paper waste consumes an outsized percentage of local landfill space every year. Some companies burn their sludge in incinerators, contributing to our serious pollution problems. to scale back disposal and pollution problems emanating from these industrial wastes, developing profitable building materials from them is most essential.

2. EXPERIMENTAL WORK

MATERIALS

CEMENT: Portland cement is the most common type of cement used as a basic ingredient of concrete. It is commonly utilized in general concrete construction when there's no exposure to sulphates within the soil or groundwater. OPC usually originates from limestone.

ARTIFICIAL SAND: Artificial sand is manufactured by granulating good quality stone metal. The practical size and shape and also the overall gradation of artificial sand is controlled in the manufacturing process, which takes place in the fully automated state-of-the-art manufacturing unit. The result's excellent quality sand with consistent gradation. Thus, the major weaknesses of natural sand are like particle sizes, presence of organic impurities, etc. are totally overawed. Artificial sand is widely used around the world and technicians of major projects around the world insist on the compulsory use of artificial sand because of its consistent gradation and zero impurity. Artificial sand is excellent quality sand that is manufactured according to the specification of IS 2116 – 1980 – 2.0 & IS:38:1970.

COARSE AGGREGATE: The aggregate having a size of more than 4.75 mm is called as coarse aggregate.

PAPER WASTE: The paper waste used in this study was collected from the Shree board paper industry in Solapur, India, which was dried in sunlight and then pulverized. The fibrous nature of waste gives very high energy absorbing ability and hence high compressive strength.

Fig -1: Waste Paper Sludge

Table -1: Chemical composition of waste paper

Sr. no.	Element	Percentage content
1.	O	15.83
2.	Ca	14.94
3.	Si	60.57
4.	Al	2.06
5.	Mg	3.59

3. MIX PROPORTIONS

By using IS method, M20 grade concrete were designed, Proportion 1:2.02:3.28

Table -2: mix proportions

Paper waste %	W/c ratio	Water (kg/m^3)	Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Paper waste (kg/m^3)	Coarse Aggregate (kg/m^3)	Slump (mm)
0	0.55	191.58	348.327	702.23	0	1145.749	25
5	0.55	191.58	330.91	702.23	17.466	1145.749	24
10	0.55	191.58	313.49	702.23	34.837	1145.749	20
15	0.55	191.58	296.077	702.23	52.249	1145.749	16

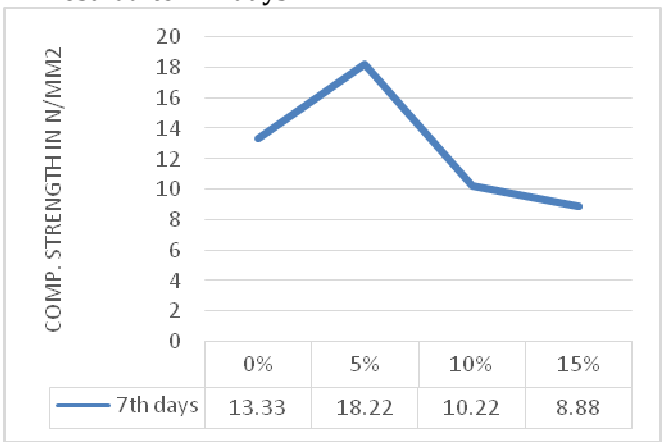
4. DETAILS OF THE EXPERIMENTAL STUDY

Compressive Strength:

Test 150 mm × 150 mm × 150 mm concrete cubes were casting using M20 grade concrete. Specimens with ordinary Portland cement (OPC) and OPC replaced with paper hypo sludge at 05%, 10%, 15%, levels were cast. During casting the cubes were mechanically vibrated by using a table vibrator. After 24 hrs the specimens were removed from the mould and subjected to water curing for 7, 14 and 28 days. After curing, the specimens were tested for compressive strength using compression testing machine.

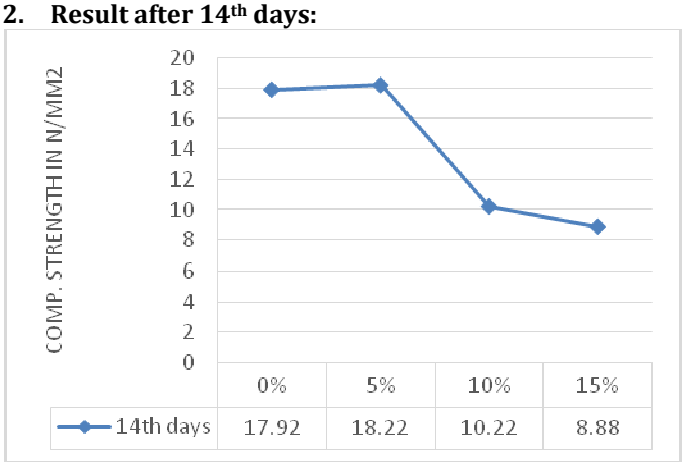
5. RESULTS AND DISCUSSIONS

1. Result after 7th days:



The graph the variation in compressive strength after 7 days. An increase in compressive strength was observed at 5% replacement of cement by waste paper and there after decreasing. The maximum compressive strength measured was 33.18% more than that of reference mix at 7th days corresponding to concrete mix containing 0% waste paper waste in place of cement. Compressive strength for concrete mix with 10% and 15% waste paper content was found to be less than that of reference mix at 7th day.

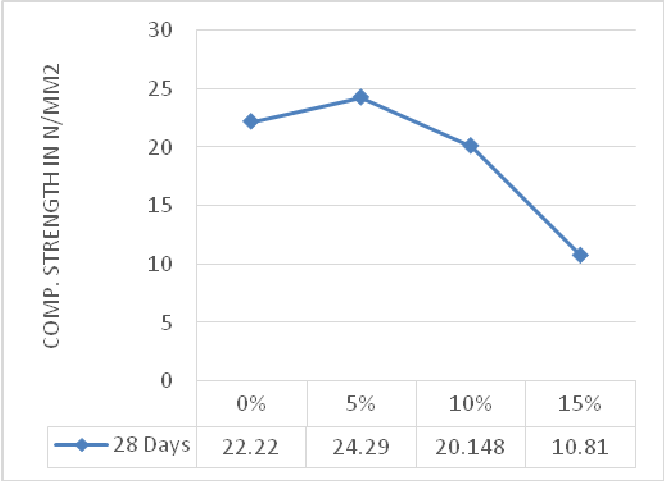
2. Result after 14th days:



The graph the variation in compressive strength after 14 days. An increase in compressive strength was observed at 5% replacement of cement by waste paper and there after

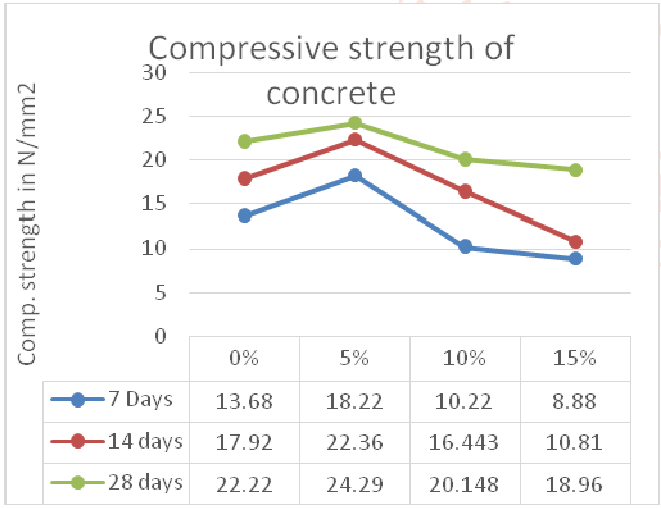
decreasing. The maximum compressive strength measured was 24.77 % more than that of reference mix at 14th days corresponding to concrete mix containing 0% waste paper waste in place of cement. Compressive strength for concrete mix with 10% and 15% waste paper content was found to be less than that of reference mix at 14th day.

3. Result after 28th days:



The graph the variation in compressive strength after 28 days. An increase in compressive strength was observed at 5% replacement of cement by waste paper and there after decreasing. The maximum compressive strength measured was 9.315 % more than that of reference mix at 28th days corresponding to concrete mix containing 0% waste paper waste in place of cement. Compressive strength for concrete mix with 10% and 15% waste paper content was found to be less than that of reference mix at 28th day.

4. Final Result:



Compressive strength test was carried out at 7, 14 and 28 days. An increase in compressive strength was observed at 5% replacement of cement by waste paper and there after decreasing. The maximum compressive strength measured was 9.315% more than that of reference mix at 28 days corresponding to concrete mix containing 0% waste paper waste in place of cement. Compressive strength for concrete mix with 10% and 15% waste paper content was found to be less than that of reference mix.

6. COST ANALYSIS

1. Cement: 310 Rs/bag
2. Crushed sand:1272.08/M3
3. Coarse aggregate: 883.39 / M3
4. Water: 1/lit

For 1M³ M20 Concrete.

Table -3: Cost Analysis Of 0% paper waste in concrete

Sr. no	Material	Quantity	Rs/unit	Total cost
1	Cement	6.97 bag	310/-	2160.7/-
2	Crushed Sand	0.46 m³	1272.08/-	585.156/-
3	Aggregate	0.75 m³	883.39/-	662.54/-
4	Water	191.58 lit	1/-	191.58/-
			Total cost	3599.976/-

Table -4: Cost Analysis of 5% paper waste in concrete

Sr. no.	Material	Quantity	Rs / unit	Total cost
1	Cement	6.61 bag	310	2049.1/-
2	Paper waste	17.42 m³	4	17.42/-
3	Crushed sand	0.46 m³	1272.084	585.156/-
4	Aggregate	0.75 m³	883.392	662.54/-
5	Water	191.58 Lit.	1	191.58/-
			Total cost	3558.056/-

Difference = 3599.976 – 3558.056 = 41.92 /-

by replacing 5% paper waste by cement we got increase in strength by 9.315% as well as save in cost is Rs 41.92/- for 1 cumec.

7. CONCLUSIONS

On the basis of results obtained, following conclusions can be drawn:

1. Concrete mixes containing 5% of paper waste, have shown an increase compressive strength respectively when compared to 10% and 15%.
2. It can be concluded that an application of 5% of paper waste, to concrete mix may be conveniently allowed.
3. Use of waste paper in concrete can prove to be economical as non-useful waste concrete and free of cost.
4. Use of waste paper in concrete will reduce the disposal problem of waste paper, reduce emission of harmful pollutants by cement manufacture industry into our environment and thus prove to be environment friendly, paving way for greener concrete.

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