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RESEARCH ARTICLE

EXPERIMENTAL INVESTIGATION ON CONCRETE USING HYPO SLUDGE AND WOOD ASH.

P.Packialakshmi[1], R.Aasha jyothi[2].

1. Structural Engineering, PG student, Sethu institute of technology, Virudhunagar, India.
2. Dept. of Civil Engineering, Assistant professor, Sethu institute of technology, Virudhunagar, India.

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Corresponding Author

P.Packialakshmi.

Abstract

The paper discusses the effects of using hypo sludge and wood ash (prosopisjuliflora ash) as a partial cement replacement in concrete. An experimental study of concrete made with Ordinary Portland Cement (OPC) and 10% of OPC, replaced by hypo sludge. The hypo sludge 10% take as constant and further adding of wood ash from 0% to 30% as cement replacement for concrete. To determine the effect of these materials on concrete properties and was compared to control M20 mix. Concrete specimens were tested for compressive strength, tensile strength, and flexural strength at age of 28 days.

Introduction:-

The interest of the construction community in using waste or recycled materials in concrete is increasing because of the emphasis placed on sustainable construction. The hypo sludge from in and around the primary paper industrial waste and disposed as landfill. It helps in reducing the cost of cement and concrete manufacturing, but also has numerous indirect benefits such as reduction in landfill cost, saving in energy, and protecting the environment from possible pollution effects. To save energy and to earn carbon credit is very essential for the betterment of mankind. To produce 1ton of ordinary Portland cement an equal amount of carbon-dioxide are released into the atmosphere which is harmful to the environment. Energy plays an important role in era of developing countries like India. By earning carbon credit by using industrial waste (hypo sludge) for building materials like cement, the energy and environment can be saved. Hypo sludge is also called as paper mill sludge. To make good quality paper limited number of times recycled paper fibres can be used which produces a large amount of solid waste. It means that the broken, low quality paper fibres are separated out to become waste sludge. This paper mill sludge consumes a large percentage of local landfill space for each and every year. Use of hypo sludge in concrete can save the paper industry disposal costs and produces a greener concrete for construction. It is also need to reduce the cost of concrete for rural development in India. It released low amount of carbon-dioxide into the atmosphere. The important needs to using hypo sludge is to reduce the environmental and population issues while using the hypo sludge the usage of cement will be reduced.

Wood ash is obtained from the combustion of wood. Wood ash prepared from the uncontrolled burning of the wood (ProsopisJuliflora). During the last decades it has been recognized with growing wood ash waste of large volume and that is increasing year in the household, mills and factories. The utilization of these waste materials can be an economical and eco-friendly alternative in nearby areas for rural road construction. Using the waste in useful manner.

Materials:-

Cement:-

Cement is general can be defined as a material which possess very good adhesive and cohesive properties which make it possible to bond with other material to form compact mass. The ordinary Portland cement is generally classified into three grades 33grades, 43 grades and 53 grades. In this study OPC 53 grade has been used.

Fine aggregate:-

The aggregate which is passing through 4.75mm sieve is known as fine aggregate. Locally available river sand which is free from organic impurities is used. The particle size of fine aggregate used in this study was such a way that it passed through 4.75mm sieve conforming to zone II

Coarse aggregate:-

The material which is retained on BIS test sieve 4.75mm is termed as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20mm was used in our work. The aggregate were washed to remove dust and dirt and were dried to surface dry condition.

Water:-

Water is used for both mixing and curing should be free from injurious amount of deleterious materials. Potable water is generally considered satisfactory for mixing and curing concrete. In the present work potable tap water was used.

Hypo sludge:-

Hypo sludge is procured from paper industries. The paper producing industry generates various processes. From the preliminary waste named as hypo sludge. Hypo sludge behaves like cement because of silica and magnesium properties.

Fig:1 Hypo sludge.

Wood ash (prosopisjulliflora ash):-

Wood ash is obtained from the combustion of wood. Wood ash prepared from the uncontrolled burning of the wood (ProsopisJuliflora). During the last decades it has been recognized with growing wood ash waste of large volume and that is increasing year in the household, mills and factories. Wood ash is generated as a by-product of combustion in wood fired power plants, paper mills, and wood burning factories. Since wood is a potential source of energy and environmentally being friendly material, there will be increased usage of wood in energy production in future.

Fig 2: Wood ash.

About the Project:-

In this project 10% of hypo sludge take as constant and further added 10% to 30% wood ash as cement replacement of concrete used in M20 grade mix. Cube specimens of size 150mm*150mm*150mm, cylinder specimens of 150mm diameter and 300mm height and prism specimens of size 100mm*100mm*500mm were casted for different proportions with wood ash. The tests performed on hardened concrete after 28 days of curing were compression test, split tensile strength test and flexural strength test.

Mix design:-

The mix design of M20 grade concrete is calculated using IS 456-2000 and IS 10262-2009. The material required as per design are given in Table: 1

Table1: Materials required as per method of design.

W/c ratio	Quantity of Materials (kg/m^3)		
	Cement	**Fine aggregate**	**Coarse aggregate**
0.5	360	706	1205

Casting:-

The test program was considered the cast and testing of concrete specimen of cube, cylinder and prism. The specimen was cast M20 grade concrete using ordinary Portland cement. Natural river sand and the crushed stone. Each three numbers of specimens were made to take the average value. The specimens were remolded after 24 hours. The specimens were allowed to the curing period.

Fig.3(a):casting of cubes.

Fig.3(b): Casting of cylinders.

Fig.3©: Casting of prism.

Experimental Procedure:-

Tests on specimens:-

The specimens were taken for testing such as compression test, split tensile test and flexure test. Three numbers of specimens in each were tested and the average value is calculated. The results were compared and analyzed with that of control mix. The test set up for Compression test, Split tensile test and Flexural strength test are shown in fig.4 (a), fig.4(b), fig.4(c) respectively.

Fig. 4(a): compression test.**Fig 4(b):** spilt tensile test.

Fig.4 (c): Flexure test set up.

Compressive strength test:-

The size of the standard cube of size 150mm x 150mm x 150mm were used to determine the compressive strength of the concrete. Three specimens were tested for 28 days with varying proportions of hypo sludge and wood ash as 0% to 30% by the weight of cement. These were compared with the conventional concrete mix. The constituent were weighed and the materials were mixed by hand mixing. The specimens were weighed and the materials were mixed by hand mixing. The specimen were remolded after 24 hours, cured in water for 28 days, and then tested for its compressive strength.

The compressive strength of the cube specimen is calculated using the following formula:

Compressive strength $F_c = P/A$ N/mm^2

Where P = Load at failure in N

A = Area subjected to compression in mm^2

Compressive strength test results of concrete cubes in Table II

TableII: compressive strength for 28 day

% of Hypo sludge and wood ash	Compressive strength @28 days (N/mm^2)
M20 mix	22.55
$HY_{10}WA_{10}$	24.52
$HY_{10}WA_{20}$	19.82
$HY_{10}WA_{30}$	18.71

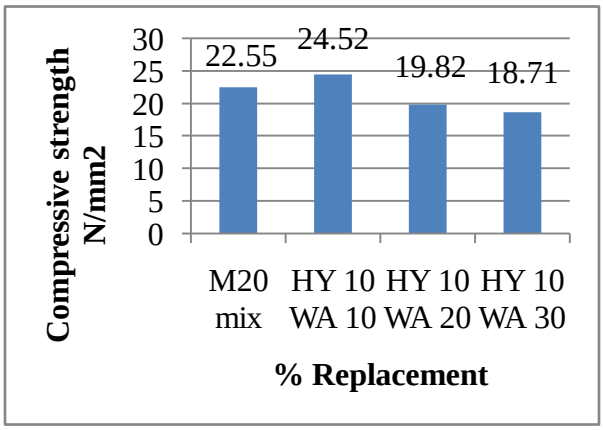

Fig.5: Average compressive strength.

The compressive strength of the cube shows that the 10% of Hypo sludge with 10% adding Wood ash gives better result.

Split tensile strength test:-
The split tensile strength of the cylinder specimen is calculated using the following formula:

Split Tensile Strength, f_{sp}= 2P/ ∏Ld N/mm^2

Where, P = Load at failure in N
L = Length of the Specimen in mm
D = Diameter of the Specimen in mm

The Split Tensile Strength test results are in the Table III
Table III: split tensile strength for 28day

% of Hypo sludge and wood ash	Spilt tensile strength @28 days (N/mm^2)
M20 mix	2.23
HY_{10} WA_{10}	2.52
HY_{10} WA_{20}	1.98
HY_{10} WA_{30}	1.88

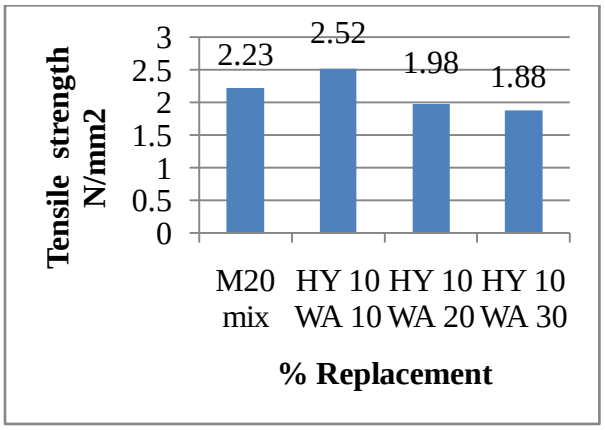

Fig 6 Average Split tensile strength.

The spilt tensile strength of the cube shows that the 10% of Hypo sludge with 10% adding wood ash gives better result.

Flexural strength test:-
The flexural strength of the specimen is calculated using the following formula:

The flexural strength f_b = 3PL/ 2bd^2 N/mm^2
Table iv:flexural strength for 28day.:

% of Hypo sludge and wood ash	Flexural strength @28 days (N/mm^2)
M20 mix	3.95
HY_{10} WA_{10}	4.45
HY_{10} WA_{20}	4.2
HY_{10} WA_{30}	3.6

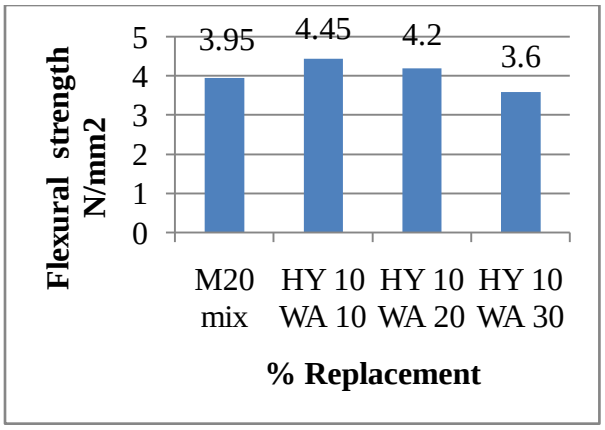

Fig.7: Average flexural strength.

The Flexural strength of the prism shows that the 10% of hypo sludge with 10% adding wood ash gives better result.

Water absorption:-

Water absorption test on concrete was conducted as per ASTM C 642-06. Cubes of size 150×150×150 mm were tested after 28 of curing. The specimens were taken out and dried in an oven at a temperature of 100 to 110C for not less than 24hours. Each specimen removed from the oven was allowed to cool in dry air to a temperature of 20 to 25C and the dry weight was determined. Then the specimens were immersed in water. The wet weights were recorded at 48 hours. The percentage of water absorption was calculated as follows.

SWA= [(Ws-Wd) / Wd] × 100

Where,

SWA - Saturated Water Absorption in percentages

Ws - Weight of the specimen at fully saturated condition in kg,

Wd - Weight of oven dried specimens in kg.

Table v: water absorption test for 28 day.

% of Hypo sludge and wood ash	Average water absorption %
M20 mix	1.91
$HY_{10}WA_{10}$	2.11
$HY_{10}WA_{20}$	2.02
$HY_{10}WA_{30}$	1.96

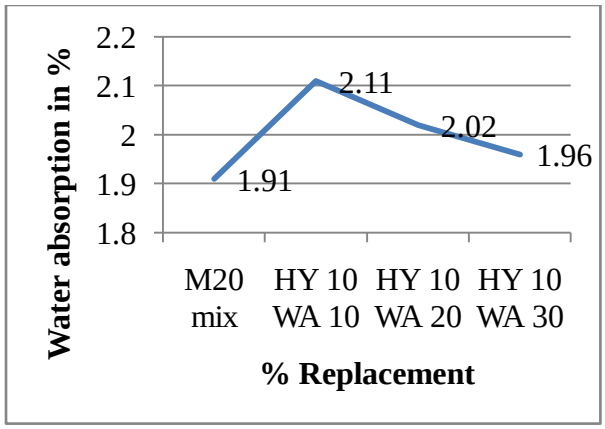

Fig.8 Average water absorption in %

Conclusion:-

1. In this project to utilize the Hypo sludge and wood ash as a replacement of cement in construction industry. The percentage replacements varied from 0% to 30% in M20 grade concrete.

2. In compressive, split tensile & flexure test results it shows that when compare to conventional concrete the % replacement concrete (10,20% & 30%) strength are increases. And the strength is optimum in 10% replacement specimens mutually. Thus we have to utilize hypo sludge 10% by replacing cement in M20 grade of concrete.
3. The 10 % replacement of hypo sludge is selected in the optimum mix. And the wood ash is added by weight of cement in concrete production. The percentage added wood ash is varied from 0% to 30% in M20 grade concrete.
4. From the above test results, the optimum percentage of replacement of hypo sludge and adding wood ash was found to be 10% and 10% respectively. It has a high strength to compare the conventional concrete.
5. Water absorption test was observed that the hypo sludge and wood ash 10% replacement of cement in concrete showed higher water absorption compare to conventional concrete. The maximum water absorption of 2.11% attained at HY 10% and WA 10%.

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