

Effect of characteristic compressive strength of concrete by replacing cement partially with hypo sludge

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Abstract:

hypo Sludge is a waste produced in the paper manufacturing industry. Paper mills generate more than 4 million tons of sludge each year for disposal. Hypo Sludge is known to contain useful fibers and chemicals, as my project to get good results by adding of ferrous oxide to the hypo sludge to the fly ash improve the strength, durability, and life span of concrete structures exposed to weather. 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. All the inks, dyes, coatings, pigments, staples and "stickiest" (tape, plastic films, etc.) are also washed off the recycled fibers to join the waste solids. The shiny finish on glossy magazine-type paper is produced using a fine kaolin clay coating, which also becomes solid waste during recycling. This 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 cropland as a disposal technique, raising concerns about trace contaminants building up in soil 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 essential to develop profitable building materials from them. Keeping this in view, investigations were undertaken

mix Concrete mixtures were produced, tested and compared in terms of compressive strength, durability & life span to the conventional concrete. These tests were carried out to evaluate the mechanical properties. For the test results for compressive strength up to 56 days are taken. This experimental investigation on strength of concrete and optimum percentage of the partial replacement by preparing a mix M40 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, 10%, 20%, 30%, 40% replacement of cement by industrial waste like fly ash and hypo sludge. In the test performed, the optimum compressive stress obtained by utilizing paper waste was at 30% replacement. At the place where strength is not of more importance or rather structure is for temporary basis then design mix proportion up to 40% replacement can also be utilized. Test also point towards developing low cost concrete by varying design mix proportion from 10% replacement to 40% replacement. The compared values of cost show gradual decrement in total cost of per cubic meter concrete. When government implement the projects for temporary shelters for who those affected by natural disaster, this material can be used for economic feasibility. To investigate the utilization of Hypo Sludge and fly ash as Supplementary Cementations Materials (SCM) and

influence of these hypo sludge and fly ash on the Strength of concretes made with different Cement replacement levels and compare with ordinary concrete. Investigate low cost concrete by using hypo sludge and fly ash as Supplementary Cementations Materials (SCM) and compare the cost of each per meter cube.

1. Introduction

Paper mill sludge is a major economic and environmental problem for the paper and board industry. The material is a by-result of the de-inking and re-pulping of paper. The aggregate amount of paper plant muck created on the planet is numerous million tones. The primary reusing and transfer courses for paper muck are landspreading as rural manure, delivering paper ooze powder, or transfer to landfill. In useful terms, paper slop comprises of cellulose filaments, fillers, for example, calcium carbonate and china earth and lingering chemicals bound up with water. The dampness substance is normally up to 40%. The material is thick, sticky and difficult to dry and can fluctuate in thickness and knottiness. It has a vitality substance that makes it a valuable competitor as an option fuel for the make of Portland concrete. Paper generation is an exceptionally capital and work serious movement.

Wood mash is the stringy material that outcomes when wood is isolated into its constituent strands by concoction or mechanical means. Squander paper is made out of beforehand disposed of paper or paperboard items. Along these lines, by utilizing this paper squander we can take care of the transfer issue. In urban communities, Solid waste administration is a standout amongst the most difficult issues, which are confronting a genuine contamination issue because of the era of colossal amounts of strong waste. In this paper presents making hypo ooze from paper squander, which is use as a development material. An utilization of hypo ooze in the development business is in the generation of auxiliary cement.

hypo sludge

Hypo Sludge Properties Where, this hypo ooze contains, low calcium and most extreme calcium chloride and least measure of silica. Hypo muck carries on like bond as a result of silica and magnesium properties. This silica and magnesium enhance the setting of the solid. While creating paper the different squanders are turns out from the different procedures in paper ventures. Because of the bond generation green house gasses are

discharged in the environment. For delivering 4 million tons of concrete, 1 million green house gasses are transmitted. Additionally, to lessen the natural debasement, this ooze has been maintained a strategic distance from in mass level transfer in land. To take out the ozone layer consumption, creation of bond gets to be distinctly lessened. For this, the hypo ooze is utilized as fractional substitution as a part of the solid as superior cement. By using this waste the quality will be expanded furthermore taken a toll decrease in the solid is accomplished.

Objectives of the study

To research the use of fly fiery debris, ferrous oxide as Supplementary Cementations Materials (SCM) and impact of these hypo muck on the Strength on concretes made with various Cement Substitution levels.

To discover compressive quality of the solid 3D square, bar and barrel. To think about the aftereffects of concretes like hypo slime solid, fly slag solid, blending of hypo muck and fly fiery remains cement and blending of hypo slop, fly powder and iron oxide concrete. To think about the consequences of compressive quality of each blends of concretes

Scope of the study

- To give a most conservative cement.
- b) It ought to be effectively received in field.
- c) Using the squanders in helpful way.
- d) To lessen the cost of the development.
- e) To advance the minimal effort lodging to the E.W.S. bunch individuals.
- f) To locate the ideal quality of the incomplete substitution of cement.
- g) Minimize the most extreme interest for bond.
- h) Minimize the most extreme corruption in environment because of bond and shield the ozone layer from green house gasses.
- i) To concentrate the break advancement in solidified concrete.

2. Literature review

In 2013, **Rushabh shah and J. Pitroda** concentrate the consequences of the bond mortar of blend extent 1:3 in which concrete is in part supplanted with Hypo Sludge as 0%, 10%, 30% and half by weight of concrete. Test comes about demonstrate the reductions in the quality properties of mortar with Hypo Sludge for quality at 7 & 28 days as incomplete supplanted with the bond in the concrete mortar 1:3. So it can be utilized as a part of non-basic components in the low range compressive quality

where quality is not required and minimal effort brief structure is prepared.

In 2014, Ritesh Patil and M.Jamnu concentrate the different mechanical properties of cement containing hypo ooze. Hypo ooze was utilized asa substitution to concrete. Substitution rates utilized amid the present review were 10%, 15%, 20%, 25%. Compressive quality of blocks were found on 3days, 7days, and 28days. The 28th day flexural quality and split elasticity of the examples was found on the individually shafts and barrels. It is found that substitution of hypo slop effect sly affect the mechanical properties of concrete.

In 2014, R. Balamurugan and R. Karthickraja create ease concrete by mixing different proportions of bond with hypo slime. Work is worried with exploratory examination on quality of concrete and ideal rate of the halfway substitution by supplanting bond by means of 5%, 10%, 15%, and 20% of Hypo Sludge. In 2014, Abdullah Shahbaz Khan et al show exposition work is coordinated towards growing minimal effort concrete from paper industry squander. Exposition work is completed with M2011 and M30 review concrete with W/c proportion.

3. Study of materials

Hypo muck delivered in a vast sum as by result of paper industry and is generally utilized as a part of solid creation as halfway substitution of concrete. It contains low calcium and least measure of silica and its because of nearness of silica and magnesium properties, that it acts like concrete.



Fig 1. Hypo sludge

Properties of Hypo Sludge

SL.NO	Constituent	Present In Hypo Sludge
1	MOISTURE	56.8
2	MAGNESIUM OXIDE(MgO)	3.3
3	CALCIUM OXIDE(CaO)	46.2
4	LOSS ON IGNESENT	27.00
5	ACID INSOLUBLE	11.1
6	SILLICA(SiO2)	9.0
7	R2O3	3.6

Materials utilized as a part of the trial work

- Cement
- Hypo ooze
- Ferrous oxide
- Fine Aggregate
- Coarse aggregate

MIX DESIGN:

The way toward selecting reasonable elements of cement and deciding their relative sums with the target of creating a solid of the required, quality, toughness, and workability as monetarily as would be prudent, is named the solid blend outline. The proportioning of element of cement is administered by the required execution of cement in 2 states, in particular the plastic and the solidified states. In the event that the plastic cement is not workable, it can't be appropriately set and compacted. The property of workability, hence, is the fate of key significance. The compressive quality of solidified solid which is for the most part thought to be a file of its different properties, relies on many components, e.g. quality and amount of concrete, water and totals; clumping and blending; setting, compaction and curing. The cost of cement is comprised of the cost of materials, plant and work. The varieties in the cost of materials emerge from the way that the concrete is a few circumstances expensive than the total, along these lines the point is to deliver as incline a blend as could be allowed. From specialized perspective the rich blends may prompt to high shrinkage and splitting in the auxiliary cement, and to development of high warmth of hydration in mass solid which may bring about breaking. The genuine cost of cement is identified with the cost of materials required for creating a base mean quality called trademark quality that is determined by the planner of the structure. This relies on upon the quality control measures, however there is probably the quality control adds to the cost of cement. The cost of work relies on upon the workability of blend, e.g., a solid blend of

insufficient workability may bring about a high cost of work to get a level of compaction with accessible hardware.

Kg/m ³	Water	Cement	Fine Aggregate	Coarse Aggregate
BY	163.4	430	516.02	1118.02
WEIGHT(KG)				

4. Experimental programme

Slump test

To decide the consistency of solid blend of given extents. Degree and Significance: Unsupported new solid streams to the sides and a soaking in stature happens. This vertical settlement is known as droop. In this test new cement is filled into a form of determined shape and measurements, and the settlement or droop is measured when supporting mold is evacuated. Droop increments as water-substance is expanded. For various works diverse droop values have been suggested. The droop is a measure showing the consistency or workability of bond cement. It gives a thought of water substance required for cement tube utilized for various works. A solid is said to be workable in the event that it can be effortlessly blended, set, compacted and wrapped up

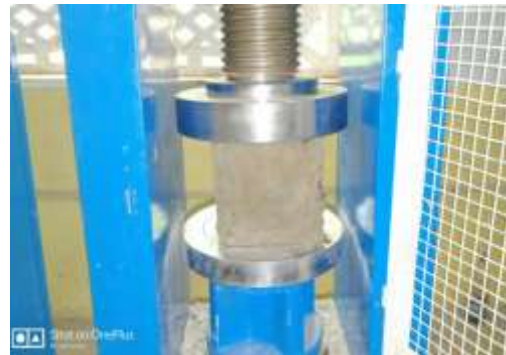


Fig 2.slump cone

Compressive strength test:

Concrete cubes of sizes 150mm×150mm×150mm were tested for crushing strength. Compressive strength depends on many factors such as w/c ratio, cement strength, quality of concrete material and quality control during production of concrete. Compression test on cube is conducted with 2000kN capability compression testing machine available in concrete technology laboratory. The investigational arrangement is disclosed in figure. The sample was placed centrally in between the plates of the testing machine and therefore the load was applied gradually

at the constant rate of 140 kg/cm²/min until the sample failed. the utmost load applied was noted for every check. The specimen results were calculated at 3 days, 7days and 28days and tabulated in next chapter. The cube compressive strength of concrete is conferred. The crushing strength is that the ratio of failure load to the area of cross section of specimen.



Split tensile strength of a concrete cylinder

The rigidity of cement is one of these essential and critical properties. Part elasticity test on solid barrel is a technique to decide the rigidity of cement. The solid is exceptionally powerless in strain because of its fragile nature and is not anticipated that would oppose the immediate pressure. The solid creates breaks when subjected to elastic strengths. Along these lines, it is important to decide the elasticity of cement to decide the heap at which the solid individuals may break.



Rapid chloride permeability test:

According to ASTM C1202 test, a water-saturated, 50 mm thick, 100 mm thick diameter concrete specimen is subjected to a 60Vapplied DC voltage for 6 hours using the apparatus and the cell arrangement is shown in Figure 5.6. In one reservoir is a 3.0% NaCl solution and in the other reservoir is a 0.3 M NaOH solution. The total charge passed is determined and this is used to rate the concrete.

Range of chloride ion penetration

Charge passed (coulombs)	Chloride ion penetrability
>4000	High
2000-4000	Moderate
1000-2000	Low
100-1000	Very low
<100	Negligible



Water penetration test:

The water penetration test is mostly used to estimate the penetration of water into the concrete, is the one specified by BS EN-12390-8:2000. In this test, water was applied on one face of the 150 mm concrete cube specimen under a pressure of 5 kg/cm². The constant pressure maintained for a period of 72 h. After the period, the specimens were taken out and split into two halves. The water penetration contour in the concrete surface was marked and then the maximum depth of water penetration value has to be recorded and considered as an indicator of the water penetration.

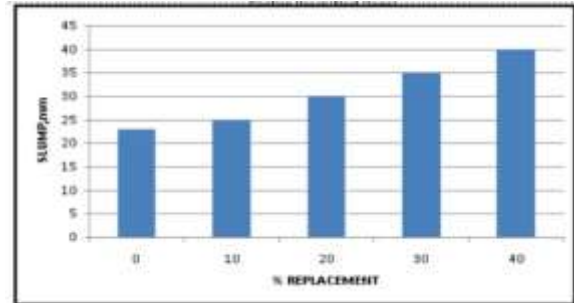


5. Results and discussions

Slump cone test

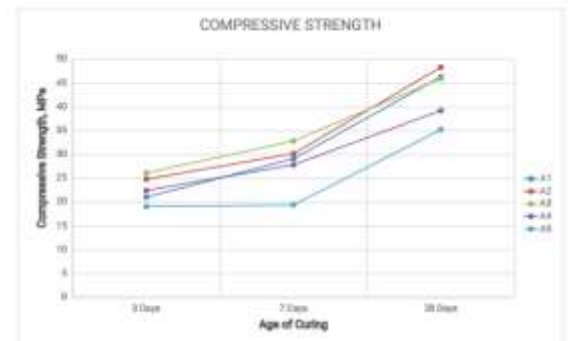
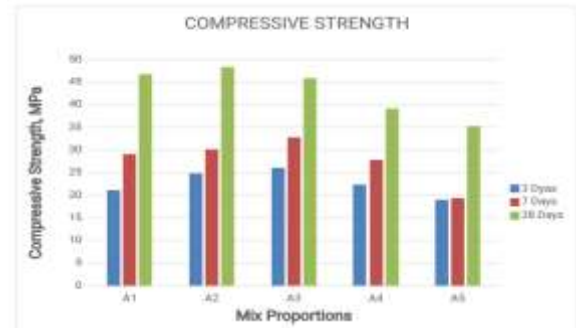


% Replacement	Slump, mm
0	23
10	25
20	30
30	35
40	40



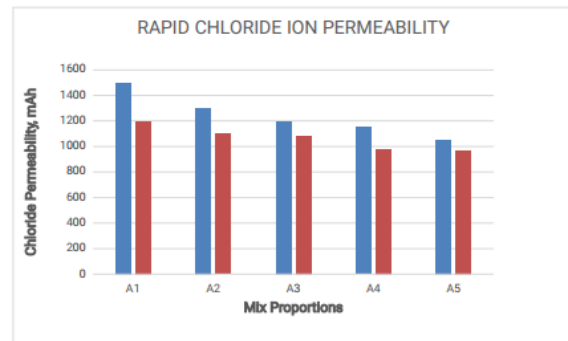
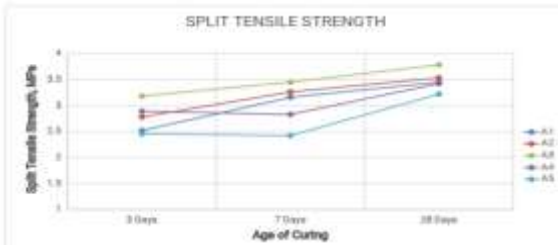
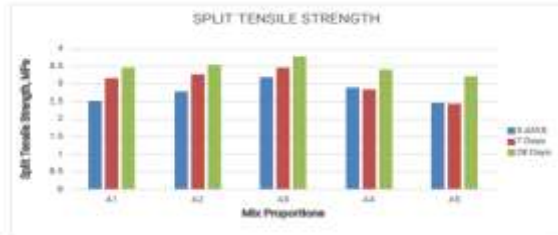
Compressive strength

Mix No.	Proportions of Binding Materials	Compressive strength N/mm ²		
		3 days	7 days	28 days
A1	Conventional mix	21.05	29.12	46.83
A2	90% Cement + 10% Hypo Sludge	24.80	30.17	48.28
A3	80% Cement + 20 % Hypo Sludge	26.12	32.82	45.93
A4	70% Cement + 30% Hypo Sludge	22.43	27.82	39.22
A5	60% Cement + 40% Hypo Sludge	19.07	19.44	35.20



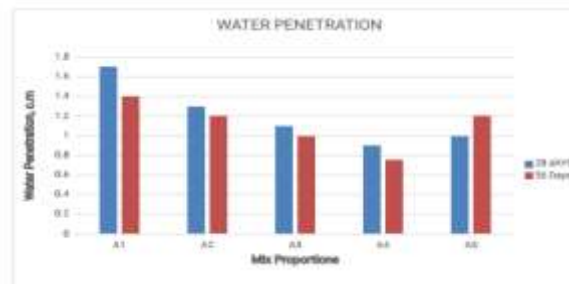
Split Tensile Strength:

Mix No.	Proportions of Binding Materials	Compressive strength N/mm ²		
		3 days	7 days	28 days
A1	Conventional mix	2.52	3.157	3.456
A2	90% Cement + 10% Hypo Sludge	2.782	3.265	3.534
A3	80% Cement + 20 % Hypo Sludge	3.189	3.450	3.782
A4	70% Cement + 30% Hypo Sludge	2.89	2.83	3.42
A5	60% Cement + 40% Hypo Sludge	2.46	2.425	3.22



Water penetration:
Effect of foundry sand and fire clay on water penetration:

Mix No.	Proportion of Binding Materials	Water penetration, c.m	
		28 days	56 days
A1	Conventional mix	1.7	1.4
A2	90% Cement + 10% Hypo Sludge	1.3	1.2
A3	80% Cement + 20 % Hypo Sludge	1.1	1.0
A4	70% Cement + 30% Hypo Sludge	0.9	0.75
A5	60% Cement + 40% Hypo Sludge	1.0	1.2



Rapid chloride ion penetration test (TEST):

Mix No.	Proportion of Binding Materials	Chloride permeability test, mAh	
		28 days	56 days
A1	Conventional mix	1500 (Low)	1200 (Low)
A2	90% Cement + 10% Hypo Sludge	1300 (Low)	1100 (Low)
A3	80% Cement + 20 % Hypo Sludge	1200 (Low)	1080 (Low)
A4	70% Cement + 30% Hypo Sludge	1150 (Low)	980 (very Low)
A5	60% Cement + 40% Hypo Sludge	1050 (Low)	970 (very Low)

6. Conclusions

Based on limited experimental investigations concerning the compressive strength and tensile strength of concrete, the following conclusions are drawn: 1. The 10% replacement of cement by hypo sludge in M40 grade of concrete gives maximum compressive strength of 48.28 N/mm² and tensile strength of 3.53N/mm² for 28 days.

2. By above results we know that the use of FERROUS HYPO SLUDGE should be in between of 10% will increase the strength of concrete.
3. A Combination of 40% Hypo Sludge in concrete shows the lowest chloride penetration rating.
4. Among the all mixes the conventional mix and the mix having 30% shown the minimum permeability when compare to the rest of mixes.

5. Use of Hypo Sludge reduces the amount of cement content. Thus, the construction work with Hypo sludge in cement becomes environmentally safe and also economical.

Scope for the future study

This experiment can also be carried out for the strength of the concrete for 56 days. And also can be done investigations for the strength of the concrete other than these percentages of replacements.

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