

# Experimental Investigation on Hypo Sludge Concrete by Using Sikicrete

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**ABSTRACT:** Over 300 million tonnes of industrial wastes are being produced per annum by chemical and agricultural process in India. These materials pose problems of disposal and health hazards. A large quantity of waste is contributed by paper industry. 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 to produce low cast concrete by blending various ratios of cement with hypo sludge. For disposal, the chemical wastes are hypo sludge and lime sludge required more spaces of landfill. Hypo sludge behaves like cement because of silica and magnesium properties. The silica and magnesium improve the setting of concrete. In this project sikacrete admixture is used to improve the strength and reduce the water content in concrete. Optimum percentage of the partial replacement by replacing cement via 5%, 10%, 15%, and 20% of Hypo Sludge and also 50ml added Sikacrete. For phase I the work is concerned with experimental investigation, mix design, Casting of cubes and testing on cubes. The mix design was carried out for M20 grade concrete.

**KEYWORDS:** Sikacrete, Hypo Sludge, industrial wastes and casting on cubes.

## I. INTRODUCTION

Concrete, is most widely used man made construction material and is the largest production of all the materials used in construction industry. Concrete is basically made of cementations materials which have to properly bind themselves together, as well as with other materials to form a solid mass. Concrete or mortar is made up of cement, water and aggregates (Coarse and Fine Aggregate) and sometimes with necessary admixtures. Concrete has attained the status of a major building material in all the branches of modern construction. It is difficult to point out another material of construction which is as variable as concrete. Concrete is the best material of choice where strength, durability, impermeability, fire resistance and absorption resistance are required. Compressive strength is considered as an index to assess the overall quality of concrete and it is generally assumed that an improvement in the compressive strength results in improvement of all other properties. Hence strength investigations are generally centered on compressive strength. Even though concrete mixes are proportioned on the basis of achieving the desired compressive strength at the specified age, flexural strength often play a vital role in concrete making .Energy plays a crucial role in growth of developing countries like India. In the context of low availability of non-renewable energy resources coupled with the requirements of large quantities of energy for Building materials like cement, the importance of using industrial waste cannot be under estimated. During manufacturing of 1 tones of Ordinary Portland Cement we need about 1-1? Tones of earth resources like limestone, etc. Further during manufacturing of 1 tones of Ordinary Portland Cement an equal amount of carbon-di-oxide are released into the atmosphere. The carbon-di-oxide emissions act as a silent Killer in the environment as various forms. In this Backdrop, the search for cheaper substitute to OPC is a needful one. 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.

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## II. HYPO SLUDGE

Hypo sludge is also known as paper industry waste. It is the byproduct of the paper waste. This hypo sludge contains low calcium and minimum amount of silica. Hypo sludge behaves like cement because of silica and magnesium properties. Hypo sludge may be used as part replacement of cement. It is usually used in proportion of percent of cement content of the mix.



Figure1.1HypoSludge

**CEMENT:** Cement may be described as a material with adhesive and cohesive properties that make it capable of bonding mineral fragments ('aggregates') into compact whole. In this process, it imparts strength and durability to the hardened mass called concrete. The cements used in the making of concrete are called hydraulic cements-so named, because they have the property of reacting chemically with water in an exothermic (heat generating) process called hydration that results in water-resistant products. We use the ordinary Portland cement (OPC) presently available in three different 'grade' (denoting compressive strength) C33, C43, and C53, conforming to IS 269:1989, IS 8112:1989 and IS 12269:1987 respectively. The numbers 33, 43, and 53 correspond to the 28-day (characteristic) compressive strengths of cement, as obtained from standard tests on cement-sand mortar specimens. These are most commonly used in general concrete construction, where there is no special durability requirement ("such as exposure to the sulphate attack").

**FINE AGGREGATE:** Sand is an inert occurring material of size less than 4.75mm. It is used as a material of construction not only as filling and as a porous foundation blanket (as for roads) but also to a wide extent as a filtering medium and as constituents of mortars and concrete. In view of these important applications sand is described as naturally granular material of a certain grain size irrespective of the shape of the grains, thus, uniformity and their mineral composition. The formation of sand during the process of rock weathering and the way in which they are transported before reaching the final position affect all of these leading characteristics. The mineralogical nature of sand is important, especially in view of the popular belief that all sands are composed of quartz particles. Although quartz is frequently major constituent, pure silica sand is the exception rather than the rule. Depending on the nature of rock from which it was found and on the erosive action to which it has been subjected, many other minerals may be found as constituents, mica feldspars, shale are a few of them. Presence of feldspars an unstable mineral cause development of hair cracks in concrete. Similarly shale particles and soluble salts are injurious to concrete if present.

**COARSE AGGREGATE:** As explained aggregate used for concrete production is classified as fine aggregate and coarse aggregate depending on its particle size. Aggregate of size more than 4.75mm, is called as coarse aggregate and is one of the most important ingredient of concrete. It gives strength to the concrete and constitutes about 70 to 75 percent volume of concrete. Crushed stone in general used as coarse aggregate which is black in color, angular and in local name known as black metal or 'Gitti'. Coarse aggregate are generally derived by crushing natural available. There are three varieties of rocks available.

**WATER:** Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully.

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Vol. 5, Issue 9, September 2016

### SIKACRETE:

The large family of Sikacrete represents some of the highest performance resins of those available at this time. Sikacrete generally out-perform most other resin types in terms of mechanical properties and resistance to environmental degradation, which leads to their almost exclusive use in aircraft components. As a laminating resin their increased adhesive properties and resistance to water degradation make these resins ideal for use in applications such as boat building. Here Sikacrete are widely used as a primary construction material for



Figure 1.2 SikaCrete

application to sheath a hull high-performance boats or as a secondary or replace water-degraded polyester resins and gel coats.

### Uses of Sikacrete

- High Performance, High Strength and Lightweight concrete
- Pre-cast Concrete for Architectural, Civil, Industrial, and Structural
- Fiber cement and Ferro cement products, Glass Fibre Reinforced Concrete.
- Mortars, Stuccos, Repair Material, Pool Plasters.

### Properties Of Sikacrete

- Increased Durability
- Increased Compressive & Flexural Strengths
- Reduced Permeability & Efflorescence
- Increased Resistance to Chemical Attack & Prevention of ASR
- Reduced Shrinkage
- Improved finishing
- Improved Color & Appearance

### BENEFITS OF HYPO SLUDGE

- Hypo sludge improves the properties of fresh and hardens concrete.
- Hypo sludge reduces degradation and bleeding.
- Hypo sludge improves the durability of concrete.
- Hypo sludge improves the setting of concrete due to presence of silica and magnesium.
- Environmental friendly.
- Light weight compare to conventional concrete.
- Hypo sludge is the cheaper substitute to OPC.

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Vol. 5, Issue 9, September 2016

## SCOPE OF THE PROJECT

- To provide a most economical concrete.
- It should be easily adopted in field.
- Using the wastes in useful manner.
- To reduce the cost of the construction.
- To find the optimum strength of the partial replacement of concrete.
- Minimize the maximum demand for cement.
- Minimize the maximum degradation in environment due to cement and safeguard the ozone layer from green house gases.
- To study the crack development in hardened concrete.

## III. EXPERIMENTAL WORK

To understand the behavior of concrete in compression, split and flexure, cubes, cylinders and prisms are cast. The average values of three specimens are taken. **Conventional concrete (C):** The conventional concrete specimens are made up of  $M_{20}$  concrete with the mix ratio. **Hypo Sludge Concrete (HSC):** Concrete specimens are made up of cement, Hypo Sludge, fine aggregate, water and Sikacrete. Increase strength of concrete added 50ml sikacrete for 1 cu.m of concrete Hypo sludge was 5%, 10%, 15% and 20% replacement of cement.

**MATERIAL USED:** The materials used for making recycled course aggregate concrete are, Cement, Fine aggregate, Course aggregate, Hypo Sludge, Sikacrete, Water

## IV. PREPARATION OF SPECIMENS

**Preparation of Conventional Concrete.** Preparation of test specimen includes the following procedure:

**Batching:** The quantity of ingredients (Cement, Fine aggregate, Coarse aggregate and water) were arrived by conducting proper weigh batching and stored separately for mixing.

**Preparation of mould:** The mould for prism, cube and cylinders were collected and they are properly checked for their dimensions. Crude Oil can be applied to inner side of the moulds for the smooth replace.

**Mixing:** The Cement and Sand in the specified proportions are mixed thoroughly. Then this mixture is spread evenly on a coarse aggregate. The mixture is turned over twice in a dry state. Then the measured quantity of water is added and the mixture thoroughly to get an uniform mix.

**Compacting:** Compacting is done by using steel rod. All fresh concrete contains tiny bubbles of air. The process of removal of entrapped air and uniform placement of concrete to form homogeneous dense mass is termed as Compaction.

**Curing:** Water curing is used for conventional concrete. Curing concrete can be defined as a chemical process that ensures the hydration of cement in newly placed concrete. The curing process is part of the chemical reaction between Portland cement and water to hydrate the product, creating a gel that can be laid down only in water-filled space. It usually involves the control of moisture loss and the temperature affecting the hydration process.

**Demoulding:** The casted specimens are demoulded in such a way that there is no possibilities of damaging of specimens.

### Preparation of Hypo Sludge Concrete

Preparation of test specimen includes the following procedure:

**Batching:** The quantity of ingredients (Cement, sikacrete, Fine aggregate, coarse aggregate Hypo Sludge and water) were arrived by conducting proper weigh batching and stored separately for mixing.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

**Preparation of mould:** The mould for prism, cube and cylinders were collected and they are properly checked for their dimensions. Crude Oil can be applied to inner side of the moulds for the smooth replace.



Figure 4.1 Material collection

**Mixing:** The Cement and Sand in the specified proportions are mixed thoroughly. Then this mixture is spread evenly on a coarse aggregate. The mixture is turned over twice in a dry state. Then the measured quantity of water is added and the mixture thoroughly to get an uniform mix.

**Compacting:** Specimen each one set 3 beams, 3 cubes and 3 cylinders were casted. Specimen was prepared by various proportion of Hypo Sludge in 5%, 10%, 15%, and 20%.

**Demoulding:** The casted specimens are demoulded in such a way that there is no possibilities of damaging of specimens.



Figure 4.2 Mixing of materials



Figure 4.3 casting of cube



Figure 4.4 Demoulding of cube

**Curing:** 28 days curing achieve strength. Water curing is used for recycled coarse concrete. Curing concrete can be defined as a chemical process that ensures the hydration of cement in newly placed concrete. The curing process is part of the chemical reaction between Portland cement and water to hydrate the product, creating a gel that can be laid down only in water-filled space. It usually involves the control of moisture loss and the temperature affecting the hydration process.



Figure 4.5 Curing of Specimen

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

## V. TESTS ON HARDENED CONCRETE

**Compressive Strength Test:** Compressive strength is the capacity of a material or structure to withstand axially directed pushing forces. When the limit of compressive strength is reached, brittle materials are crushed.

**Testing Machine:** The testing machine may be of any reliable type, of sufficient capacity for the tests and capable of applying the load at the required rate. The permissible error shall be not greater than  $\pm 2$  percent of the maximum load. The testing machine shall be equipped with two steel bearing platens with hardened faces. One of the platens (preferably the one that normally will bear on the upper surface portion of a sphere, the centre of which coincides with the central point of the face of the platen. The other compression platen shall be plain rigid bearing block. The bearing faces of both platens shall be at least as large as, and preferably larger than the nominal size of the specimen to which the load is applied. The compression mechanism is shown in Figure 4.6

Compressive Strength =  $P/A$

Where,

P - Ultimate Load

A - Cross sectional area of the specimen



Figure 4.6 Compressive Strength Test

## VI. RESULTS AND DISCUSSIONS

**COMPRESSIVE STRENGTH TEST:** 150 mm X 150mm X 150mm concrete cubes were casting using  $M_{20}$  grade concrete. Specimens with ordinary Portland cement (OPC) and OPC replaced with hypo sludge at 5%, 10%, 15% and 20% levels and add 50ml sikacrete admixture constants were cast. During casting the cubes were mechanically vibrated by using a table vibrator. After 24 hours, the specimens were removed from the mould and subjected to water curing

Mix Design	% of Cement	% of Hypo Sludge	% of Fine Aggregate	% Course Aggregate	Compressive Strength $N/mm^2$
$M_{20}$	100	0	100	100	22.06
	95	5	100	100	24.26
	90	10	100	100	26.45
	<b>85</b>	<b>15</b>	<b>100</b>	<b>100</b>	<b>28.71</b>
	80	20	100	100	23.98

Table 5.1  $M_{20}$ - Compressive strength at 7<sup>th</sup> days

for 7<sup>th</sup>, 14<sup>th</sup> and 28<sup>th</sup> days. After curing, the specimens were tested for compressive strength using a calibrated compression testing machine of 2000kN capacity.

**$M_{20}$  Compressive Strength at 7th Day:**  $M_{20}$  grade of concrete Compressive Strength at 7<sup>th</sup> Days curing. Increase strength of concrete added Hypo Sludge 5%, 10%, 15% and 20% replacement of cement and 50ml added admixtures Sikacrete.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

**M<sub>20</sub> Compressive Strength at 14th Day:** M<sub>20</sub> grade of concrete Compressive Strength at 14<sup>th</sup> Days curing. Increase strength of concrete added Hypo Sludge 5%, 10%, 15% and 20% replacement of cement and 50ml added admixtures Sikacrete.

Mix Design	% of Cement	% of Hypo Sludge	% of Fine Aggregate	% Course Aggregate	Compressive Strength N/mm <sup>2</sup>
M <sub>20</sub>	100	0	100	100	23.56
	95	5	100	100	24.89
	90	10	100	100	27.04
	<b>85</b>	<b>15</b>	<b>100</b>	<b>100</b>	<b>29.24</b>
	80	20	100	100	24.04

Table 5.2 M<sub>20</sub>- Compressive strength at 14<sup>th</sup> days for sikacrete

**M<sub>20</sub> Compressive Strength at 28th Day:**

M<sub>20</sub> grade of concrete Compressive Strength at 28<sup>th</sup> Days curing. Increase strength of concrete added Hypo Sludge 5%, 10%, 15% and 20% replacement of cement and 50ml added admixtures Sikacrete.

Mix Design	% of Cement	% of Hypo Sludge	% of Fine Aggregate	% Course Aggregate	Compressive Strength N/mm <sup>2</sup>
M <sub>20</sub>	100	0	100	100	25.56
	95	5	100	100	27.89
	90	10	100	100	29.04
	<b>85</b>	<b>15</b>	<b>100</b>	<b>100</b>	<b>31.25</b>
	80	20	100	100	25.08

Table 5.3 M<sub>20</sub>- Compressive strength at 28<sup>th</sup> days for sikacrete

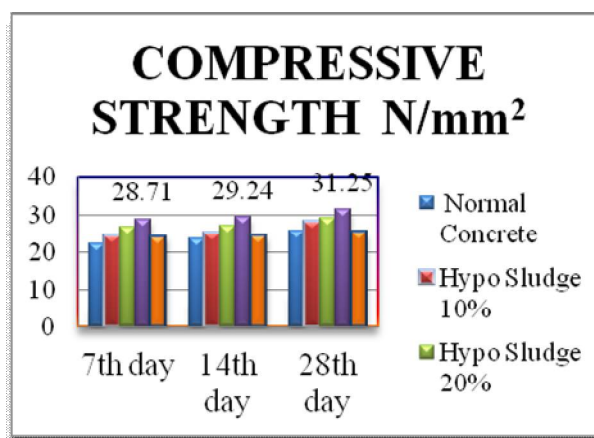


Figure 5.1 Compressive Strength Bar Chart

### VII. CONCLUSION

Finally I conclude our project with full satisfaction of completing the project Casting of conventional cement concrete cubes has been done Casting of concrete cube added with paper industrial waste (HYPO SLUDGE ) has also been done Comparison of results has been done Testing of concrete cubes with various methods like compression test has been done for both cubes Up to 15% of hypo sludge concrete, the compression strength has been increased, so up to 15%

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

cement has been replaced by hypo sludge compression test of concrete with various mixes with different curing periods which are 7,14 and 28 days by partial replacement of cement with hypo sludge that is 0%, 5%, 10%, 15% ,20% and 50ml sikacrete added which are noted. The compressive strength increases as the curing period increasing for M20 grade concrete, compressive strength is increase with 15% replacement finally hypo sludge 15% replaced in cement.

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