



## **A Review of Experimental Study and Analysis on Strength of Concrete by using Hypo Sludge and Fly-Ash with Several Stages**

*Anudeep Kanthed<sup>1</sup> and Dr. Rajeev Chandak<sup>1</sup>*

<sup>1</sup>Department of Civil Engineering, Jabalpur Engineering College, Jabalpur (M.P.)

### **ABSTRACT-**

Hypo sludge is a by-product of the paper and board manufacturing industry. Waste paper is estimated to represent 0.7% of the total municipal waste in India. Paper sludge is a serious economic and environmental dilemma in the paper industry. Strong and weak fibers can be found in paper sludge. Strong residual fibers are used in the recycling process to make recycled paper, while weak residual fibers are discarded. This settlement has resulted in serious problems of air, water and soil pollution. Paper sludge is being replaced with cement to reduce the disposal problem. Due to the properties of silica and magnesium, the waste paper acts like a cement, which increases the setting time of the cement.

**KEY WORD-** Cement, Hypo Sludge, Compressive strength, Workability, Split tensile Strength.

### **1. INTRODUCTION**

Energy plays an important role in the development of developing countries like India. In the context of the low availability of non-renewable energy resources as well as the need for large amounts of energy for construction materials such as cement, the importance of industrial waste utilization cannot be overstated. During the manufacturing of 1 ton of Ordinary Portland Cement, we require about 1 ton of land resources like limestone etc. Also, the same amount of carbon dioxide is released into the atmosphere during the manufacture of 1 ton of ordinary Portland cement. , Carbon dioxide emissions act as a silent killer on the environment in many ways. In such a situation, it is necessary to find cheap alternatives to OPC.

In the present work lime slaked is used in place of cement. Lime Sludge (Hypo Sludge) is a substance obtained from the process of chemical recovery in paper production. Hypo Sludge is available in large quantities all over the world, but so far its use is very limited. In our project, we used lime sludge instead of cement. Lime sludge (I-hypo sludge) is a by-product of the chemical recovery process in paper production.

Paper waste (hypo sludge) is a waste of the paper and board industry. It is estimated that paper waste accounts for 0.7% of all municipal waste generated in India. Paper sludge is a major economic and environmental problem in the paper industry. Paper sludge varies with strong and weak fibers. The strong fibers of the waste are taken for recycling and the weak fibers are taken to landfill. Due to this dumping it causes a huge problem of air pollution, water pollution and soil pollution. Paper sludge is replaced to reduce the waste problem. Hypo sludge is used instead of sludge production and its mechanical, physical and chemical properties are investigated. Waste substitution will save resources and avoid the ecological and environmental damage caused by mining and exploitation of raw materials for cement production. The demand for concrete is increasing across the world at a low cost, by producing this concrete it will reduce the demand for concrete and reduce CO<sub>2</sub> emissions from the cement industry. This project summarizes the technical and environmental benefits of using additional cement additives and researches the parameters of concrete incorporating paper waste as a partial replacement for cement.



Figure 1 Hypo sludge

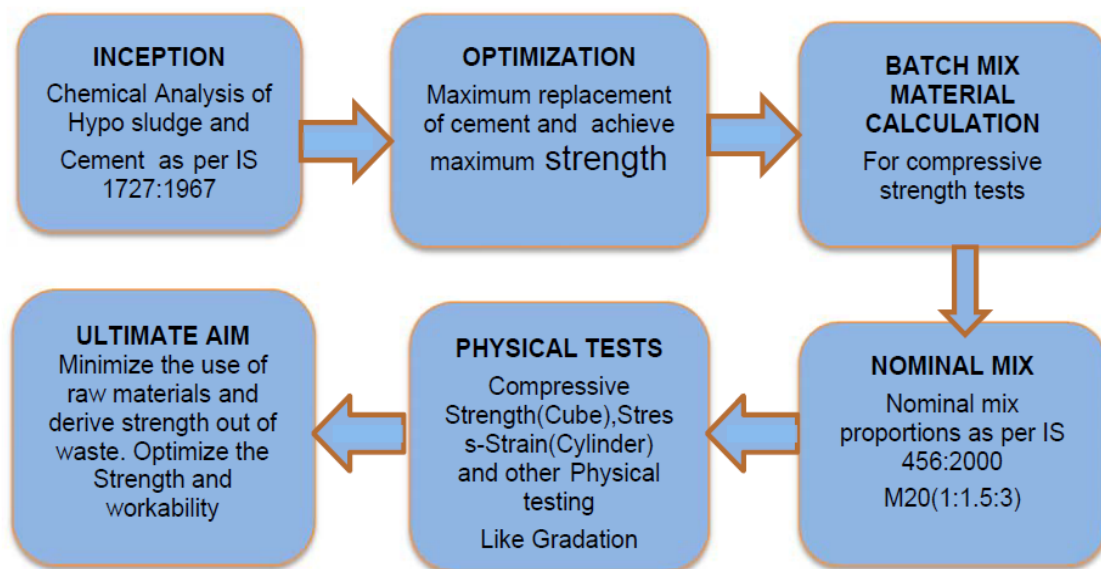


Figure 2 Process of Hypo sludge

## 2. LITERATURE REVIEW

**R. Balamurugan and Shri R. Karthikraj (2014)** In this paper, the research work deals with the investigation of concrete strength test and major percentage of component replacement by 5%, 10%, 15%, and 20% of cement. , Hypo Sludge. To keep all these considerations in mind, the object of investigation is the behavior of concrete when adding sludge with different proportions of hypo sludge in concrete using tests such as compressive strength and tensile strength. Mix design for M25 grade concrete is done as per IS-10262-2009. **Ritesh Patil and M. Jamnu (2014)**, hypo sludge was used instead of cement. The replacement percentages used during the present study were 10%, 15%, 20%, 25%. **Balamurugan and Dr. P. Perumal (2014)**, their experimental study shows that the variation of concrete strength obtained at room temperature by replacing sand with quarry dust over 7 years and 28 days. and to evaluate the strength loss effect of heating on concrete cubes at 100oC on the 28th day of casting.

**Michael Nirmal. X. (2015)**, it is the result in this test that the strength of about 50-50% replacement of RCA and M-sand reaches the maximum strength of about 23.96% than normal concrete. Hence the use of RCA and M-Sand is recommended as an alternative to obtain optimum strength at high mass percentages. **Ankur Jain and Manish Dubey (2016)** This research study deals with the investigation of concrete strength test and maximum percentage of component replacement by cement replacement such as dynamic compressive strength and workability. Mix design is done for M30 and M40 grade

concrete as per IS: 10262-2009. The hypo sludge particles passing through 90 micron IS sieve will replace cement in concrete. **S. Sarma, and N.C. Anil (2016)** recommended that further research be done to gather more facts about the suitability of replacing the OPC component with hypo mortar in concrete. **S. Selvarani (2016)** this project deals with concrete strength test and investigation of maximum percentage of component replacement by cementing like compressive strength and tensile strength. Mix design for M25 grade concrete is done as per IS: 10262-2009.

**T. Karthika and Ms. S. Shanti (2017)** This project presents the results of an experimental investigation carried out to evaluate the effects of replacing cement with hypo sludge which is an industrial waste product on the strength of concrete for construction of M20, M25, M30 Mix. flexural strength. Papermaking often produces large amounts of solid waste. In view of this, research is being done to prepare low cost concrete by mixing cement and hypo sludge in different proportions. **G.L. Abhishek (2017)** Concrete is strong and durable but it is a porous material that interacts with the environment. Paper fibers that generate a lot of solid waste can be used. Explored new uses of Hypo Sludge in concrete manufacturing as a cementitious material as an alternative to conventional concrete. This research work deals with concrete strength test and investigation of maximum percentage of component replacement by cement replacement using tests like compressive strength, tensile strength and flexural strength. **Devi et al. (2018)** Rapid increase in construction activities leads to effective shortage of common construction materials such as cement, fine aggregate and reinforcing aggregate. Mixing various proportions of fine aggregate with hypo sludge is very important to produce low cost concrete and reduce the problems of waste and pollution caused by hypo sludge, making hypo sludge a profitable building material. These tests are designed to test the subjects' durability after 28 days. This research work deals with the investigation of strength test of concrete and total percentage of constituent replacement by adding fine aggregates like Acid attack, Sulphate attack, Rapid chloride penetration, Sorptivity test. Mix design for M20 grade concrete is done as per IS: 10262-2009.

**Chavan et al. (2020)** The increasing amount of waste is a reality related to the emergence of environmental sustainability issues. A large quantity of Hypo Sludge has come out from the paper mill. About 300 million tons are produced annually. Their general disposal in landfills leads to environmental pollution. Also, cement production causes global warming by releasing carbon dioxide. Therefore the new use of industrial waste in the manufacture of concrete (concrete pavement) as a stone additive can help to reduce the environmental problem. This research work deals with the investigation of strength test of concrete mixed with hypo sludge. Instead of cement, hypo sludge is added in the range of 10% to 40% by weight of cement. Also there is a huge drop in power. The ultimate compressive strength and ultimate tensile strength of the M20 concrete mix were 31.6 N/mm<sup>2</sup> and 3.5 N/mm<sup>2</sup>. And cost analysis shows that with the installation of hypo sludge.

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### 3. SOURCE OF HYPO SLUDGE

The process of making pulp to paper involves the following processes where hypo sludge is formed as the by product waste is chemical waste and does not contain any biodegradable material. Most mills use only raw wood materials (bamboo, juniper, casuarina, poplar and other hardwoods), but some mills use significant amounts of bagasse as a raw material. Most paper mills in India prepare bleach liquor (calcium hypochlorite) using lime and elemental chlorine. Six out of eight mills use ClO<sub>2</sub> as a partial replacement for chlorine or as a bleaching agent in the final bleaching stage to achieve the desired brightness level. These mills produce ClO<sub>2</sub> in an environment friendly process. Three of the eight mills still use calcium hypochlorite in the final bleaching stage. The solid waste generated during the production of calcium hypochlorite is called hypo sludge.

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### 4. NEED FOR HYPO SLUDGE UTILIZATION

Various processes in the paper industry generate various wastes during the production of paper. The first waste, called Hypo Sludge due to its low calcium content, has been removed for our project to replace the use of cement in concrete.

Green house gases are released into the air due to cement production. To produce 4 million tonnes of cement, they release 1 million tonnes of greenhouse gases. Also, to reduce the destruction of the environment, this soil has been saved from being destroyed on a large scale in the world. The production of cement is reduced to prevent the depletion of ozone layer. In this case, Hypo Sludge is used as a partial replacement of concrete in the form of High Performance Concrete. Its use will increase energy wastage and reduce the cost of concrete.

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### 5. BENEFITS OF HYPO SLUDGE

1. Hypo sludge improves the properties of fresh and hard concrete.
2. Hypo sludge reduces wear and tear.
3. Hypo sludge improves the durability of concrete.
4. Hypo sludge improves the setting of concrete due to the presence of silica and magnesium.
5. It doesn't care about the environment.
6. Lightweight compared to regular concrete.
7. Hypo sludge is a cheap substitute for OPC.

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## 6. LIMITATIONS OF HYPO SLUDGE

1. Availability
2. Handling the problem

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## 7. MANUFACTURED SAND

Manufacturing aggregates are the final product and, for concrete manufacturers, the raw material used to produce concrete. The quality of the aggregate may be affected while the raw materials, stones or rocks may have characteristics that cannot be changed by the manufacturing process. One thing that is very important is a constant supply, a good mix. In this regard, the study collection formed by basaltic stones and river sand is a great natural source of beautiful collections in our country.

However, the intensive construction activity is causing an increasing shortage and price rise of natural sand in the country, besides the aggregate and concrete industry is currently facing increasing public awareness related to environmental hazards. Therefore, it is imperative to find an effective alternative to natural sand. There is another method used to replace the use of M-Sand. Due to lack of predictability of natural sand availability and increase in manufacturing processes, a time will come when M-Sand will play an important role as an ingredient in concrete production.

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## 8. CHARACTERISTICS

When stone was crushed and shaped in a quarry, its main purpose was usually to prepare overall courses and materials for road construction. M sand is defined as an all purpose finely milled aggregate produced from a suitable source material. Manufactured sand is produced by various types of crushing machines including cone crushers, impact crushers, roll crushers, road rollers etc. The raw material for the production of M Sand is bulk stone. It is based on the parent rock that the chemical, mineralogical properties, texture, structure of the sand may change.

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## 9. MATERIALS USED

### 9.1 CEMENT

The most common cement used is ordinary Portland cement. Type 1 is selected as per IS: 269-1976, used for general concrete structures. Of the total product, Ordinary Portland Cement makes up about 80-90 percent. Several tests are conducted to strengthen stability test, setup test, sound test etc. some of them.

Cement is made by grinding calcined limestone and clay into a very fine, gray powder. Cement is one of the binding agent in this project. Cement and water form a paste and bind the other materials together. Ordinary Portland Cement (53 grade) conforming to IS:8112-1989 is being used. Several tests were carried out on cement.

### 9.2 AGGREGATE

Aggregates are the main components of concrete. They make the body solid, reduce shrinkage and economic impact. One of the most important aspects of producing effective concrete is the good setting of the aggregate. Good grading means that the constituents of the sample are mixed in the required proportion so that the sample contains the least number of voids.

### 9.3 Coarse Aggregate

Fractions from 80 mm to 4.75 mm are called coarse aggregate.

### 9.4 Fine Aggregate

Those particles from 4.75 mm to 150 micron are called fine aggregate.

### 9.5 Water

Water is important in the concrete gradient because it chemically reacts with the cement. The water-cement ratio is defined here in terms of the average distance between adjacent cement particles, and the work volume, air, compaction, and working time are normalized to the water content. Control the proportion and water content of the field.

## 10. METHODS AND MATERIALS

Technical buildings are primarily building materials or buildings. Prior to the final selection of materials to be used for a specific application, various types of building materials and the different properties of materials such as durability, shape, water permeability, water pressure, and temperature tolerance, physical and chemical operating conditions of buildings under Properties must be carefully refined. A specific and suitable material must be selected according to the required properties to maximize the compatibility and value of the building structure. Lightweight, reinforced concrete is mainly composed of cement mix, lightweight aggregate, natural aggregate, air conditioning agent and admixture. For the implementation of the project, the following materials have been selected:

1. Cement
2. Cinder Aggregates
3. Silica fume
4. Fly ash

## 11. CONCLUSIONS

The mix design was produced for a maximum aggregate size of 20 mm. The grade of ready concrete for the experimental study was M30. The mix ratio was 1:1.065:2.45 with water cement ratio of 0.45. The cement content in the concrete was 438 kg/m<sup>3</sup>. Cubic specimens of size 150 x 150 x 150 mm and cylinder specimens of size 100 mm x 200 mm were used for their exploration to determine the compressive strength and split tensile strength. After 24 hours of casting the samples were cast and placed in a curing tank for water curing. Samples to be tested were taken from the treated tank on the 7th and 28th day of treatment.

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