International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

A REVIEW PAPER ON PARTIAL REPLACEMENT OF CEMENT BY HYPOSLUDGE

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Abstract *- The increasing amount of waste is a concerning reality that has arose the sustainability issues of the environment. Hypo plant in the paper industry generates a large volume of waste in the form of slurry, disposal of which causes environmental pollution. The production of cement also accounts for the global warming by releasing carbon dioxide in the atmosphere. Therefore, formulation of concrete with industrial waste can help in minimizing the environmental problems. Here hypo sludge is used as a replacement of cement in concrete. It may be use as a partial replacement of cement in pervious concrete. In this research study the (OPC) cement has been replaced by hypo sludge accordingly in the range of 15%,25% and 35% by weight of cement for 0.30, 0.35, and 0.40 water/cement ratio.*
The workability of concrete was tested immediately after preparing the concrete whereas the compressive strength, splitting tensile strength and flexural test of concrete tests were tested after 7,14 and 28 days of curing. The addition of hypo sludge increases the strength of concrete for all curing ages up to certain point. After that, there is an abrupt reduction in strength of the concrete. Concretion of hypo sludge decreases the cost of concrete up to 18.35%.

Key Words: **Hypo sludge, OPC Cement, compressive strength, splitting tensile strength, flexural test.**

1.INTRODUCTION

Hypo sludge is the byproduct of the paper waste. Paper making industry generally produces a large quantity of solid waste. In paper mill sludge consumes a large percentage of local landfill space for each and every year. To reduce disposal and pollution problems remove from these industrial wastes, it is most imperative to develop profitable building materials from hypo sludge. The quantity of sludge varies from industry to industry. It contains low calcium and maximum calcium chloride and minimum amount of silica. It behaves like cement because of silica and magnesium properties. It may be used as partially replacement of cement. So hyposludge is use as a partial replacement of cement in pervious concrete. In this we can study the OPC cement has been replaced by hypo sludge accordingly in the range of 10% and 20% by weight of cement for 0.30, 0.35, and 0.40 water/cement ratio. Compressive strength test and flexural strength test is carried out for 7, 14 and 28 days to measure the compressive strength and flexural strength of concrete. Aim of this investigation is to study the behavior of pervious concrete while replacing the hypo sludge with different proportions in concrete. Test results have reflected, the compressive strength and flexural strength achieved up to 20% replacement of cement with hypo sludge will be optimum without effecting properties of fresh and hardened concrete

Concrete, is most widely used man made byproduct and is the largest manufacturing of all the materials used in construction industry. Concrete is fundamentally made of cementitious materials which have to properly tie 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 achieved 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 changeable as concrete. Concrete is the best material of alternative 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. Hypo sludge (paper industry waste) has a huge possible in this factor and it is well documented that the use of hypo sludge in concrete results in a remarkable improvement is the rheological prosperities.

Industrial wastes are produced yearly by chemical and agricultural process in India. These waste materials possess problems of disposal, health hazards and aesthetic problem. Paper fibers can be recycled for a limited number of times before they become too weak to make high quality paper. The broken, low- quality paper fibers are separated out which further becomes waste sludge. Paper sludge act like cement because of silica and magnesium properties which improve the setting of the concrete. The quantity of sludge varies from industry to industry. The amount of

sludge generated by a recycled paper mill is greatly dependent on the types of furnish being used and end product being manufactured.

This project is discussed with experimental study on strength of concrete and optimum percentage of the partial replacement by replacing cement via 5%, 10%, 15%, 20% and 25% of Hypo Sludge. The objectives of this study is to evaluate the strength and durability of concrete by partially replacing cement with Hypo Sludge, to compare the compressive strength of hypo sludge concrete with the conventional mix, to establishing an alternative for cement with partial use of hypo sludge in concrete and to investigate the utilization of Hypo Sludge as Supplementary Cementatious Materials (SCM). Hypo Sludge is the preliminary waste from paper industry. Where, it contains low calcium and maximum calcium chloride and minimum amount of silica. Hypo sludge act like cement because of silica and magnesium properties. The silica and magnesium improve the setting of the concrete. While producing paper the various process in paper industries. From the preliminary waste named as hypo sludge, due to its low calcium is taken out for our project to replace the utilization in concrete. For producing 4 million ton of cement, 1 million ton greenhouse gases are emitted. Also, to reduce the environmental humiliation, this sludge has been avoided in mass level disposal in land.

1.1 Objectives:

- To study the compressive strength of concrete using hypo sludge.
- To study the compressive strength, flexural strength and split tensile strength of concrete using hypo sludge.
- To study the workability of concrete using hyposludge (as partial replacement of cement).

1.2 Scope of the Project:

- The scope of this paper is to provide a most economical concrete.
- It should be easily adopted in field.
- The wastes from paper production can be converted in useful manner.
- To reduce the cost of the construction, to promote the low cost housing to the E.W.S. group people, 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 greenhouse gases.

2. MATERIAL USED AND THERE PROPERTIES

A) Cement:

Cement may be defined as adhesive materials capable of uniting fragments or masses of solid matter to a compact hole. The four major potential components are normally termed as Tri-calcium silicate, Di-Calcium Silicate, Tri Calcium Aluminates and Tetra calcium alumina ferrate. In this research work, Ordinary Portland cement (OPC) of grade 53 is used throughout the experimental work.

Table 1. Properties of Cement

Sr. No.	Properties	Results
1.	Fineness of Cement	2 %
2.	Specific Gravity	3.18
3.	Standard Consistency of Cement	30%
4.	Setting Time of Cement a) Initial Setting Time b) Final Setting Time	 32Minutes 10 Hours

B) Fine Aggregate

Locally available good quality river sand was used. Locally available sand is used as a fine aggregate conforming to zone II of IS 383-1983.Maximum size of aggregate used is 4.75 mm.

Table 2. Properties of Fine Aggregate

Sr. No.	Properties	Results
1.	Particle shape	Crushed angular
2.	Maximum Size	4.75 mm
3.	Fineness Modulus	3.2
3.	Specific Gravity	2.74
4.	Water Absorption	1.046 %

C) Coarse Aggregate

The properties such as moisture content, water absorption etc. would help in adjusting quality of mixing water for concrete mix. Locally available crushed stone aggregate with size 12.5 mm to 20mm and of maximum size 20mm are used.

Table 3. Properties of Coarse aggregate

Sr. No.	Properties	Results
1.	Particle shape	Crushed angular
2.	Maximum Size	20 mm
3.	Fineness Modulus	7.018

4.	Specific Gravity	2.72
5.	Water Absorption	0.5%

D) Hyposludge

Hyposludge is also known as paper industry waste. It is the by product of the paper waste. Hyposludge act like cement because of silica and magnesium properties.

Table 4 Properties of Hyposludge

Property	Value
Specific gravity	2.9

E) Water

Water is an important material of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quality and quantity of water is required to be looked into very carefully. Its PH value shall not be less than 6.

3. METHODOLOGY

Testing of Specimens:

Testing of hardened concrete plays an important role in controlling and confirming the quality of raw materials, which help to achieve higher efficiency of material used and greater assurance of performance of concrete. In the present study test conducted on harden concrete were carried out by using Compressive Testing Machine(CTM) of capacity 3000 KN and Universal Testing Machine (UTM) of capacity 600 KN as per IS 516:1959.

Test conducted on Concrete:-

a) Compressive Strength Test.
b) Split Tensile Strength Test.
c) Flexural Strength Test.

a) Compressive Strength Test:(IS: 516-1959)

According to IS: 516-1959 for the compression test the cubes of size 150 mm x 150 mm x 150 mm (according to IS: 10086-1982) are placed in machine in such a manner that the load is applied on the forces perpendicular to the direction of cast. The rate of loading is gradual and failure load is noted.

The compressive strength of specimen was calculated by the following formula:

$f_{cu} = P_c / A$

Where,

P_c=Failure load in compression,

A = Loaded area of cube,

f_{cu} = Compressive strength, N/mm^2

Fig.1. Setup for Compressive Strength Test

b) Split Tensile Test :(IS: 5816-1999)

According to IS 5816:1999 for determining split tensile strength cylinder specimens of size 150 mm in diameter and 300 mm in length (according to IS: 10086-1982) are horizontally placed between the two plates of compression testing machine. In these tests, in general a compressive strength is applied to a concrete specimen in such a way that the specimen fails due to tensile stresses induced in the specimen.

The split tensile strength of cylinder is calculated by the following formula,

$f_{cys} = 2P_{sp} / \pi D L$

Where,

f_{cys}=Split Tensile strength, Mpa

P_{sp}=Load at failure, N

L =Length of cylinder, mm

D =Dia. Of cylinder, mm

Fig.2. Setup for Split Tensile Test

c) Flexural Test:(IS: 516-1959) :

According to IS: 516-1959 the standard beam specimen of size 150mm x 150mm x 700mm (according to IS: 10086-1982) were supported symmetrically over a span of 400mm in the machine in such a way that the load is applied to the upper most surface as cast in the mould. All beams are tested under one-point loading.

The flexural strength is determined by the following formula:

$f_{cr} = P_f L / bd^2$

Where,

f_{cr}=Flexural strength, MPa

P_f = Central load through two point loading system (N).

L= Span of beam, mm

b = Width of beam, mm

d =Depth of beam, mm

Fig.3. Setup for Flexural Test

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