OPEN ACCESS INTERNATIONAL JOURNAL OF SCIENCE & ENGINEERING

EXPERIMENTAL STUDY ON STRENGTH OF CONCRETE BY PARTIALLY REPLACING OF CEMENT WITH HYPO SLUDGE

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Abstract: **The increasing amount of wastes is a concerning reality that has arose the sustainability issues for the environment. Large amount of hypo sludge (from paper mill industry). Are generated around 300 million tons annually. Their disposal generally by landfills leads to environmental pollution. Also, the production of cement accounts the global warming by releasing carbon dioxide. Therefore an innovative use of the industrial wastes in concrete formulation (rigid pavement) as the supplementary cemetatious material can help in minimizing the environmental problem. This research work is concerned with the experimental investigation of the strength of concrete blended with hypo sludge. The cement has been replaced by hypo sludge in the range of 10% to 40% of weight of cement. Concrete mixtures were produced, tested and compared with the conventional concrete mix in the terms of workability, compressive strength and splitting tensile strength. The tests were carried out after 3,7 and 28 days. The gradual increase was seen in compressive strength and splitting tensile strength of concrete blended with 10% to 40% of hypo sludge content for all curing ages. Beyond that there is a significant reduction in strength. The maximum compressive strength and splitting tensile strength of M20 concrete mix were 31.6 N/mm2 and 3.5 N/mm2. Also the cost analysis indicates that with incorporation of hypo sludge decreases the cost of concrete.**

Keywords: *Hypo Sludge, Supplementary Cementations Materials (SCM)*

I INTRODUCTION

GENERAL INFORMATION

The concept of recycling and sustainability has been introduced to maintain the level natural resources. Industrial wastes are being produced per annum by chemical and agricultural process in India. By the inclusion of industrial waste in concrete, the energy and the environment can be saved. The use of these by-products offers environmental advantages like divert the material from the waste stream, reduce the energy used in processing virgin materials, use of virgin materials, and decreases pollution. To produce ordinary Portland cement we use earth resources like limestone. During manufacturing of one tons of ordinary Portland cement an equal amount of carbon-dioxide is released into the atmosphere which is harmful to the environment. So there is a need to choose an alternative. In urban cities, solid waste management is one of the most challenging issues, which is a serious pollution problem due to the generation of huge quantities of solid waste. Also, the cost of cement is also steadily increasing day by day. So, there is a great need to use industrial waste products in an appropriate manner to reduce cost and environmental problems. Paper mill sludge is a major economic and environmental problem for the paper and board industry. The pulp and paper industry generates large volume of waste called Hypo sludge; which is technology-dependent but the estimate is around 100 tons of waste for 550 tons of pulp production which causes the problem to the environment. The amount of sludge generated by the recycled paper mill depends on the furnish being used and end product being manufactured. Paperfibrecan be recycled only a limited number of times before they become too short or weak to make high quality of paper. Hypo sludge contains, low calcium and maximum calcium chloride and minimum amount of silica. Hypo sludge behaves like cement because of silica and magnesium properties. This silica and magnesium improve the setting of the concrete. Paper sludge consists of

cellulose fibers, calcium carbonate and china clay and residual chemicals bound up with water. Hypo sludge contributes beneficial properties to the concrete while helping to maintain economy. Therefore, numerous contemporary researches have focused on the application of hypo sludge in cement and concrete production to attain sustainable development. Many researchers have investigated the feasibility of using the paper industry waste in concrete production as partial replacement of cement. The use of hypo sludge in concrete can save the paper industry disposal costs and produces a green concrete for construction. Moreover, all the generated residues from cellulose and paper manufacturing are classified as not dangerous in the Catalogue of European Residues (CER). The current residues produced in the manufacture of paper, which are used in the ceramics industry and in agricultural compost, are catalogued as clean. This research work describes the feasibility of using hypo sludge in concrete production as partial replacement of cement. The mix were blended with various proportion of hypo sludge in concrete, tested and compared with the conventional concrete.

To save energy and to earn carbon credit is very much essential for the betterment of mankind. To produce 1 tons of Ordinary Portland Cement we use earth resources like limestone, etc & during manufacturing of 1 t of Ordinary Portland Cement an equal amount of carbon-dioxide are released into the atmosphere which is harmful to the environment.

II LITERATURE REVIEW

A lot of investigators have worked on the hypo sludge properties to evaluate its importance in various fields. Some of them are mentioned below:-

Pitrodaet al, (2013) focused on investigation of strength of concrete and optimum percentage of the partial replacement by replacing cement via 10%, 20%, 30%, and 40% of Hypo Sludge. Keeping all this view, the aim of investigation is the behavior of concrete while adding of waste with different proportions of Hypo sludge in concrete by using tests like compression strength and split strength. mortar of mix proportion 1:3 in which cement is partially replaced with Hypo Sludge as 0%, 10%, 30

Shah And Pitroda (2013) study the results of the cement %and 50% by weight of cement. Test results indicate the decreases in the strength properties of mortar with Hypo Sludge for strength at 7 & 28 days as partial replacement with the cement in the cement mortar 1:3. So it can be used in non-structural elements in the low range compressive strength where strength is not required and low cost temporary structure is prepared.

Patil and Jamnu (2014) study the various mechanical properties of concrete containing hypo sludge. Hypo sludge was used as a replacement to cement. Replacement percentages used during the present study were 10%, 15%, 20%, 25%. Compressive strength of cubes were found on 3days, 7days, and 28days. The 28th day flexural strength and split tensile strength of the specimens was found on the respectively beams and cylinders. It is found that replacement of hypo sludge have beneficial effects on the mechanical properties of concrete.

III METHODOLOGY

GENERAL

Replacement levels of OPC by Hypo Sludge of 10%, 20%,30% and 40% were chosen for this research work. Batching was carried out by weighing as per calculated amount of each concrete constituent according to the mix ratio of 1: 1: 2 and M25 grade of concrete was adopted. The constituents were then mixed thoroughly until a uniform mix was obtained. Water was then added and the mix was repeated. The fresh concrete mix was then placed in a mould of size 150 mm3, compacted, and left for 24 hours before testing Compressive Strength of specimens were tested at the ages of 3,7 and 28 days.

The following methodology will be adopted for project work,

1) Collection and review of literature.
2) Study for need of project.
3) Study for objectives and scope of project.
4) Material properties testing as per Indian Standards Code (IS 383 - 1996) procedures.
5) Mix designing for concrete proportions as per IS 10262 - 2009 casting and curing the concrete specimens as per Indian standards procedure.
6) Testing the characteristic strength of hardened concrete specimen as per IS 456 - 2008.Finding the optimum strength of the optimum replacement of hypo sludge as cement.
7) Comparative study of conventional concrete with Hypo Sludge concrete.
8) Comparative Cost Analysis.

IV PROPERTIES OF RAW HYPO SLUDGE

Sr.No	Constituents	% Present In Hypo Sludge
1	Moisture	56.8
2	Magnesium oxide (MgO)	3.3
3	Calcium oxide (CaO)	46.2
4	Acid insoluble	11.1
5	Silica (SiO2)	9.0
6	R_2O_3	3.6

V MIX DESIGN

Concrete mix design is a process of proportioning of various ingredients such as cement, aggregates water and admixture. In the most optional manner so as to produce a concrete at minimum cast having specified properties of workability and homogeneity in fresh state and strength and durability in hardened state.

A. **Factors Affecting Mix Design**

1. Grade designation M25
2. Type and grade of cement
3. Maximum nominal size of aggregates
4. Grading of combined aggregates
5. W/c ratio
6. Workability
7. Durability
8. Quality control

B. **Basic Consideration For Mix Proportioning**

1. The compressive strength of concrete is governed by its W/C ratio.
2. For the given aggregates characteristics the workability of concrete is governed by its water content.
3. The proportioning of concrete mix is accomplished by the use of certain empirical relations.
4. Type of cement used and its strength at 28 days.
5. Limiting dosage of admixtures. Workability is specified in terms of slump.

C. **Silent Features Of New IS: 10262-2009**

1. New code explains mix proportioning procedure using a typical mix design problem.
2. It is applicable to only ordinary and standard concrete grades only and not for high strength concrete grade.
3. The requirements for selecting W/C ratio, water content and estimating fine/coarse aggregates content have been modified. Consideration of air content has been deleted.

STIPULATIONS FOR PROPORTIONING

a) Grade designation	M_{25}
b) Type of cement	OPC 43 grade conforming to IS8112
c) Maximum nominal size of aggregate	20 mm
d) Minimum cement content	320 kg/m3
e) Maximum water-cement ratio	0.5
f) Workability	100 mm (slump)
g) Exposure condition	Severe (for reinforced concrete)
h) Method of concrete placing	Pumping
j) Degree of supervision	Good
k) Type of aggregate	Crushed angular aggregate
m) Maximum cement content	450kg/m3

TEST DATA FOR MATERIALS

a) Cement used	OPC 43 grade conforming toIS 8112
b) Specific gravity of cement	3.15
c) Specific gravity of:	
1) Coarse aggregate	2.74
2) Fine aggregate	2.74
d) Fine aggregate :	Conforming to grading Zone I of Table 4

e) Water absorption

a) Coarse aggregate: 2.0 %
b) Fine aggregate: 1.0 %

f) Free (surface) moisture

a) Coarse aggregate: Nil
b) (Absorbed moisture full)
c) Fine aggregate: Nil

CUBE TESTS AND RESULTS

SR No	% Replacement of Hypo Sludge	Surface area of cubes (mm^2)	Ratio	Load in KN	Comp strength (N/mm^2)
1	10	150X150	1:1:2	556.12	26.05
2	20	150X150	1:1:2	627.52	27.89
3	30	150X150	1:1:2	591.52	26.29
4	40	150X150	1:1:2	572.17	25.43

Compressive Strength Results for 28 days of curing for M_{25} grade of concrete

V CONCLUSION

1. Compressive strength of concrete with replacement of Hypo Sludge at 20% dosage is maximum as compared to conventional M25(1:1:2) concrete for 7,14 & 28 days of curing

2. Compressive Strength of Hypo Sludge concrete gives similar strength for 10%,20%,30% &40% replacement of Hypo Sludge as compare to normal conventional concrete M25(1:1:2)

3. As the dosage of Hypo Sludge increase there will be considerable decreases in bulk density.

4. On comparing the cost estimate of Hypo Sludge concrete compare to normal conventional concrete, the Hypo Sludge concrete proves to be economical.

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