iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VI **Month of publication:** June 2022

DOI: https://doi.org/10.22214/ijraset.2022.43063

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VI June 2022- Available at www.ijraset.com

Experimental Study on Use of Hypo Sludge and Nylon Fibre in Paver Blocks: A Review

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Abstract: ***For a greener and sustainable future we have to develop innovative ways to save fuel and mitigate carbon footprints therefore develop alternative ways by which building materials can be modified To produce low cost concrete by blending various ratios of cement with hypo sludge & to reduce disposal and pollution problems due to hypo sludge it is most essential to develop profitable building materials from hypo sludge. The cement has been replaced by waste paper sludge accordingly in the range of 0% (without Hypo sludge), 5%, 10%, & 15% by weight. Concrete mixtures were produced, tested and compared in terms of strength with the conventional concrete. These tests were carried out to evaluate the mechanical properties like compressive strength of paver blocks up to 7, 14 and 28 days.***
Keywords: Hypo Sludge, Nylon Fibres, Compressive Strength, Flexural Strength.

I. INTRODUCTION

Paper mill sludge is a major environmental problem for the paper and board industry. The material is by-product of the de-inking and re-pulping of paper .The million tons quantity of paper mill sludge produced in the world. Paper sludge behaves like cement because of silica and magnesium properties which enhance the properties of the concrete. The quantity of sludge varies from mill to mill. The amount of sludge generated by a recycled paper mill is greatly dependent on the type of furnish being used and end product being manufactured. Paper mill sludge can be used as an alternative material applied as partial replacement of fine aggregates in manufacturing fresh concrete intended to be used for low cost housing projects. About 300 kg of sludge is produced for each tone of recycled paper. This is a relatively large volume of sludge produced each day that makes making landfill uneconomical as paper mill sludge is bulky. By adjusting the mixture to an equivalent density, concrete mixtures containing the residuals can be produced that are equal in slump and strength to a reference concrete without residuals. The main recycling and disposal routes for paper sludge are land spreading agricultural fertilizer, producing paper sludge ash, or disposal to landfill. In functional terms, paper sludge consists of cellulose fibers, calcium carbonate and china clay and residual chemicals bound up with water.

II. LITERATURE REVIEW

Some information has been published on uses for hypo sludge. There is a lack of information on the engineering properties of the material.

A. Determined the compressive strength, water absorption and flexural strength of paver blocks by adding coconut fibres in the top 20 mm thickness was published by **G. Navya et al**. **(2010).** Coconut fibres were added in proportions of 0.1%, 0.2%, 0.3%, 0.4%, and 0.5% in volume of concrete. The compressive strength, flexural strength and water absorption were determined at the end of 7 and 28 days. Test results indicate that addition of coconut fiber by 0.3% paver block attains maximum compressive strength. Test results indicate that addition of coconut fiber gradually increases flexural strength and water absorption at 7 and 28 days.(1)

B. Investigated suitability of concrete reinforced with synthetic fiber for the construction of pavements was published by the author **Rakesh Kumar (2014).** The effects of addition of polypropylene discrete and fibrillated fibre on the properties of a paving grade concrete mix of about compressive strength 48 MPa at 28 days are discussed. Six concrete mixes were casted with fiber dosages 0.05%, 0.10%, and 0.15%. The properties such as settlement, compressive strength, drying shrinkage and abrasion resistance of the concrete were evaluated.(2)

C. Experimental investigation on strength of concrete and optimum percentage of the partial replacement by preparing a mixM20 grade was described In **2013** by the author **Jayraj et al**. The author was designed the concrete mixture as per Indian Standard method and the same was used to prepare the test samples. In the test performed, the optimum compressive stress

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obtained by utilizing paper waste was at 30% 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.(3)

D. **Dharani .N et al** studied on the mechanical properties of concrete with industrial wastes. During the present study, an attempt had been made to study the mechanical properties of concrete in which Hypo sludge and Copper slag were as a replacement material for cement and fine aggregate respectively. Replacement percentage used during this study was 10%, 20% and 30% of Hypo sludge for cement. Fine aggregate was replaced with 30%, 40% and 50% of Copper slag. Compressive strength of cubes was found on 7th, 28th and 56th days. Split tensile strengths of the cylinders were found on 28th and 56th days. Flexural strengths of prism specimens were found on 28th day. It has been found that usage of Hypo sludge and Copper slag as a replacement material has beneficial effects on the Mechanical properties of concrete.

E. **Mehtab Alam et al** conducted the study on use of hypo sludge in cement concrete. A large quantity of this is contributed by paper industry where three kinds of wastes are generated, i.e. , fibrous sludge called reject which is biodegradable, Hypo sludge, solid wastes generated during calcium hypo chlorite generation and Lime sludge, generated during causticisation of green liquor. The hypo sludge and lime sludge are purely chemical wastes and require large spaces of landfill for their disposal. Limited land fill sites augment the disposal problems of these wastes. Use of these wastes in cement concrete can not only solve the problem of their disposal but economize the concrete by partially replacing cement. Response to various loads and durability of such concretes might be prime concern of construction engineers, structural designers and owner of the structure. Therefore, a scientific experimental study of such concretes is inevitable.

III. MATERIALS AND PROPERTIES

A. Materials

Hypo Sludge
Cement
Fine Aggregate (Dust)
Sand
Nylon Fiber
Water

1) *Hypo Sludge:* Hypo sludge is formed as waste by product is purely a chemical wastes and do not contain any bio degradable element. Most of the paper mills in India prepare bleach liquor (calcium hypochlorite) using lime and elemental chlorine. Six mills among eight mills are using ClO2 as bleaching agent either as partial substitution of elemental chlorine or in final stage of bleaching to attain desired brightness level. These mills are producing ClO2 with environmental friendly process. Three mills among eight mills are still using calcium hypo chlorite in final stage for bleaching. Solid wastes generated during calcium hypo chlorite generation are called hypo sludge.

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 as the result of testing, it shows that WPSA is similar to the chemical properties of OPC and the water absorption of the mortar is 27.05%. However the total percentage of the three combinations of SiO2, Al2O3 and Fe2O3 was 45% and expected to possess low Pozzolanic reactivity (50%). WPSA was used in mortar with proportions of 50%, 60%, 70%, 80%, 90% and 100% as cement replacement by volume along with sand and water in fix quantity. An additional control mix mortar without WPSA was also prepared. The compressive strength of each mortar mix was also determined on 7, 14 and 28 days. Results show that the compressive strength increased with increasing curing age for all concrete mixes and the compressive strength decreases with increasing WPSA in the mortar. The inclusion of 50% WPSA can gain favorable strength mortar at 16.4 MPa. Meanwhile 70% and 100% replacement can be adopted for economical environmental mortar to suit lower strength mortar construction at 12.5 MPa and 7.7 MPa respectively. The following tables shows the hypo sludge chemical properties and comparison between cement and hypo sludge.

2) *Nylon Fibres:* Nylon is a type of plastic derived from crude oil. Nylon is known as one of the most useful synthetic fiber in the world. It's a plastic that is in everyday products but is also fibers for making fabrics. This plastic is then put through an intensive chemical process, resulting in the strong, stretchy fibers that make it as useful as a fabric. Nylon is a synthetic man-made fiber derived from petrochemicals, which is used extensively throughout the fashion industry. One of the primary benefits of nylon fabric is its relatively low cost of manufacture. It has good hardness, resilience and durability.

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B. Methodology

The evaluation of hypo sludge for use as a replacement of cement material begins with the concrete testing. The author said that the comparative studies were made on each concrete mix for 0.30, 0.35 and 0.40 W/C ratio of partial replacement of cement with hypo sludge as 10% and 20%. In this paper the specimens were tested after 7, 14 and 28 days for compressive strength test. In their result the author has said that the result w/c ratio of 0.40 and 20% replacement of hypo sludge has a more compressive strength as compare to 7 and 14 days. Replacement levels of cement by Hypo Sludge of 10%, 20%, 30% and 40% were chosen for this research work. The author had test the samples after 3, 7.and 28 days. In this paper author is mentioned that the compressive strength of 20% replacement of hypo gives more compressive strength as compared to other blocks

C. Properties

1) Cement:

Lime	-	60-70%
Silica	-	17-25%
Alumina	-	3-8%
Iron Oxide	-	0.5-6.0%
Sulfur Trioxide	-	2.0-3.5%
Magnesia	-	0.5-4%
Calcium Sulfate	-	0.1-0.5%
Alkaline	-	0-1%

2) Hypo Sludge:

Silicon dioxide (SiO2)	-	9.27%
Aluminum oxide (Al2O3)	-	1.45%
Iron oxide (Fe2O3)	-	1.68%
Calcium Oxide (CaO)	-	29.83%
Magnesium Oxide (MgO)	-	4.28%
Loss on Ignition	-	49.24%
Specific gravity	-	2.82

3) Nylon Fibre:

Lustrous.
Elastic.
Very strong.
Damage resistant to oil and many chemicals.
Resilient.
Does not absorb water.
Dries quickly

4) Fine Aggregate :

Fine aggregate should be clean i.e. it should be free from lumps, organic material, etc.
It should be strong and durable.
It should not react with cement after mixing.
Also, it should have a tough floor.
It should not absorb greater than 5% of water.

D. Test

1) Fineness Modulus
2) Specific Gravity
3) Water Absorption
4) Compressive Strength

5) Specific Gravity of Cement, Coarse Aggregate and Fine Aggregate
6) Water Absorption
7) Free (Surface) Moisture
8) Compressive Strength

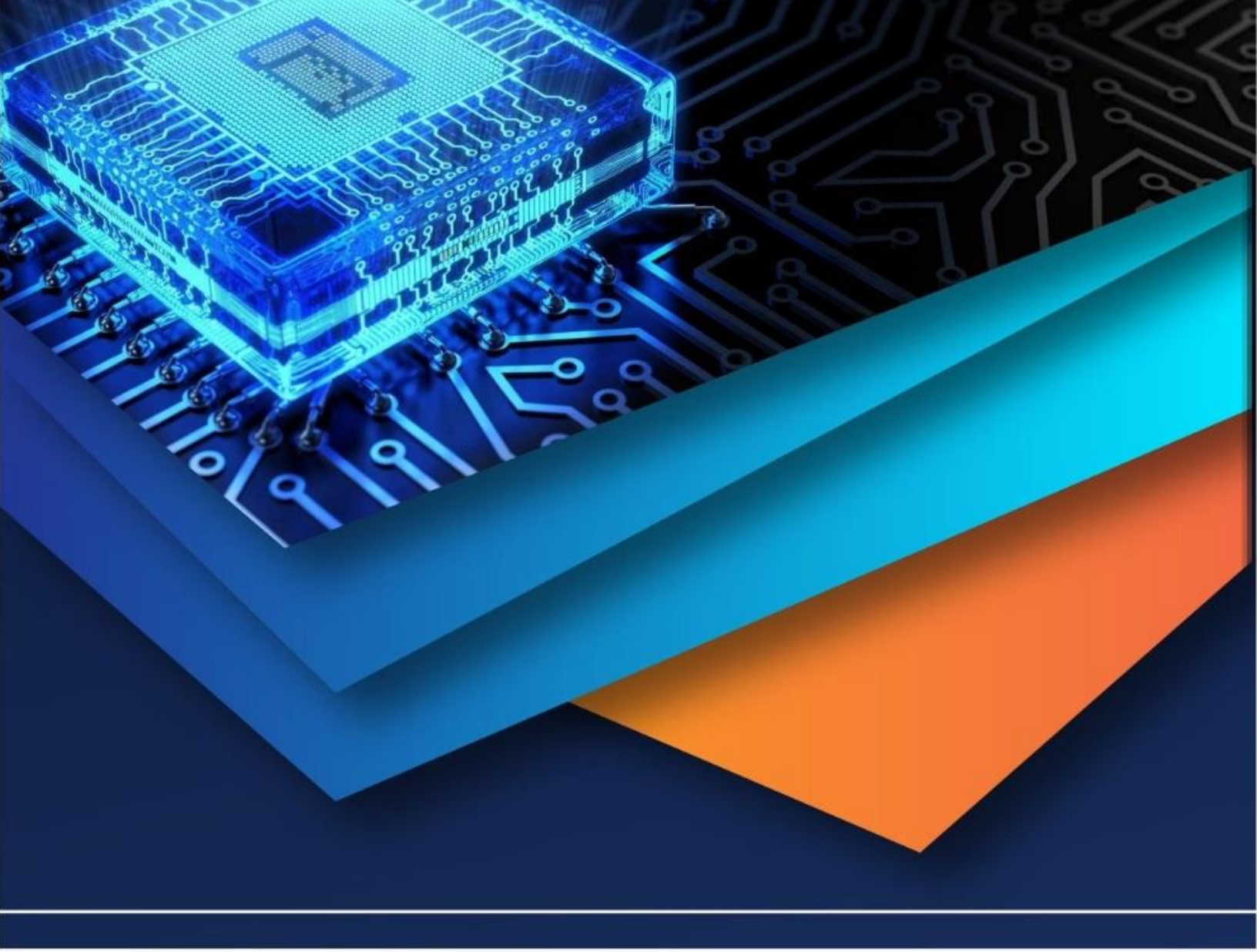
IV. CONCLUSION

After Studying Number of paper we are concluded that,

Hypo Sludge is a better innovative sustainable cementitious construction material which is used in concrete. So, the hypo sludge is proves to be economical and sustainable and it can save the paper industry wastes disposal costs and produce a "greener" concrete for construction. When W/C ratio is increase respectively, Compressive Strength and Flexural Strength of Concrete is increased[4]. The Compressive Strength of Concrete is increases by replacing 20% of Cement with Hypo Sludge. The Compressive strength of concrete with replacement of Hypo Sludge is maximum as compared to conventional M25 (1:1:2) concrete for 7, 14 & 28 days of curing. Compressive Strength of Hypo Sludge concrete gives similar strength for 10%,20%,30% &40% replacement of Hypo Sludge as compare to normal conventional concreteM25(1:1:2). As the amount of Hypo Sludge increase there will be considerable decreases in bulk density. On comparing the cost of Hypo Sludge concrete compare with conventional concrete, the Hypo Sludge concrete proves to be economical and sustainable[6].

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