International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 7 Issue 1, January-February 2023 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

# Investigate the Potential of Hypo Sludge and Steel Fiber, Which Can Be Partially Mixed Into the Concrete

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## ABSTRACT

Concrete and steel are the two main construction materials used in reinforced concrete structures around the world. The material that is utilised the most frequently is concrete, aside from this. These materials' manufacturing procedures result in the production of greenhouse gas (GHG) emissions. GHG emissions can be decreased by lessening the environmental impact and improving the sustainability of cement replacement while maintaining the physical and mechanical characteristics of concrete. These materials' disposal seriously pollutes the environment. Hypo Sludge (HS), a waste product from the paper industry, is dumped in significant quantities as slurry. Therefore, using HS as a partial replacement for cement in the production of concrete can aid in reducing the problem of environmental pollution. With the aim of determining an acceptable optimum replacement of HS without noticeably reducing physical and mechanical properties compared to regular concrete of the same grade, the current study, which is based on prior research, uses HS as a partial replacement of cement varying up to 40% for concrete manufacturing in combination with the addition of Steel Fibre (SF) up to 4% with super plasticizer.

***KEYWORDS:*** *HS, SF, workability, compressive strength, split tensile strength, flexural strength*

***How to cite this paper:*** Naina Dangi | Rajesh Misra "Investigate the Potential of Hypo Sludge and Steel Fiber, Which Can Be Partially Mixed Into the Concrete" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-7 | Issue-1, February 2023, pp.687-690, URL: www.ijtsrd.com/papers/ijtsrd52740.pdf

IJTSRD52740



## I. INTRODUCTION

Important engineering structures were applied gradually, such as fibre reinforced concrete and high-performance concrete. High-performance concrete was widely used in the current engineering field for the advantages of low cost, easy fabrication, and performance improvement, as was steel fibre reinforced concrete. The distribution of fibre in concrete increases the density and improves the mechanical properties of steel fibre reinforced concrete. The paper industry is the largest producer of hypo sludge by product. Hypo sludge has low Ca (Calcium) and maximum CaCl2 (Calcium Chloride) and a minimum amount of SiO2 (Silica). It behaves like cement because of its Sio2 and Mg properties. Hypo sludge improves the properties like setting of the concrete. Paper sludge consists of cellulose, china clay, fibres, calcium carbonate, and residual chemicals that are bound up with water. It is used in concrete construction as a partial replacement for cement.

## II. Literature review

**Shende et al. (2012)**, critical investigation for M-40 grade of concrete having mix proportion 1:1.43:3.04 with water cement ratio 0.35 to study the compressive strength, flexural strength, split tensile strength of steel fibre reinforced concrete (SFRC) containing fibers of 0%, 1%, 2% and 3% volume fraction of hook tain. Steel fibers of 50, 60 and 67 aspect ratios were used. A result data obtained has been analyzed and compared with a control specimen (0% fiber). A relationship between aspect ratio vs. Compressive strength, aspect ratio vs. flexural strength, aspect ratio vs. Split tensile strength represented graphically. Result data clearly shows percentage increase in 28 days Compressive strength, Flexural strength and Split Tensile strength for M-40 Grade of Concrete.

**Kaur et al. (2015)**, 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 0%, 5%, 10%, 15% and 20% for M-20 mix. 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 7, 14 and 28 days. The

workability of concrete decreases with the increase in content of hypo sludge the gradual increase was seen in compressive strength and splitting tensile strength of concrete blended with 0% to 10% 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 were 27.62 N/mm2 and 3.79 N/mm2. Also, the cost analysis indicates that with incorporation of hypo sludge decreases the cost of concrete, but at the same time strength also decreases. 20% replacement of cement with hypo sludge leads to 18.35% reduction in cost.

**Joshi et al. (2016)**, The various aspects covered are the materials, mix proportioning for M20, M25, M30, M40 grades of concrete. As the concrete is weak in tension, a work has been carried out to investigate the improvement in tensile, shear, flexure, and even compressive strength of concrete and also to investigate the cracking strength and reserve strength of concrete & FRC.M20, M25, M30, M40 grades of concrete have been added to investigate the compressive strength, tensile strength & shear strength of concrete. Steel fibers acts as a bridge to retard their cracks propagation, and improve several characteristics and properties of the concrete. Fibers are known to significantly affect the workability of concrete. The aspect ratio (50) and variable in this study were percentage of volume fraction (0, 0.5, 1.0 and 1.5) of steel fibers. Compressive strength, splitting tensile strength and flexural strength of the concrete were determined for the hardened properties. Their main purpose is to increase the energy absorption capacity and toughness of the material. But also, the increase in tensile and flexural strength is often the primary objective. A marginal improvement in the ultimate strength was observed. The addition of fiber enhanced the ductility significantly.

**Salam et al. (2016)**, an experimental investigation was conducted to determine the effect of dosage of the mentioned admixture. Concrete mixes with SP dosages of 400, 600, 800, 1000 and 1200 ml/100kg of cement were prepared, together with two control mixes (water/cement ratio were 0.56 and 0.66 respectively). After casting, normal curing was carried out on the concrete samples. Properties such as compressive strength, porosity, water absorption, permeability and initial surface absorption were determined, besides determining the workability and setting time of the fresh concrete. Over dosage of SP were found to deteriorate the properties of concrete with indication of lower compressive strength and higher porosity. However, if the dosage levels are lower than the optimum dosage, increase in admixture dosage might help to enhance the concrete characteristics.

**Prajapati et al. (2017)**, the single crystal is essentially a single giant grain in which the arrangement of molecules exhibits strict order. Due to this, the crystal lattice is continuous and unbroken to the edges of the sample, with no grain boundaries. The absence of the defects associated with grain boundaries can give monocrystals unique properties to the single crystal materials. The Czochralski process and the Bridgeman technique are most commonly used for formation of single crystal materials. Because of the good physical properties particularly mechanical, optical and electrical, single crystals produced by the Czochralski process are widely used in the semiconductor and solar photovoltaic industries. The other application of single crystal material is to manufacture the turbine blades by the Bridgeman technique using nickel-based alloy because conventionally cast turbine blades are polycrystalline having grain boundaries which lead to creep, and this creep is responsible for turbine failure. Apart from that, single crystalline diamond has extraordinary physical properties and used in abrasives, cutting and polishing tools, CO2 lasers, and gyrotrons. Inspite of having this much good property, due to the lack of large, high quality single crystals prevents its use in many applications. So, the formation of large single crystal at high growth rate can open a new era for applications of the material. This paper reviews several formation techniques of single crystal material and various applications of it.

**Ahirwar et al. (2018)**, paper making generally produces a large amount of solid waste. Newspaper fibers can be recycled only a limited number of times before they become too short or weak to make high quality valuable paper. Concrete specimens were prepared with 7.5%, 10%, 12.5% and 15% hypo sludge as a replacement of cement weight, the most important mechanical property of concrete is compressive strength and it is evaluated on 150X150X150 mm cubes. Result was obtained at the age of 7 days and 14 days. The cubes were tested using Compression Testing Machine (CTM) of capacity 2000KN available in structures lab. The compressive strength is up to 22.52 N/mm2 and 31.60 N/mm2 at 7 and 28 days. The final result was observed at 10% replacement of Hypo sludge.

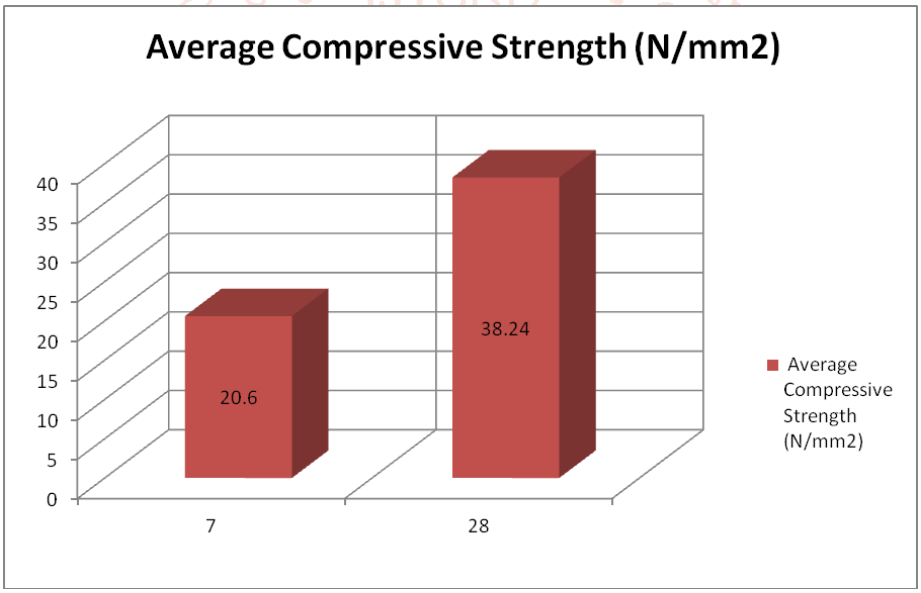
**Velumani and Lakshmipriya (2018)**, at the global level to reduce the environmental pollution in the respective countries as per the environment rules. In current situation disposal of waste material from the industries or from the other sources play a main role. Reuse of process finished materials indicates in the reduction of unnecessary land filling / dumping. Hypo

sludge is an industrial preliminary waste generated from the NaOH (Caustic Soda) process of paper making and other specific manufacturing industries. In this study, preliminary steps have been performed so as to confirm the doable utilization of hypo sludge as an ancillary cementitious material in appropriate proportions. Cement sludge blocks were tested for compressive strength after 28 days of curing and compared for 10%, 20% sludge addition with cement. The result was observed after 28 days curing 33.79 KN. It was observed that the strength for mortar cubes at 10 % of replacement was increased. At 10% sludge replacement give required strength which verified as per IS:1489-1991. Water absorption of mortar increases as the percentage of addition of hypo sludge increases and ranges from 4.12 % to 5.06 %. For all combination the absorption of water does not exceed 5%. The block density varies from 2300 t0 2700 kg/m3.

## III. Fine Aggregate

In fine aggregate (sand) particle size passing through 4.75mm BIS sieve BIS:383-1970. In the nature (ATM) sand is naturally occurring with action of weathering seasoning and rock spelled in river. Due to weathering action rock convert in small size of stone that stones moved by river water and it concert in another small size stone and finally convert into sand particle. After that it collected from various placed and also screening it by performed sieve analysis for sand as well as aggregate. According to the Bureau of Indian Standard BIS:383-1970 fine aggregate (sand) divided into 4 Zones (I, II, III&IV) When we go with zone I to zone IV aggregate become finer. After studying I choose II zone fine aggregate sand. After that I determine SP, FM and water absorption before used in the mixed.

**Figure 1 Fine aggregates**




**Graph 1.Compressive strength in N/mm2 at 0% of HS and 0% of SF after 7 day and 28 days.**

## IV. Conclusion

Based on the above study following conclusions can be made:

- The split tensile strength of Hypo Sludge and Steel Fiber mixed concrete is 5.87 N/mm2 after 7 days and 28 days of curing with 20% HS and 1% SF addition, but it begins to decrease with an increase in HS and SF addition, and the mix with the highest compressive strength is Mix 3.
- The Flexural strength of Hypo Sludge and Steel Fiber mixed concrete is 3.85 N/mm2 after 7 days and 28 days of curing with 20% HS and 1% SF addition, but it begins to decrease with an increase in HS and SF addition, and the mix with the highest flexural strength is Mix 3.
- The workability of Hypo Sludge and Steel Fiber with super plasticizer mixed concrete is 185 cm for fresh concrete with 40% HS and 4% SF addition and the mix with the highest workability is Mix 5.
- The initial and final setting time of Hypo Sludge and Steel Fiber with super plasticizer mixed concrete is 485 minutes and 596 minutes for fresh concrete with 40% HS and 4% SF addition and the mix with the highest initial and final setting time is Mix 5.

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