

## **COMPARSATION OF BOND STRENGTH CHARACTERISTICS OF POLLUTED AND NON POLLUTED REBAR BY USING HYPO SLUDGE**

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### **ABSTRACT**

*In Present days Bond strength is the most important characteristic to the concrete and Rebar. In these days rebar may polluted by the construction site. In present experiment we have done a research on oil polluted reinforced Rebar's with concrete. Now-a-days development of structures has been increased. A long with this we need to increase cementsious materials. This paper describes how the usage of paper waste (Hypo Sludge) in cement by partial replacement. It develops the low cost of concrete. By using Hypo-Sludge 5-30% of cement will be replaced to develop the M25 grade concrete. Concrete made with Hypo-Sludge more than the normal concrete. In this experiment we have conducted 3 tests to test the strength of concrete. Those are pull-out, compression test. We have observed that the both tests strength of concrete is increased.*

**Key words:** Bond strength, oil polluted, cement, Hypo Sludge ash.

### **INTRODUCTION**

The transfer of axial force from reinforcing steel bar to the surrounding concrete produced from the development of tangential stress components along the contact surface. The stress acting parallel to the bar along the interface is called bond stress. (Pillai & Kirk 1938, Hadi 2008). For the reinforced concrete material, it is necessary to create suitable bond between steel bars and surrounding concrete. Bond ensures that there is no slip of the steel bars relative to the concrete and the means by which stress is transferred across the steel-concrete (Hadi 2008, Warner et al 1998). Bond resistance is made up of chemical adhesion, friction and mechanical interlock between the bar and surrounding concrete. To avoid the adhesion of the hardened concrete and the constructional forms, the oil is widely used nowadays in the site constructions. This practical method may influence on the bond between the concrete and steel bars due to the pollution of steel bars by the oil before concrete casting. While load transfer through bearings depends on the geometry of the steel and the magnitude of the friction, the adhesion between steel and concrete depends on the properties of the concrete. Research have shown that contaminants such as oil, found on construction sites affect bond strength.

### **HYPO SLUDGE ASH:**

In the present scenario, 300 million tons of waste paper was produced per annum by agro-based industries in India. These materials serve as a huge problem in the disposal, leads to health hazards and aesthetic problems. Nowadays because of low accessibility of natural resources, the ordinary Portland cement has been used rapidly for construction of industries, residential buildings and other concrete based structures. Thus, resulted in the huge production of waste paper and utilization of this in concrete can reduces heat of hydration caused by cement. By using Hypo sludge as a partial replacement to cement we can decrease the amount of waste produced by the paper mills. The Hypo sludge is rich in magnesium and silica particles which would help to increase the strength of concrete. As Hypo sludge is a fresh arrival among cementitious materials and was originally produced as artificial pozzolana while producing paper, the waste products that has come out from various processes used in paper industry.

### **Experimental program:**

The experimental study of the materials is cement, Fine aggregate, Coarse aggregate and water. The properties of these ingredients are given below.

**Cement:** The ordinary Portland cement which conforms to BIS: 12269 – 2013 53 grade

(penna) was used for making concrete. The basic properties of cement as per the code IS456-2000 are tested. The results obtained were Fineness test 6%, Standard consistency 33%, initial setting time 38 min, and Specific gravity 3.12.

**Fine aggregate:** The river sand was found to be zone – II as per IS: 10262 – 2009, IS: 383-1970. the properties of fine aggregate were Specific gravity 2.29, Bulk density (g/cc) 1.52.

**Coarse Aggregate:** The sieve analysis for coarse aggregates was done as per IS 383-1970.

The natural crushed stone of 20mm and 10mm was used as coarse aggregate. Physical properties of coarse aggregate were Specific gravity **10mm** 2.3, **20mm** 2.78 and Bulk density Kg/m<sup>3</sup> **10mm** 1.3, **20mm** 1.59.

**Water:** The water which is used is free from oil, acids, vegetable matter, alkalis clay and portable drinking water.

**Hypo sludge:** Hypo sludge is a recent arrival waste produced material from the paper industry. The preliminary tests are to be conducted on hypo sludge are. Specific gravity 2.13

And Fineness test 8%.

**Reinforcing Bars:** Reinforcing bars used in the present experimental study is of 12mm diameter and of 750 mm long. It is provided as per IS: 2770 (part 1) -1967.

**Used engine oil:** Used engine oil with specific gravity of 0.89 was applied as a coating on the embedded bar surface at varying coverage areas.

**Chemical Composition of Hypo Sludge:** The chemical composition of hypo sludge is given by **Tirumala Venkateshwara Paper & Board Pvt. Ltd.**

### **PREPARATION OF SPECIMENS:**

The research is carried out to study the properties of M25 grade concrete with replacement 30% of hypo sludge by the volume of cement. The mix proportion was 1:1.625:3.217 with water cement ratio 0.5. The compressive strength, pull out test were carried out. The experimental program to casted 21 cubes of size 150x150x150 mm, 42 cylinders of size 150x300 mm. The development length of rebar was 300mm.

**0% pollution:** The embedded length of rebar 0% polluted.

**50% pollution:** The embedded length of the rebar half of the surface area polluted (50%).

**100% pollution:** The embedded length of the rebar fully surface area polluted (100%).

### **Results and Discussions**

#### **Compressive Strength**

In this test, to take the readings which place load reached the ultimate point. The test results are depends upon the many factors quality of material, surface moisture condition.

These specimens are tested compressive testing machine after 7, 14, 28, days curing. Fig.1. shows the variation of % of hypo sludge ash content Vs Compressive strength of concrete at 7, 14, and 28 days.

### Pull out strength

The cylinders were each inserted into a 500 KN capacity electronic tensile test machine and loaded until failure in the form of tensile splitting of the concrete or pull-out of the rebar. The failure load was then recorded. The load from the machine was distributed onto the test specimen by a steel plate at the rate of 2.5 KN/sec.

$$\tau_{bd} = \frac{p}{\pi dl}$$

### Development length:

$$L_d = \frac{\phi \sigma_s}{4\tau_{bd}}$$

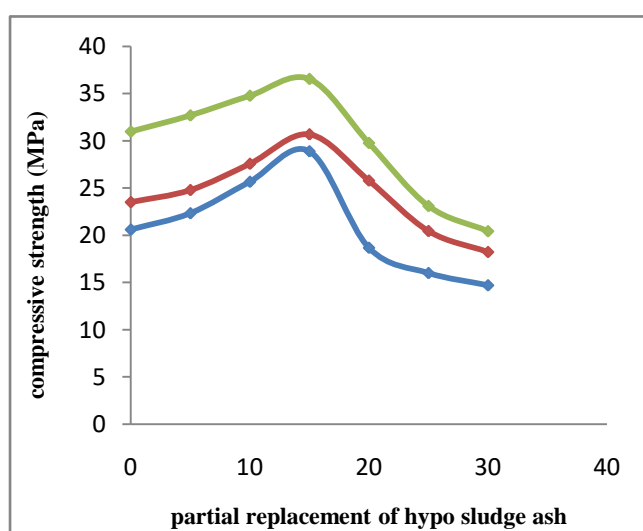


Fig.1. Variation of % of hypo sludge ash Vs Compressive strength of concrete at 7,14,28 days

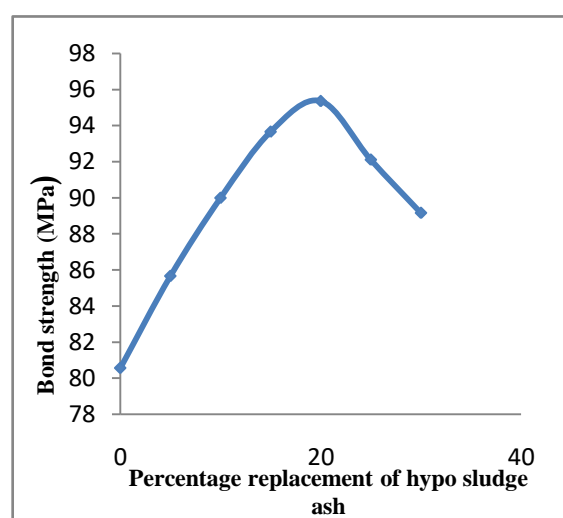
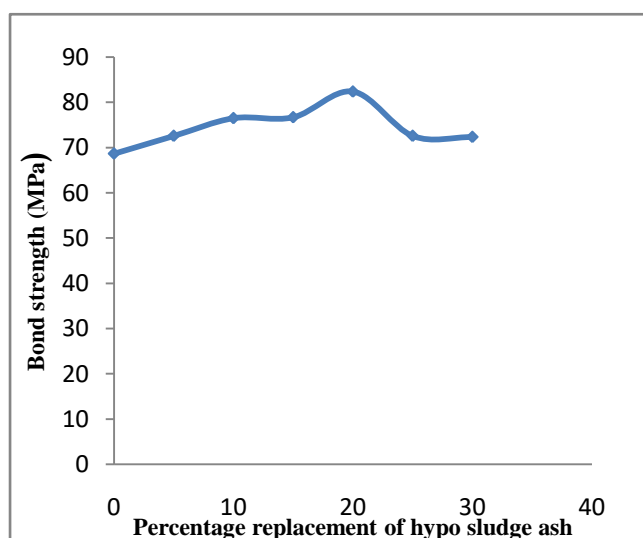


Fig 2 Average bond strength of concrete with 0% polluted rebar for 28days



Graph 3 Average bond strength of concrete with 50% polluted rebar

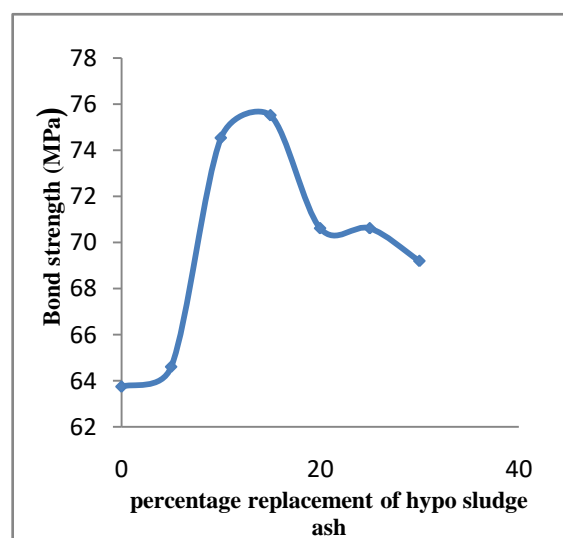


Fig 4 Average bond strength of concrete for 28days with 100% polluted rebar

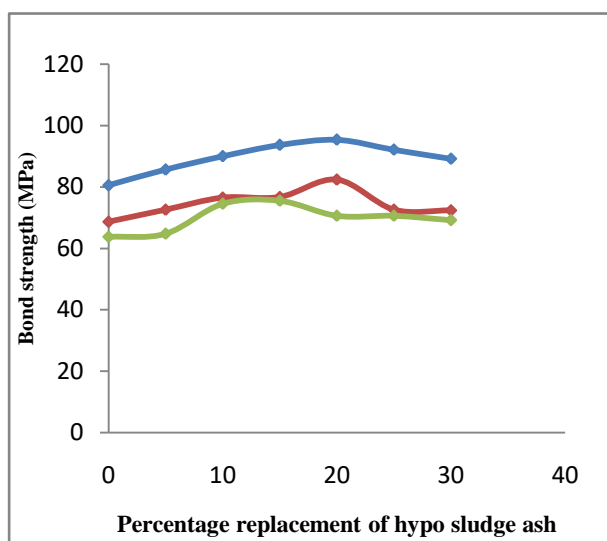


Fig 5 comparision between 0%,50%,100%, polluteds rebar for 28 days

### **Conclusion:**

1. From the above study we can conclude that the non-polluted gains high strength when compared to half-polluted and fully polluted. Due to the change in length of bar and its diameter there is a change in bond strength and is inversely proportional.
2. The used engine oil for the concrete in steel negatively affects the bond strength through the protective layers between materials within the bond zone. The serviceability and ultimate strength of the reinforced concrete elements were also affected due to decrease in strength.
3. By using hypo sludge, we can reduce the environmental impacts due to the utilization of wastes disposal from paper mills. When compared to conventional concrete, hypo sludge gains more strength.
4. In this project, hypo sludge is used as a partial replacement in concrete with 0%,5%,10%,15%,20%,25% and 30%.From the above replacements, the strength of the concrete increases in pull out test at 20%.and 15% replacement of hypo sludge the compressive strength increases at 28 days.

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