Experimental Investigation on Concrete by Partial Replacement of Cement & Fine Aggregate using Hypo Sludge & Sea Sand

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Abstract

The rapid increase of the construction industry leads to be a shortage of conventional construction materials such as cement, fine aggregate and coarse aggregate which are mainly used in conventional concrete. Concrete is the most indispensable material being used in construction development throughout the world. Umpteen varieties of concretes (FAC, SCC, FRC, HPC, HSC, and others) were researched in several laboratories and brought to the field to suit the specific needs. The cement industries are releasing a large amount of carbon dioxide during processes that effecting the environment and causing global warming. And by large mining of river sand [fine aggregate], it will cause a decrease in water level in the earth. Then the ground water table is effected, and also river sand is very high cost. Researches were searching for cheaper materials that can be used as a substitute for these materials. And they were studying for low-cost materials as a substitute for the cement materials. The recent studies were shown that the waste from paper industries has pozzolanic property termed as hypo sludge which contains low calcium and the minimum amount of silica. Hypo sludge behaves like cement because of silica and magnesium properties. The magnesium and silica improve the setting of concrete. By utilizing hypo sludge the strength of concrete will be increased and also cost reduction in the concrete is achieved. River sand has been the most popular choice for the fine aggregate of concrete in the past, but overuse of the material has led to environmental concerns, the depleting of securable river sand deposits and a concomitant price increases of material. Therefore, it will obtain cheap and friendly substitutes for river sand that is preferably sea sand. Sea Sand is being used in the construction industry in the Asia Region and also in some European countries. This study is to experiment on suitability, to know the Strength & Durability Of Concrete By using sea sand as a partial replacement for river sand as fine aggregate for concrete & Hypo sludge as the partial replacement for cement in concrete. The work is carried out with M20 & M30 grade concrete. and hypo sludge is replaced in different percentages such as 10%, 20% by weight of cement, and sea sand is replaced in different percentage such as 10%, 20% by weight of river sand. Cubes of 150mm x 150mm size, Cylinders of 150 mm dia and 300mm height, and beams of 100 mm x 100mm x 500mm are cast for conventional concrete and PRH (Replacement of hypo sludge by weight of cement) test specimen respectively.

Keywords: Cement of Grade 53, Hypo Sludge, Sand and Coarse Aggregate

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I. INTRODUCTION

A. General

Concrete is a widely used man-made construction material and it was the largest production of all the materials used in the construction industry. Concrete is basically made of cementitious materials which have to properly bind themselves together, as well as with other materials to form a strong and solid mass.

The cement industries are releasing a large amount of carbon dioxide during processes that effecting the environment and causing global warming. And by large mining of river sand [fine aggregate], it will cause a decrease in water level in the earth. And also the river sand cost is increasing day by day due to scarcity. For this reason, we partially replace the cement and fine aggregate with hypo sludge and sea sand at a time.

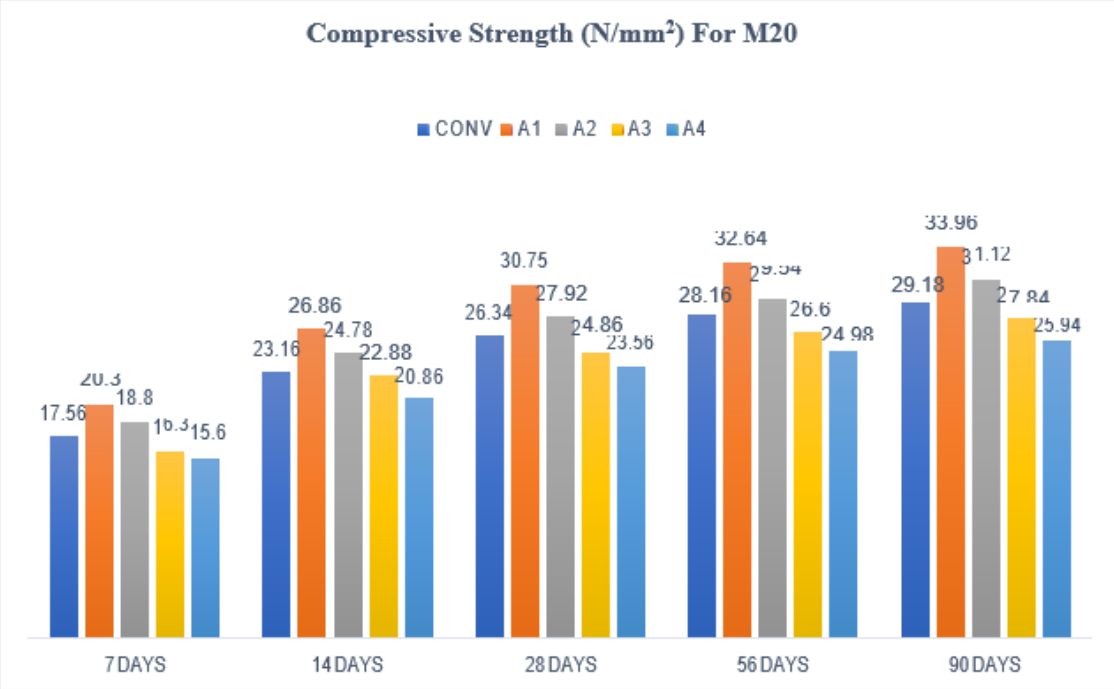
Using these materials will be bits of help in the reduction of the concrete cost. So then the cement replaced with paper mill sludge and river sand replace with sea sand in concrete. A lot of studies shown that using sea sand will decrease the strength of concrete. And by using hypo sludge as cement replacement the strength of concrete will increase.

So I will take both sea sand and hypo sludge as a partial replacement of cement and fine aggregate at a time to know the strength and durability of concrete. In this case, the cost of concrete will also decrease.

II. RESULTS AND DISCUSSIONS

A. Compressive Strength Results for M20 Grade

Mix			*Compressive Strength (N/mm²)M 20*				
S.NO	*HYPO SLUDGE*	*SEA SAND*	*7 Days*	*14 Days*	*28 Days*	*56 Days*	*90 Days*
Conventional	*0%*	*0%*	*17.56*	*23.16*	*26.34*	*28.16*	*29.18*
A1	*10%*	*10%*	*20.30*	*26.86*	*30.75*	*32.64*	*33.96*
A2	*20%*	*10%*	*18.8*	*24.78*	*27.92*	*29.54*	*31.12*
A3	*10%*	*20%*	*16.30*	*22.88*	*24.86*	*26.60*	*27.85*
A4	*20%*	*20%*	*15.60*	*20.86*	*23.56*	*24.98*	*25.94*



The compressive strength results of paper mill sludge and sea sand are shown in below for M30 grade.

B. Compressive Strength Results for M30 Grade

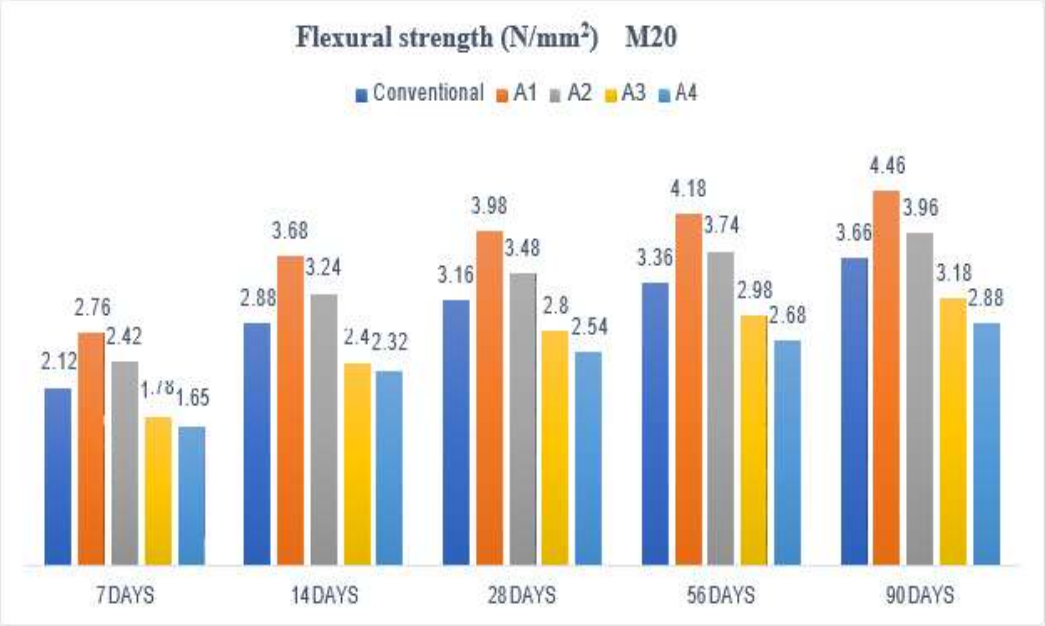
Mix			*Compressive Strength (N/mm²) M 30*				
S.NO	*HYPO SLUDGE*	*SEA SAND*	*7 Days*	*14 Days*	*28 Days*	*56 Days*	*90 Days*
Conventional	*0%*	*0%*	*21.68*	*28.96*	*32.18*	*33.88*	*35.38*
B1	*10%*	*10%*	*28.64*	*38.66*	*42.26*	*45.18*	*48.42*
B2	*20%*	*10%*	*23.23*	*31.56*	*35.12*	*38.68*	*40.14*
B3	*10%*	*20%*	*22.44*	*30.44*	*33.68*	*36.46*	*38.56*
B4	*20%*	*20%*	*20.28*	*27.46*	*30.06*	*31.80*	*33.08*

C. *Flexural Strength Results*

Flexural strength of concrete war obtains by casting beam specimens. Generally, the beam dimensions are of 500mm x 100mm x 100mm. The flexural strength values for both grades are described as below shown in the table.

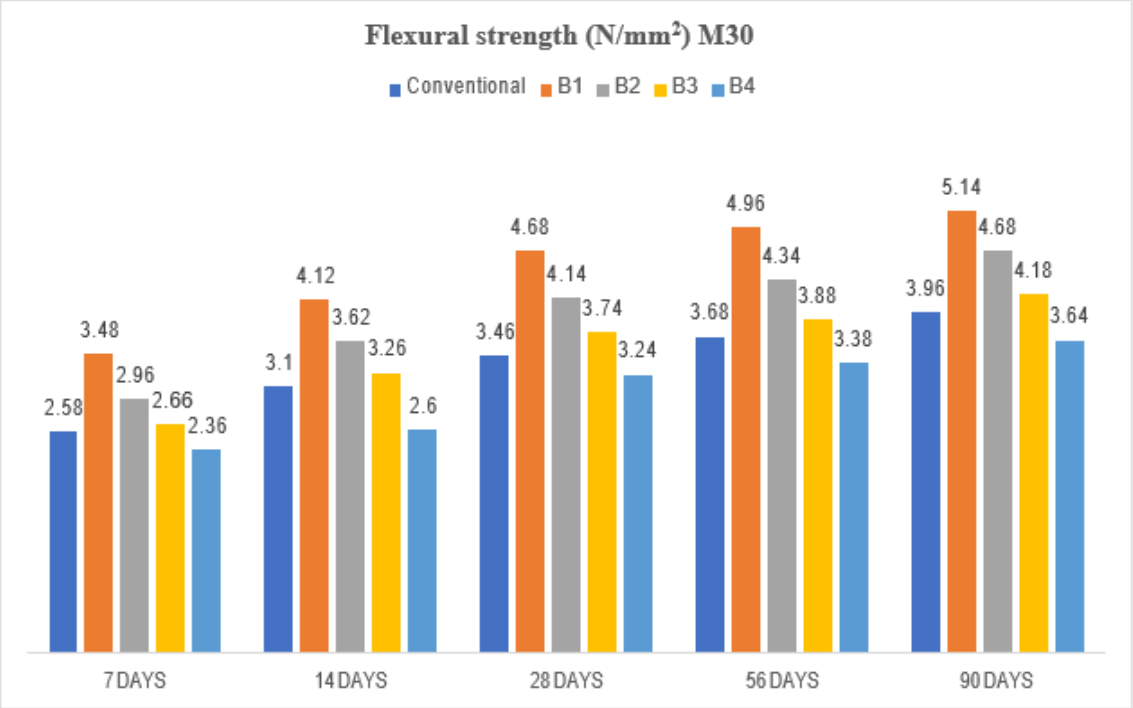
D. *Flexural Strength Results for M20 Grade*

Mix			*Flexural strength (N/mm²) M20*				
S.NO	*HYPO SLUDGE*	*SEA SAND*	*7 Days*	*14 Days*	*28 Days*	*56 Days*	*90 Days*
Conventional	*0%*	*0%*	*2.12*	*2.88*	*3.16*	*3.36*	*3.66*
A1	*10%*	*10%*	*2.76*	*3.68*	*3.98*	*4.18*	*4.46*
A2	*20%*	*10%*	*2.42*	*3.24*	*3.48*	*3.74*	*3.96*
A3	*10%*	*20%*	*1.78*	*2.40*	*2.80*	*2.98*	*3.18*
A4	*20%*	*20%*	*1.65*	*2.32*	*2.54*	*2.68*	*2.88*



E. Flexural Strength Results for M30 Grade

Mix			*Flexural strength (N/mm²) M30*				
S.NO	*HYPO SLUDGE*	*SEA SAND*	*7 Days*	*14 Days*	*28 Days*	*56 Days*	*90 Days*
Conventional	*0%*	*0%*	*2.58*	*3.10*	*3.46*	*3.68*	*3.96*
B1	*10%*	*10%*	*3.48*	*4.12*	*4.68*	*4.96*	*5.14*
B2	*20%*	*10%*	*2.96*	*3.62*	*4.14*	*4.34*	*4.68*
B3	*10%*	*20%*	*2.66*	*3.26*	*3.74*	*3.88*	*4.18*
B4	*20%*	*20%*	*2.36*	*2.60*	*3.24*	*3.38*	*3.64*

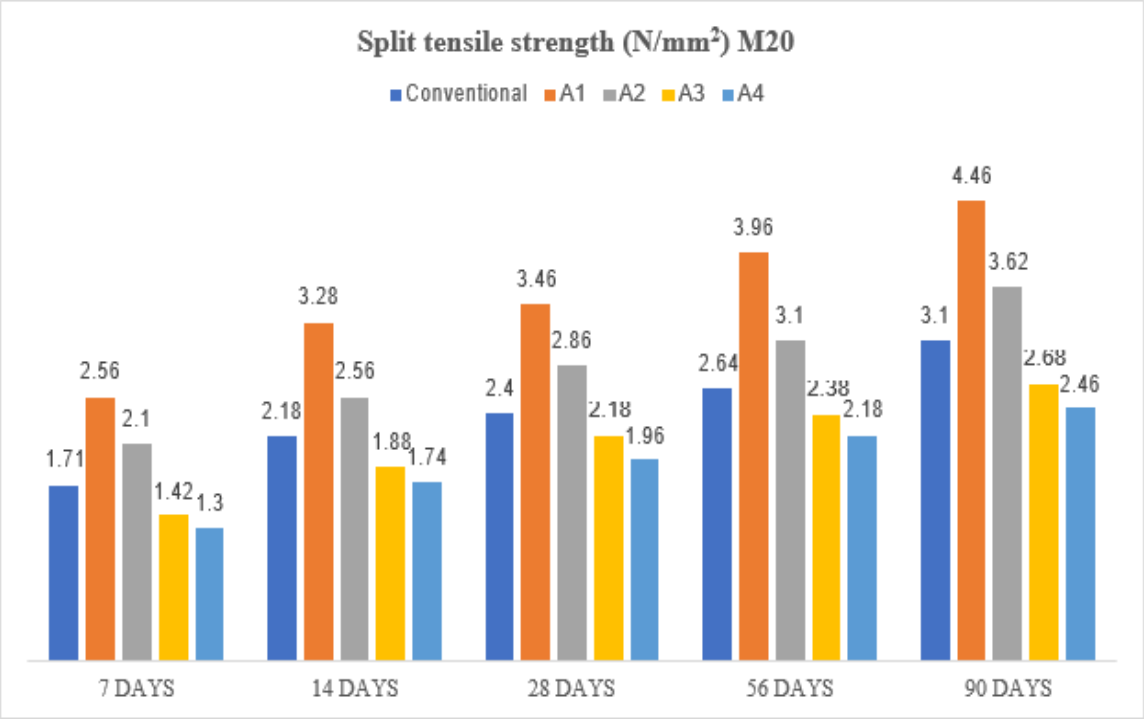


1) Split Tensile Strength:

Except for all the properties of concrete, tensile strength is very important. The tensile strength is obtained by testing cylindrical specimens of size 300mm height and 150mm diameter. Every set of specimens are tested for 7 days, 14 days, 28 days, 56days, 90 days of curing. The details of test results are presented below

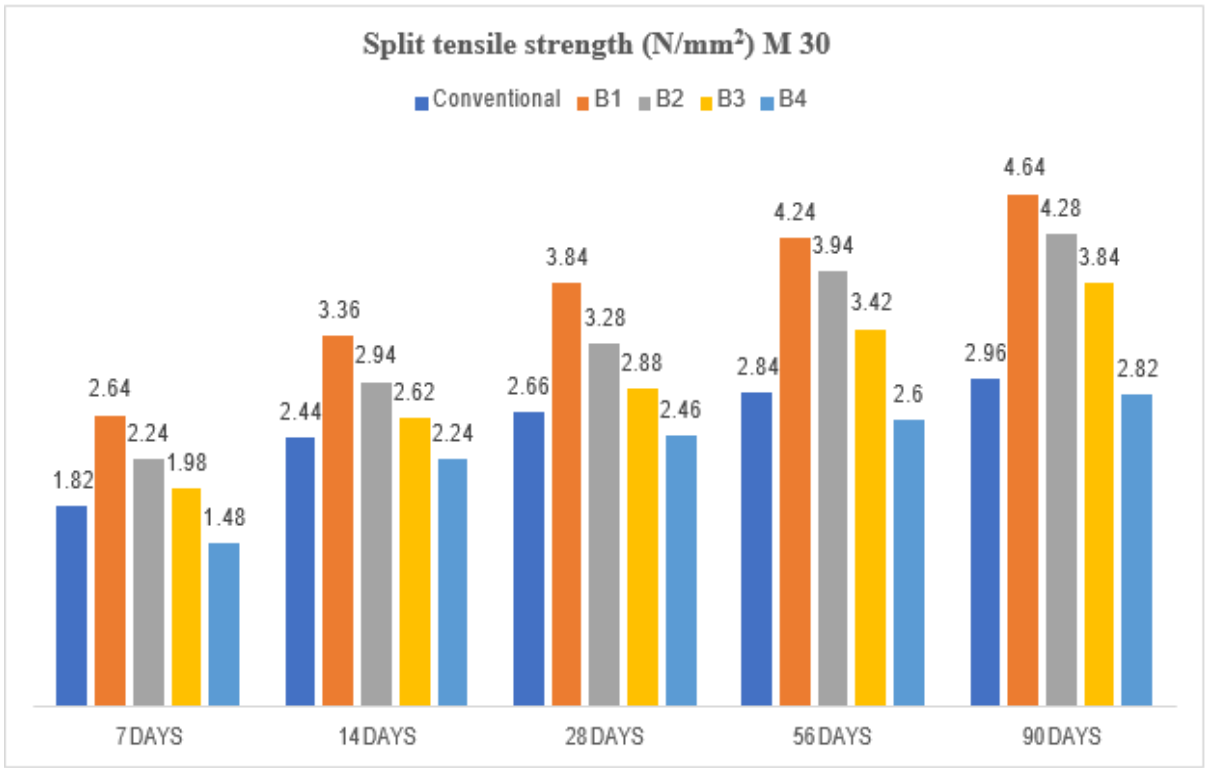
F. Split Tensile Strength Results for M20 Grade

Mix			*Split tensile strength (N/mm²) M20*				
S.NO	*HYPO SLUDGE*	*SEA SAND*	*7 Days*	*14 Days*	*28 Days*	*56 Days*	*90 Days*
Conventional	*0%*	*0%*	*1.71*	*2.18*	*2.40*	*2.64*	*3.10*
A1	*10%*	*10%*	*2.56*	*3.28*	*3.46*	*3.96*	*4.46*
A2	*20%*	*10%*	*2.10*	*2.56*	*2.86*	*3.10*	*3.62*
A3	*10%*	*20%*	*1.42*	*1.88*	*2.18*	*2.38*	*2.68*
A4	*20%*	*20%*	*1.30*	*1.74*	*1.96*	*2.18*	*2.46*



G. Split Tensile Strength Results for M30 Grade

Mix			*Split tensile strength (N/mm²) M 30*				
S.NO	*HYPO SLUDGE*	*SEA SAND*	*7 Days*	*14 Days*	*28 Days*	*56 Days*	*90 Days*
Conventional	*0%*	*0%*	*1.82*	*2.44*	*2.66*	*2.84*	*3.96*
B1	*10%*	*10%*	*2.64*	*3.36*	*3.84*	*4.24*	*4.64*
B2	*20%*	*10%*	*2.24*	*2.94*	*3.28*	*3.94*	*4.28*
B3	*10%*	*20%*	*1.98*	*2.62*	*2.88*	*3.42*	*3.84*
B4	*20%*	*20%*	*1.48*	*2.24*	*2.46*	*2.60*	*2.82*



III. CONCLUSIONS

A. *Discussion on M20 Grade Concrete Strength*

1) From the results, that the maximum compression strength is obtained at 10% replacement of hypo sludge and sea sand as partially in cement and river sand. It will be nearly 17% increased as compare with Conventional concrete.
2) When the hypo sludge is increased to 20% and the sea sand at 10% the strength is increased up to 6% than Conventional concrete. But when compare to concrete with 10% hypo sludge & sea sand mix, nearly 10% strength is decreased.
3) In case by increase the sea sand from 10% to 20% and hypo sludge at 10% or 20% the strength of concrete will be decreased as compared with Conventional concrete up to 6% and 12% respectively.
4) This shows, when sea sand % is increased more than 10% the strength of concrete will be decreased as compared to conventional concrete.
5) And also it shows that hypo sludge % is increased more than 20% the strength of concrete is decreased as compared with conventional concrete.

B. *Discussion on M30 Grade Concrete Strength*

1) In M30 grade, by 10% replacement of hypo sludge and sea sand in concrete the strength is increased up to 31% then Conventional concrete. Because of the cement ratio in M30 grade is increased as compared to M20 grade.
2) When the hypo sludge is increased to 20% and sea sand is at 10% the strength is increased up to 10% than Conventional concrete, But when compare to concrete with 10% hypo sludge & sea sand mix, nearly 20% strength is decreased.
3) In M30 grade concrete, the slight difference is obtain when compare with M20 grade concrete. In M30 grade concrete when sea sand is increased to 20% and hypo sludge is at 10% the strength of concrete is increased up to 5% as compared with conventional concrete.
4) But the 20% replacement of both hypo sludge & sea sand the strength is decreased up to 7% as compared to conventional concrete.