Effects of Silica Fume, Crusher Dust and Coir on the Performance of Concrete

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Abstract: The comparative analysis of the experimental results of the combined use of Silica Fume, Crusher Dust and Coir as an eco-friendly waste material in aggregate with different ratios of Silica Fume @20%(Replacement with cement), Crusher Dust @60%(replacement with fine aggregates) and Coir @ 5%(addition) are presented during this thesis. Since the traditional times, many researchers and advancements were carried out to boost the physical and mechanical properties of concrete. Fibre concrete is one in all those advancements which offers a standard practical and economical method for overcoming micro cracks and similar kinds of deficiencies. Since concrete is weak in tension hence some measures must be adapted to overcome this deficiency. Coconut fibre is another fibrous matter available in abundance and is affordable. It also reduces environmental problems. Reuse of recycled or waste materials for the development of civil structures is a difficulty of great importance during this century. Addition of waste products in Fibre-reinforced concrete is additionally quite common nowadays.

Keywords: Coconut fibre, Coir, Crusher Dust,Fibre-reinforced concrete, Silica Fume.

I. INTRODUCTION

Concrete utilised as a development material, due to its capacity to get formed into any shape and accordingly has supplanted stone and block brick work. It is a composite material made of concrete, totals and water in a decent proportion to accomplish sufficient properties. At the point when these fixings are combined as one, they structure a liquid mass that is effectively formed into shape and over the long haul the concrete structures a hard grid which ties the other fixings together into strong stone like material.Concrete could be a mixture of cement, water and aggregate and sometimes admixtures in required proportion. The mixture when placed in forms and allowed to cure hardens into a rock-like mass called concrete.The mixture consists of a combination of varied sizes of gravel and sand. When water is added to cement, a chemical change takes place causing the combo to harden. Cement is basically made of a combination of limestone and clay, which is ground into a awfully fine powder then burnt at a warm temperature in an exceedingly rotating kiln, thereby fusing it into a fabric called clinker. The clinker is cooled down and ground into a fine powder. Gypsum and various additives are then added to the cement. Concrete is comparable in composition to mortar, which is employed as a bonding material in masonry works. Mortars are however normally made using sand as the sole aggregate, whereas concrete contains a substantial amount of larger size aggregate. Cement is the most expensive of the ingredients required for supplying concrete. This suggests that to increase the prices of the concrete, the number of cement used depends on the aim that the concrete is required. In recent years, advanced concrete technology has developed concrete with compressive strengths of over 90MPa, employed in large and sophisticated structures like skyscrapers and offshore oil platforms. A large range of chemicals is added to the concrete so as to vary its features, said as admixtures, they're used for purposes like increasing the fluidity of the concrete mix, accelerate or retard the curing process, make it more frost resistant, increase its strength and plenty of more reasons.

II. CEMENT

Most commonly used cement is termed hydraulic cement patented in 1824 in England. The essential raw materials employed in the manufacture of cement are carbonate found in limestone or chalk, and silica, alumina and iron oxide found in clay or shale. The word "cement" is often traced back to the Roman term opus cementitious, wanting to describe masonry resembling modern concrete that was made of gravel with calcined lime as binder. In the present, organic polymers are sometimes used as cements in concrete. In present day concrete, cement may be a mixture of limestone and clay heated in an exceedingly kiln to 1400 - 1600oc. This amount represents about two minutes of output from a ten, 000 ton per day cement kiln. Hydraulic cement is the most typical style of cement generally used. It’s a basic ingredient of concrete, mortar and lots of plasters. British masonry worker Joseph Aspdin patented hydraulic cement in 1824.

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III. PROPERTIES OF CEMENT

Table 1

S.No	Properties	Observations
1	Bulk Density	1450kg/□3
2	Specific Gravity	3.15
3	Initial Setting Time	30 min
4	Final setting Time	600 min
5	Standard Consistency	5-7%
6	Fineness(90 microns IS sieve)	5%
7	28 days Compressive strength	42.17Mpa

AGGREGATE.

The term "aggregate" refers to all or any materials which don't undergo chemical transformation even though they contribute to the ultimate results of the structure being treated: stones, sand, and bricks. They form

the reinforcing structure of the mortar, occupying approx. 65-70% of its total volume. Since their grain-size will affect the standard of the voids to be filled by the binder, it's important for the grain sizes of the combination and therefore the binder to differ so as to guarantee a compact mass. During this way, the crystals of the binder are shorter and hence more resistant so shrinkage during drying is reduced to the minimum. Sand is the most generally used variety of aggregate: natural if it comes from quarries, rivers, lakes or the ocean, and artificial if it's the results of the crushing of rocks or artificial products. Reckoning on its nature and on the kind of rock from which it originates, sand may have different grain sizes, and this may affect the standard of the mortars produced. For instance, the presence of impurities like soil, clay and fine dust reduces the binding power of the carbonate and hence the resistance of the mortar, and therefore the use of sea sand, thanks to the presence of chlorides, tends, over time, to guide to the emergence of salt efflorescence.

Silica Fume.

Silica fume is a result of silicon and silicon composite creation and is a pozzolanic material of which a benefit is taken to work on the properties of cement to a significant degree. It contains a huge measure of SiO2 particles and structures around 90% of silica rage particles. It makes the new substantial more durable, which thus diminishes isolation and the substantial likewise show decreased dying. Silica seethe is a pozzolanic material and the pozzolanic material is one which is siliceous and aluminous material, having next to zero succinct worth of its own, yet when the material is in fine powder structure synthetically respond with calcium hydroxide at surrounding temperature and in presence of water to shape compounds having cementitious properties. Additionally it diminishes the draining by truly hindering the pores in the new concrete and option of it doesn't influence the unit weight of cement.

Physical Properties Of Silica Fume

Table 2

S.No	Physical Properties	Description
1	Colour	White , pale grey , dark grey
2	Specific gravity (Gs)	Equal to amorphous silicon 2.2, and varies from 2.4-2.55
3	Specific surface area	10 times than cement = 20000m2 /Kg
4	Particle size	Mostly < 1μ and diameter of about 0.1μ
5	Bulk Loose density	230 – 300Kg/m3

Coir

Coir or Coconut fibre is found on the external covering of husk of coconut and is of two sorts white and Brown Fibres. White filaments are extricated from unripe coconut and are better than the other one while brown fibre is obtained from ready coconut husks and both enjoy various benefits. As it follows from the former truth that in concrete the last option can be utilised as it were. It is intriguing to note that the coir fibre don't get impacted by saline circumstances and are essentially waterproof and this property of coir can be taken advantage of in substantial development for example by coir impregnated concrete in saline climate. Anyway for the purpose of handling earthy colored fibre requires new water while the other requires the two kinds of water for example new as well as salt water.

Crusher Dust / Robo Dust / Stone Dust.

It is acquired by establishing the stones at the assembling site. It is believed to be a toxin yet it can help in procuring a ton of benefits to organisations that are managing in mining. It can move into fake sand during the assembling process. It is fascinating to know that while quarrying various sorts of stones are created and yet slag is delivered as well, so to stay away from this waste creation organisations have embraced a method for changing over this slag in stone residue so it could be used without dirtying the climate.

IV. EXPERIMENTAL PROGRAMME

To study the interaction of Coconut Fibre with Crusher Dust concrete experiments were conducted on 45 cubes, 15 beams and 15 cylinders. Each group consists of 9 cubes of size

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150mm X 150mm X 150mm, 3 beams of size 150mm X 150mm X 700mm and three cylinders of size 150mm diameter and 300mm length respectively.

1. The primary group is the plain concrete with 0% fibre by weight of coarse aggregate 0 % silica Fume and 0% Crusher Dust by weight of Fine aggregate(MC-00)
2. The second group consists of 1% Coconut Fibre fibre by weight of cement 5% of Silicafume and 60 Crusher Dusts by weight of Fine aggregate(MC-03)
3. The third group consists of 1.5% Coconut Fibre by weight of cement, 10% of silica fume and 60% Crusher Dust by weight of Fine aggregate(MC-06)
4. The fourth group consists of 3% Coconut Fibre by weight of cement , 15% of silica fume and 60% Crusher Dust by weight of Fine aggregate(MC-09)
5. The fifth group consists of 5% Coconut Fibre by weight of cement, 20 percent of silica fume and 60% Crusher Dust by weight of Fine aggregate(MC-12)
6. The Sixth group consists of 6% Coconut Fibre by weight of cement, 25% percent of silica fume and 60% Crusher Dust by weight of Fine aggregate(MC-15)
7. Cement is added to the sand and mixed thoroughly by hand to induce the same colour.
8. The coarse aggregate and Crusher Dust is spread on the bottom and coconut fibres of length 5 cm and silica fume is mixed with cement sand mixture to induce the same distribution of the mixture.
9. For casting the cubes, beam specimens, standard forged iron metal moulds of size 150x150x150 cubes, 150x150x700mm beam moulds are used.
10. After oil is applied on all sides of moulds thoroughly mixed concrete is filled into the mould in three layers of equal heights followed by tamping employing a rod of 16mm diameter.
11. Then the mould is placed on the table vibrator and also the excess concrete is aloof from the highest layer.
12. The specimens are stored within the laboratory for twenty-four hours at temperature.
13. After removing from the moulds the specimens are submerged in fresh and clean water and cured for 28 days.

V. CONCLUSION

From the Experimental Study we can conclude that each one of the materials chosen has some positive effect on the properties of concrete. Be the compressive strength of concrete enhanced by stone dust, increase in split tensile strength on account of addition of coconut fibres and efficient cohesiveness and less permeability due to silica fume. These valuable properties we got only when these materials were deployed individually or with some other materials but if we use them in a composite way ,we can get a high strength performance and cost efficient concrete which is our main job to do

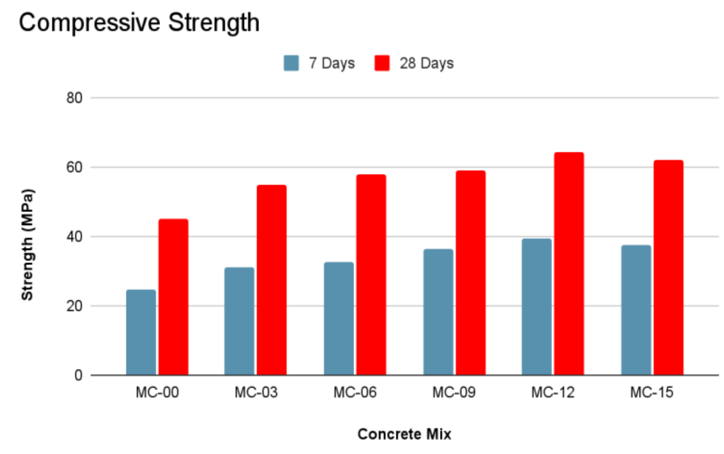
The concrete mixes

Compressive strength of concrete after addition of Coconut Fibre to the concrete

Table 3

S.No	%of Crusher dust	%of Silica Fume	%of Coir	Compressive Strength	
				7 Days Strength	28 Days strength
1	0	0	0	24.79	45.2
2	60 % Constant	5	1	31.10	54.86
3		10	1.55	32.78	57.71
4		15	3	36.22	59.09
5		20	5	39.42	64.27
6		25	6	37.33	62.12

Fig 1, Graph showing Compressive strength at 7 days and 28 days



Split Tensile strength of concrete after addition of Coconut Fibre to the concrete

Table 4

S.No	%of Crusher dust	%of Silica Fume	%of Coir	Split Tensile Strength	
				7 Days Strength	28 Days strength
1	0	0	0	1.234	2.84
2	60 % Constant	5	1	1.485	3.74
3		10	1.55	1.685	3.96
4		15	3	1.725	4.25
5		20	5	2.106	4.39
6		25	6	1.912	4.28

Fig 2, Graph showing split Tensile strength at 7 days and 28 days

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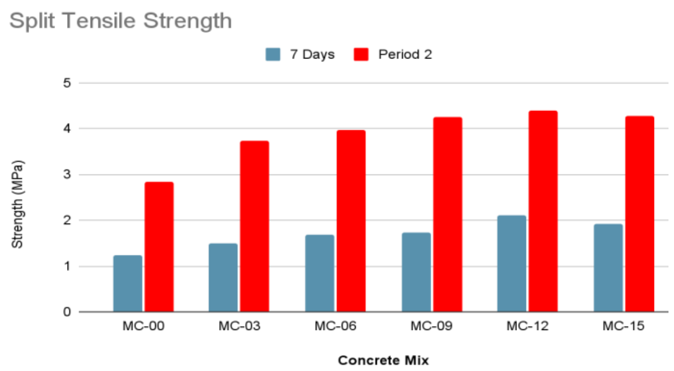
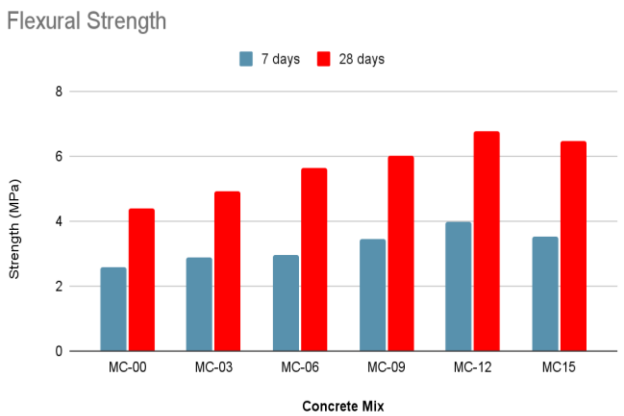


Flexural strength of concrete after addition of Coconut Fibre to the concrete

Table 5

S.No	%of Crusher dust	%of Silica Fume	%of Coir	Flexural Strength 7 Days Strength	Flexural Strength 28 Days strength
1	0	0	0	2.58	4.4
2		5	1	2.88	4.9
3	60 % Constan	10	1.55	2.96	5.62
4		15	3	3.44	6.02
5		20	5	3.97	6.77
6		25	6	3.51	6.48

Fig 3 Graphing showing Flexural strength at 7 and 28 days



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