International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 04 | Apr -2017 www.irjet.net p-ISSN: 2395-0072

Strength Characteristics of Cement - Coir pith Composite and Cement - Coir pith - Glass Powder Composite: Soft Ground Arresting System

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Abstract - *In one of our country's worst disasters, an Air India Express Flight 812 from Dubai to Mangalore crashed while landing at the Mangalore Airport on 22nd May 2010. The aircraft overrun while landing and takeoff can be avoided by providing a safety area beyond the end of runway. Federal Aviation Administration recommends the use of Engineered Material Arresting System commonly known as EMAS as a Soft Ground Arresting System (SGAS). EMAS is a bed of engineered materials that are built at the end of runway. These high energy absorbing materials which will reliably and predictably crush under the weight of an aircraft can stop an overrunning aircraft. The present study aims in investigating the strength characteristics of cement-coir pith and cement – coir pith-glass powder composite as a soft ground arresting system (SGAS).*

***Key Words*: Engineered Material Arresting System (EMAS), Soft Ground Arresting System (SGAS), Aircraft overrun, Runway safety area, Compression strength.**

1. INTRODUCTION

An Engineered Material Arresting System (EMAS) uses materials of closely controlled strength and density which are placed at the end of runway to stop or decelerate an overrunning aircraft. The best material found to date is a light weight crushable concrete. When an aircraft runs over such a system the material crushes if the contact pressure between the tyre and arresting bed exceeds the compressive strength of bed the and the tyres of aircraft sink into the arrestor bed [1]. The EMAS bed consist of foamed concrete blocks that are joined and sealed at top in order to counter negative environmental effects[2].

In the present work an attempt was made to make use of coir pith and glass powder which are found as waste material in our surrounding environment. In the first part, sand in mortar was completely replaced by coir pith and in the second part cement was partially replaced by glass powder in cement- coir pith composites. Coir pith is a by-product of coir fibre processing units. Improper dumping of this waste material can cause serious environmental issues such as ground water contamination, mosquito breeding etc. Also with the increased use of glass products over years has led to the accumulation of waste glass [3]. One of the major techniques adopted to dispose this waste material is in the landfill which is obviously an unsustainable method as it does not decompose. Hence, it is the need of the hour to effectively make use of these two waste materials in some other fields. In the study an attempt was done to make use of these waste materials in the construction sector.

2. MATERIALS

2.1 Cement

Cement used was Ultratech Portland Pozzolanic Cement (PPC).Properties of cement is listed in Table1.

Table -1: Properties of Cement

Specific Gravity	3.125
Consistency	39%
Initial setting time	45 minutes
Final setting time	6 hours

2.2 Coir pith

Coir pith is a spongy material that binds the coir fibre in the coconut husk. These are non-fibrous and light weight corky material which constitutes about 50-70 percent of the husk. Coir pith has high amount of lignin and cellulose which resist its decomposition by microorganisms [4].

Fig -1: Coir pith

For the experimental work coir pith was collected from Karshika Market, Pala. Initial tests conducted on coir pith includes sieve analysis, specific gravity, water content, water absorption and swelling .The results are shown below:

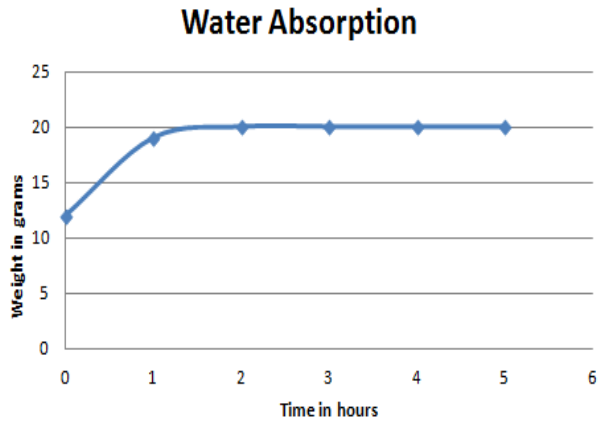

Chart -1: Water absorption characteristics of coir pith

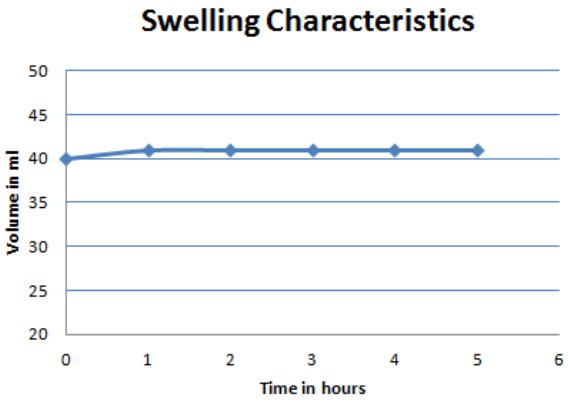

Chart -2: Swelling characteristics of coir pith

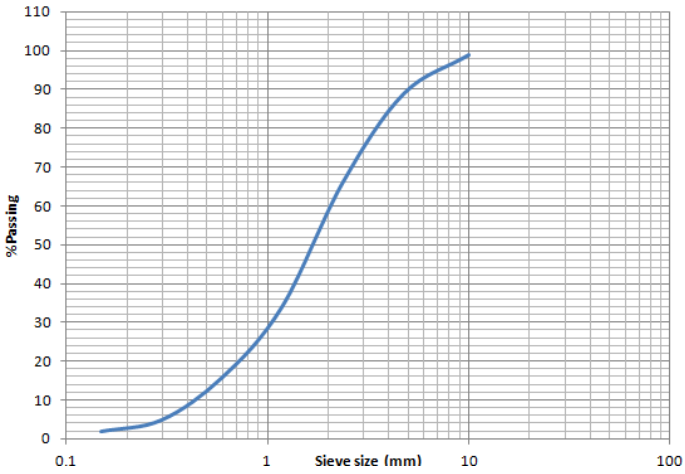

Chart -3: Particle size distribution of coir pith

Table -2: Properties of Coir pith

Specific Gravity	0.71
Water Content	85%
Water Absorption	67%
Swelling	2.5%

2.3 Glass Powder

Finely powdered glass has found its use as a partial replacement of cement .For the study purpose glass powder was collected from ARPN Alagappa Nadar and Bros, Madurai.

Fig -2: Glass powder

Physical properties of glass powder are shown in Table 3. Chemical composition glass powder are shown in Table 4

Table -3: Physical properties of glass powder

Specific Gravity	2.6
Colour	White
Particle size	75µ

Table -4: Chemical composition of glass powder

Properties	Glass powder
Sio_2	75.31%
Al_2O_3	1.11%
CaO	8.83%
MgO	2.80%
Na_2O	10.77%
K_2O	0.41%

3. METHODOLOGY

For Compression strength test mortar cubes of standard size 70.6mm X70.6mm X70.6 mm were casted. Samples for the test were prepared by volume batching. Coir pith was used in a state of saturated surface dry condition. Water cement ratio was fixed as 0.3 by trial mixes. For each mix three samples were casted and tested. The result tabulated shows the average value.

Fig -3: Casting of cubes

Fig -4: Cubes of various mix proportion

Various mix ratios (cement :coir pith) 1:1, 1:2, 1:3, 1:4, 1;5 were casted and tested for 7 day and 28 day compressive strength after curing.

4. RESULTS AND DISCUSSION

7day and 28 day compressive strength for different mix ratios of cement: coir pith is shown in Table 5 and Table 6. It was observed that the compressive strength value decreased with increase in coir pith content .A linear relationship was obtained between density and compression strength.

Table -5: 7 day compressive strength of cement-coir pith cubes

Mix ratio (Cement : Coir pith)	Density (g/cc)	Stress(N/mm^2)
1:1	1.73	13.87
1:2	1.49	4.3
1:3	1.46	3.84
1:4	1.36	2.1
1:5	1.23	1.63

Table -6: 28 day compressive strength of cement-coir pith cubes

Mix ratio (Cement : Coir pith)	Density (g/cc)	Stress(N/mm^2)
1:1	1.73	22.03
1:2	1.5	7.28
1:3	1.43	5.4
1:4	1.3	2.71
1:5	1.24	1.76

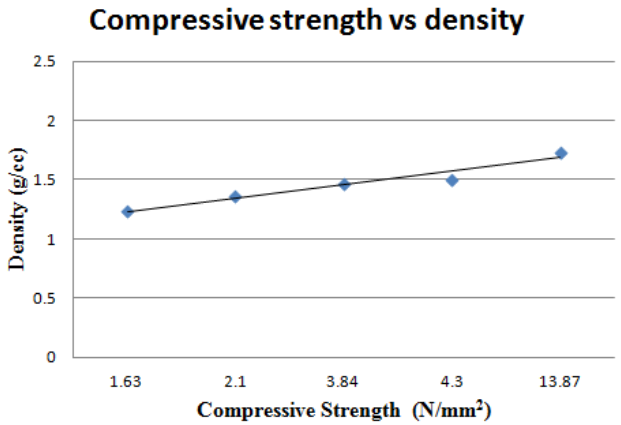

Chart -4: 7 day compressive strength vs density

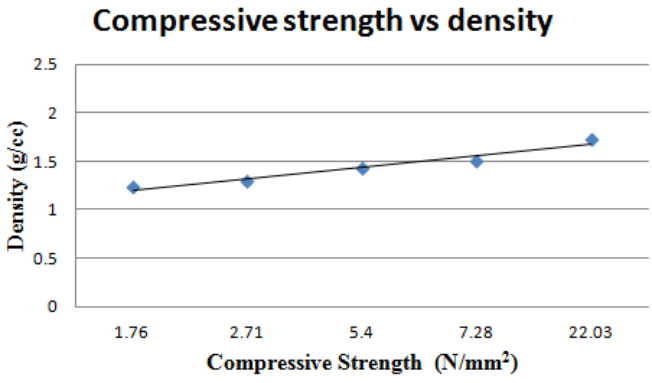

Chart -5: 28 day compressive strength vs density

The results of cement partially replaced by glass powder for all the above mentioned ratios are tabulated .It was observed that the compression strength value decreased with higher percentage of glass powder.

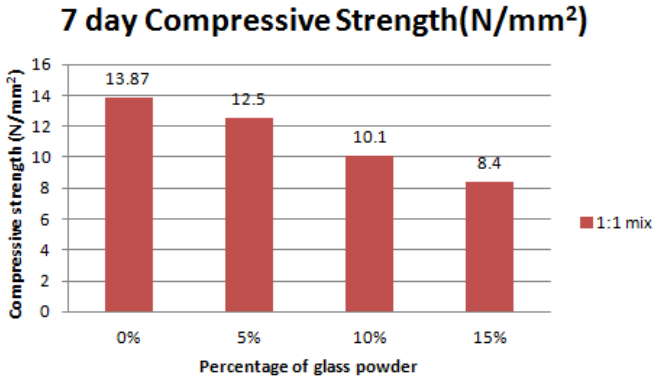

Chart -6: 7 day compressive strength of 1:1 mix

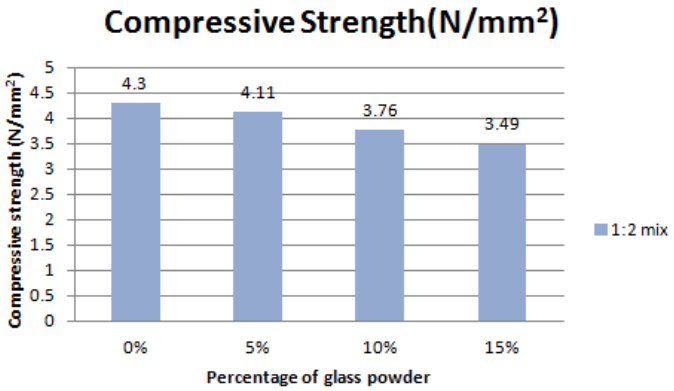

Chart -7: 7 day compressive strength of 1:2 mixes

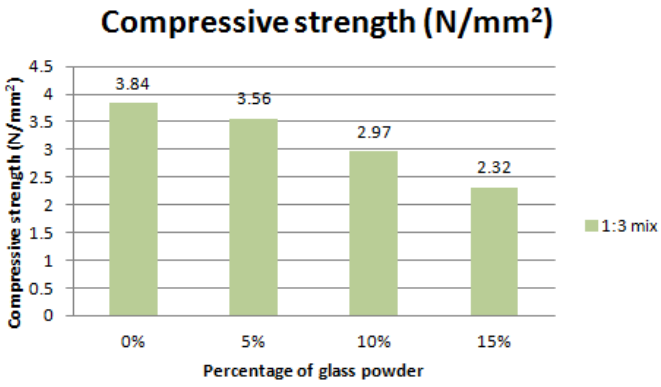

Chart -8: 7 day compressive strength of 1:3 mixes

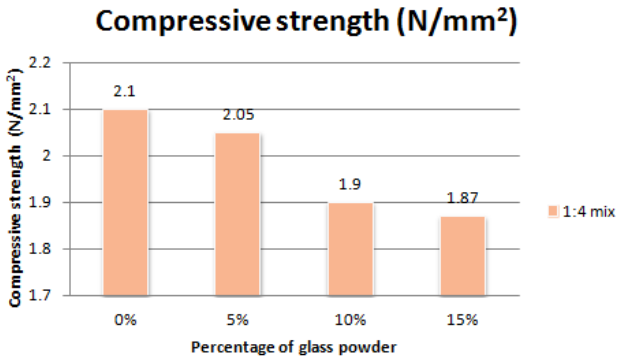

Chart -9: 7 day compressive strength of 1:4 mixes

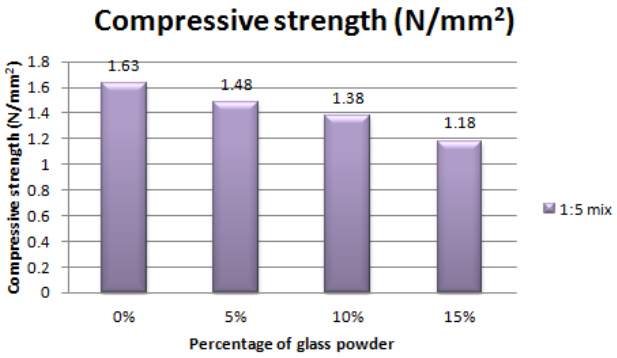

Chart -10: 7 day compressive strength of 1:5 mixes

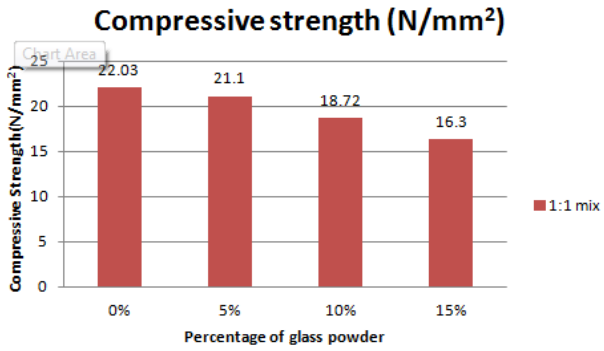

Chart -11: 28 day compressive strength of 1:1 mix

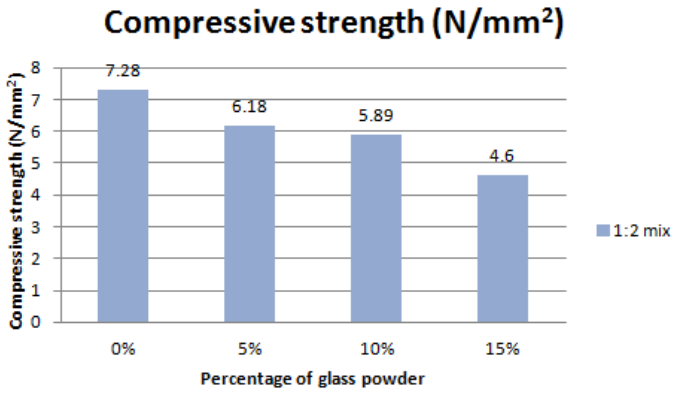

Chart -12: 28 day compressive strength of 1:2 mixes

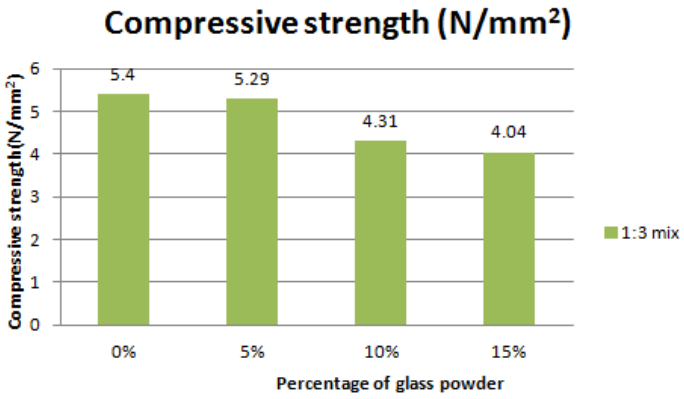

Chart -13: 28 day compressive strength of 1:3 mixes

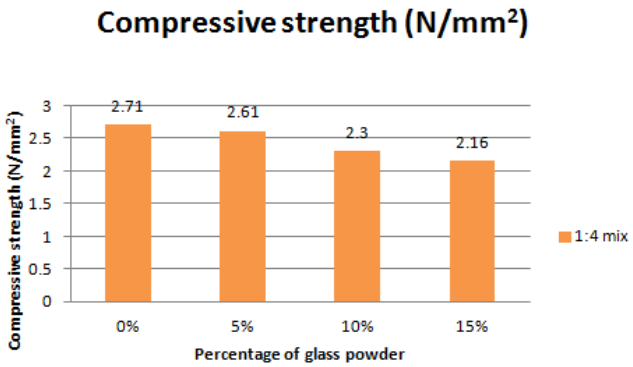

Chart -14: 28 day compressive strength of 1:4 mixes

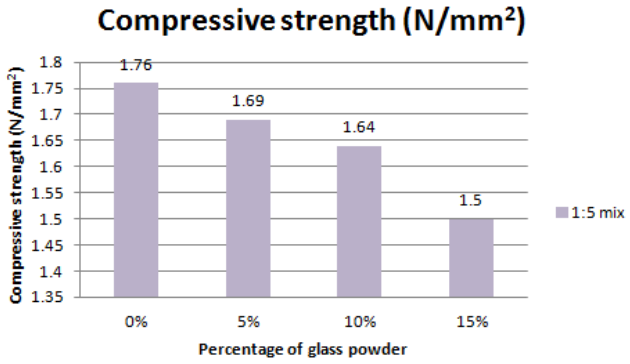

Chart -15: 28 day compressive strength of 1:5 mixes

5. CONCLUSIONS

Based on the results of the investigation it was observed that density and compressive strength of cement – coir pith cubes are directly proportional to each other. Density decreased with increase in coir pith content, thereby compressive also strength reduced. When glass powder was added to the mix as a partial replacement of cement it was observed that there was further reduction in compressive strength with increase in the percentage of glass powder. Since the results obtained satisfied the strength requirement for an arresting bed, these innovative materials can be used as a soft ground arresting system in safety areas. Further, other required parameters like water absorption, impact, sorptivity, abrasion etc. can also be checked for all the proportions.

ACKNOWLEDGEMENT

The authors express heartfelt and sincere gratitude to God Almighty; also we would like to express our sincere thanks to all the staff, Department of Civil engineering, SAINTGITS College of Engineering. Big thanks to all my friends who kept on inspiring the work.

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