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Utilization of EPS Beats and Polypropylene Fiber in Controlled Low Strength Material

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ABSTRACT

Controlled low-strength material (CLSM) is a self-levelling cementitious material. It is not concrete nor soil-cement, however, it possesses properties similar to both. CLSM is widely used as a replacement for soil-cement material in many geotechnical applications such as structural backfill, pipeline beddings, void fill, pavement bases and bridge approaches. This paper study potential possibility of polypropylene fiber in CLSM. Harden and fresh properties compressive strength , flowability and density for the proposed CLSM were investigated. This CLSM mix design with different percentage of polypropylene fiber and pond ash, cement and water. EPS beats and polypropylene add 0 %, 0.5%, 1.0% and 1.5% of total weight is added in CLSM MIx. Results show that the CLSM incorporating EPS beats and polypropylene satisfies compressive strength requirement as per the requirements of ACI committee 229. polypropylene decreases the flowability of CLSM mix and at the same tine by adding EPS beats the density of CLSM mix are reduce which become lightweight CLSM mix. from this it can conclude that polypropylene fibers is less effective in CLSM mix and EPS beats make CLSM mix lightweight which create lightweight CLSM mix applicable for filling application.

Keywords-- Pond Ash, EPS Beats, Polyprophylene Fiber, CLSM, Flowbility

I. INTRODUCTION

Controlled low-strength material (CLSM) one of the self-levelling and self compacting cementitious material for backfill used in place of compacted conventional fill [1]. CLSM also called as flowable fill self compacted backfill, slurry, soil cement, and flowable mortar etc.[2,3]. The application of CLSM has a broad range like structural fill conduit bedding, pavement base, trench backfilling, conduit bedding and void filling[4]. generally cost of CLSM is more than conventional granular backfill or compacted soil, but CLSM has many advantages include less equipment requirement (flowable) and less on-site labour and, speedy construction, the ability for use in the tight or confined access area. Generally, CLSM has sufficient strength and act as a substantial structural fill, backfill material. harden time depends on water content used in CLSM mixture, usually, CLSM mixture contains more water required more time of harden (in some cases 8–24 h). Ramme et al. [5] recommended scratching can be minimizing the use of more volumes of the fine grade material in CLSM. gypsum dry wall and pond ash are fine material use in proposed CLSM. Gypsum contains high contents of $CaSo_4$ which is used as a binder[6]. gypsum dry wall board use in many innovative and architectural construction activity. dry wall resulting due to new or demolish existing old building are dumped nearby roadside and then landfilling [7]. Studies show that local waste and the industrial byproduct is used in CLSM effective way to solve the disposal problem of waste. powdered gypsum, quarry dust, rise husk, pond ash, fly ash, blast furnace slag, bagasse ash mostly utilise in CLSM in India. for example, Siddique studied spent foundry sand and industrial by product in CLSM[8-9], Chittoori utilise native high plasticity clay in construction of CLSM[10], Uchibagle and rathan Lal used gypsum wall board and the blast furnace slag for CLSM and also bagasse ash .[11-14]. Ram Rathan Lal and Marjive examine behaviour EPS Beats and stone dust in the CLSM.[15]. Horiguchi use incinerated sewage sludge ash used in the construction of CLSM [16].

The main objective of the study is to search an additives in CLSM mix which are useful for the construction of CLSM. the EPS beats and the polypropylene fiber is added in the CLSM mix to study performance of these additives in the CLSM according to ACI 229 R. study show that study the CLSM incorporating EPS beats and polypropylene satisfies compressive strength requirement as per the requirements of ACI committee 229. polypropylene decreases the flowability of CLSM mix and at the same tine by adding EPS beats the density of CLSM mix are reduce which become lightweight CLSM mix. from this it can conclude that polypropylene fibers is less effective in CLSM mix and EPS beats make CLSM mix lightweight.

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II. MATERIAL

(a) (b)

Figure 1: (a)Polypropylene fiber (b) EPS beats

Polypropylene is a 100% synthetic fiber which is transformed from 85% propylene. The monomer of polypropylene is propylene, Polypropylene is by product of petroleum. Polypropylene fiber are hydrophobic, that is they do not absorb water therefore, placed in a concrete matrix they need only be mixed long enough to insure dispersion in concrete mixture. It is a fact that addition of Fibers has an excellent effect in preventing controlling Micro Shrinkage Cracks as well as prevents ingress of Water into concrete. Cracks form a conduit for permeability of Water and Chloride Ions present in permeated water and cause Corrosion of Steel present inside Concrete, and over a period of time affects the durability of structure. fig 1 shows the picture of polypropylene fiber and EPS beats. The mixing time of fibrillated or tape fibers should be kept to a minimum to avoid possible shredding of the fibers. properties of polypropylene fiber are shown in Table 1.

Table 1: Properties of Polyprophylene

Charetertics	**Properties**
Diameter (mm)	**0.0445**
Length (mm)	**20**
Tensile strength	**500-750 mpa**
Specific Gravity	**1.33**
Aspect Ratio (l/D)	**139 33**

All the mix is prepared according to mix given in table 2. Moisturized pond ash placed in oven for minimum 30 min. mix prepared pond ash added 80%, cement 20%, and water pond ash ratio 45%. with 0.5% of polypropylene fiber by total weight of total sample. Put all dry material in iron pot and mixed manually, Then add 45% water gradually to maintain flowability. Mixed sample properly with the help of trowel.

Table 2: CLSM Mix

Percentage of polypropylene fiber	Weight of cement (gm) (20%)	Weight of Pond Ash (gm) (80%)	Weight of polypropylene fiber	Water percentage (45-55%)
0%	540	2150	0 gm	1215ml
0.5%	540	2150	13.5 gm	1215ml
1.0%	540	2150	27 gm	1215ml
1.5%	540	2150	40.5 gm	1215ml

Flowability of the sample measured by pouring the sample into 75 mm diameter and 150 mm height of pipe and it will move upward and measure the flowable sample. Take cylindrical mould of size 75mmx 150mm apply oil layer over inner surface of mould. Fill the mould completely and smoothen off the surface. After 24 hr remould the cube and place it for curing. Repeat above procedure for 1.0% and 1.5% for polypropylene fiber. Test sample under compression test machine after 7 days and 14 days to get compressive strength.

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III. RESULT AND DISCUSSION

The compressive strength of CLSM is a very important property and it is correlated to mix component of material as mainly CLSM is used as structural fill/ backfill. In the present study, a cylinder of size 75mmx150mm was used for testing compressive strength as per ASTM D4832 and ACI229R. the material is flowable so the cylindrical mould was covered by plastic and no vibration and rodding required. for each mix total, 12 cylinder were casted for compressive strength test. the curing was done for 7 and 28 days. The water content was maintained 45% to 55% for all CLSM mixtures. The moisture pond ash kept in the oven for 30 min. the result obtain indicate that as when polypropylene fiber added to CLSM the strength increases up to 1% additives and then the strength will decreases as the % of Polypropylene increases as shown in fig 3.the compressive strength increases as the curing period increases . the maximum compressive strength obtain 11.36 Mpa for 0.5% of polypropylene fiber. and minimum compressive strength obtain in 6.46 Mpa for 1.5% of polypropylene additives. the result of experimental work for compressive stress fpr 7 days and 28 days curing , flowability and density are shown in table 3. tje result for EPS beats represent in table 4 . it indicate strength for the EPS beats when added to clsm mix the compressive strength decrease. thes aswhen added to the clsm mix. the maximum compressive strength obtain 9.5 Mpa and minimum strength obtain is 6.36 Mpa.

Table 3: Performance of polypropylene fibre in CLSM

Percentage of polypropylene fiber (%)	Flowability (mm)	Dry Density Kg/m^3	Compressive strength at 7days (N/mm^2)	Compressive strength at 28days (N/mm^2)
0%	250	1408.16	7.17	9.82
0.50%	160	1402.26	7.48	11.36
1.00%	145	1402	5.98	8.5
1.50%	132	1399.41	5.53	6.46

Table 4: Performance of polypropylene fibre in CLSM

Percentage of EPS beats (%)	Flowability (mm)	Dry Density Kg/m^3	Compressive strength at 7days (N/mm^2)	Compressive strength at 28days (N/mm^2)
0%	250	1408.16	7.17	9.82
0.50%	200	1386	7.28	9.5
1.00%	180	1355	6.98	7.5
1.50%	170	1250.41	4.63	6.36

(a) (b)

Figure 2: (a) and (b) testing for compressive stress

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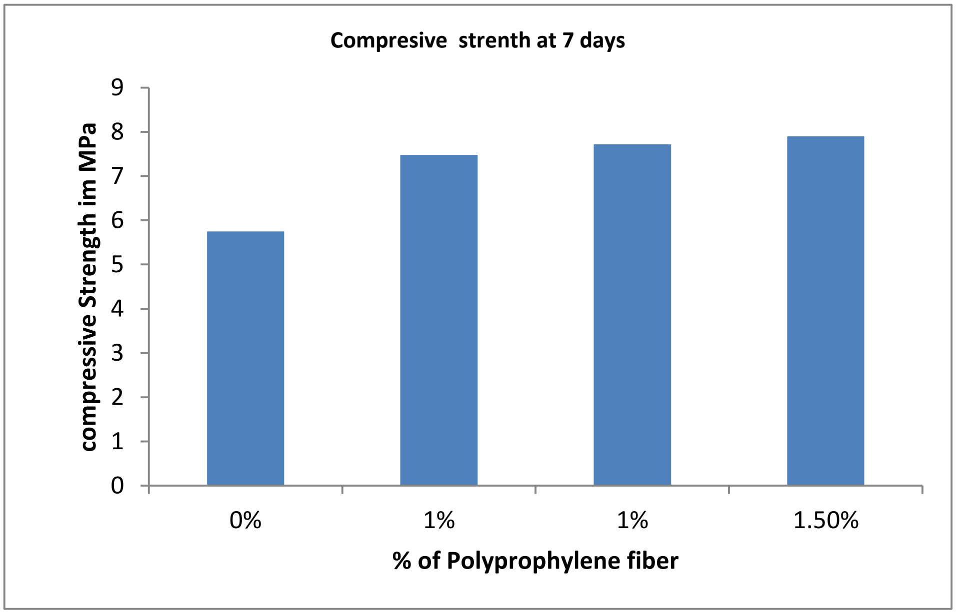

Figure 3: (a) and (b) testing for compressive stress

The test of flowability was conducted by using open-ended cylinder 75 mm x 150 mm according to ASTM D610. Measurement of flowability shown in the Fig. 4.(a) and(b) .from Fig 5 it is cleared that when polypropylene fiber increses the flowability drastically decreases from 250 mm to 132 mm. it shows the bledding more when this reinforcement is added so it is not suitable additives for CLSM as per ACI 229R. the performance of EPS beats in flowability is not effective to improve flowability but it is in the range of medium flowability . the flowability obtain is in the range of 250 mm to 170 mm which is in the range.

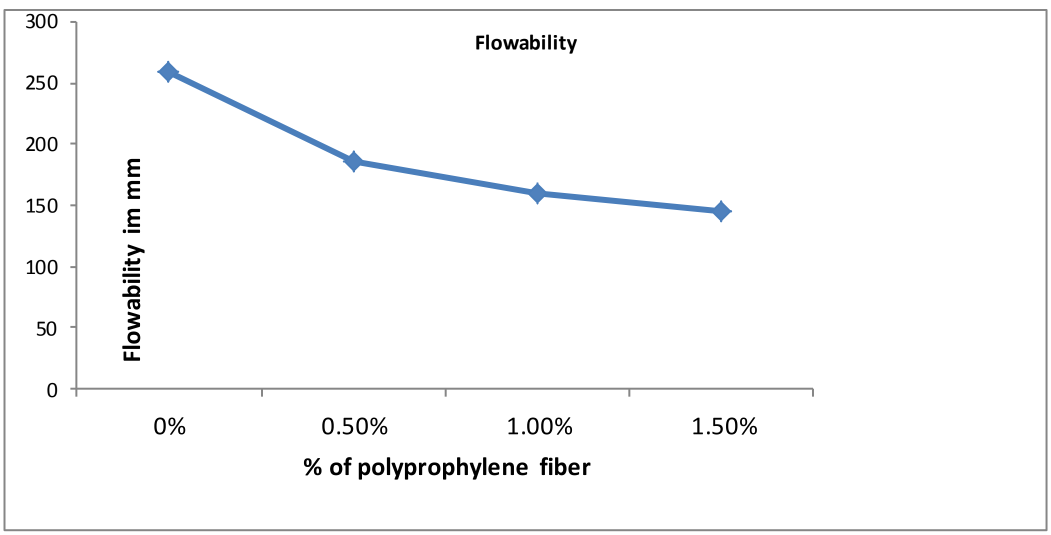

Figure 4: Flowability

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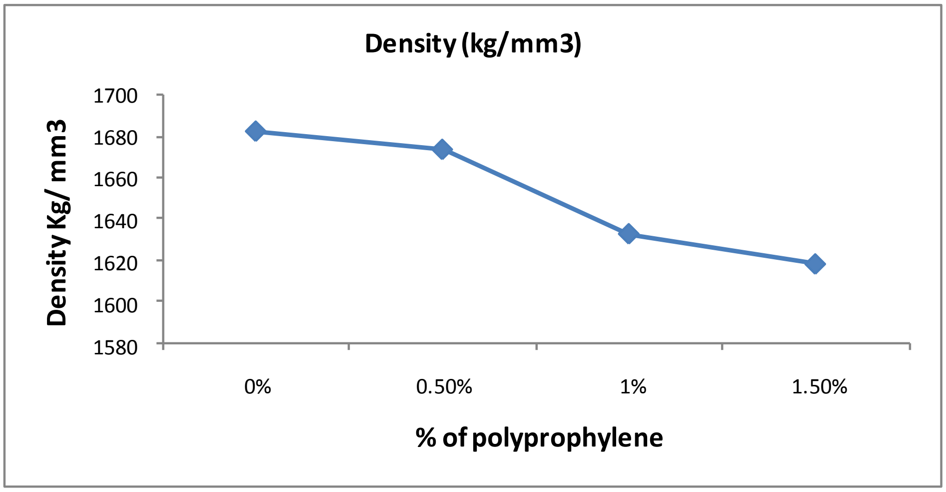

Figure 5: Density

Dry density was measured after attending7 and 28 days curing at the time of testing. density were calculated by taking an average of densities of three cylinders. first weight of the cylinder was calculated accurately as well volume of cylinder were determine and Densities for mixtures calculated in kg/m3. Fig. 6 shows that the density of CLSM mix Decreases as increasing the % of Eps beats added. it is contribute to create lightweight CLSM which is helpful for the application of CLSM mix in filling material.

IV. CONCLUSION

1. Polypropylene fiber reduces the flowability of material but not improve on bleeding.
2. As we increases the percentage of polypropylene fiber there is increase in compressive strength upto certain limit then it gradually decreases.
3. EPS Beats is added to improve the flowability but it is fail to improve the flowability.
4. Flowability without EPS beats is 210 mm and flowability with EPS beats is 180mm
5. When polypropylene fibre added to CLSM, the flowability is decreases from 300 mm to 210 mm for 0.5 % Pp/BFS ratio.
6. When polypropylene fibre is used it is notice that material shows bleeding problem, and density reduces .
7. Flowability and strength is main parameter for CLSM and When fibre use in CLSM it is directly affected flowability And strength requirement for CLSM is up to 8.3 Mpa only. So we can ignore the reinforcement in CLSM.

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