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RESEARCH ARTICLE

FLOATING CONCRETE BY USING LIGHT WEIGHT AGGREGATES

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ABSTRACT

The aim of the research is to identify the material which makes the concrete float and it should also have the strength. Floating concrete is a type of concrete having density less than water and it floats on water. There are many types of lightweight concrete which makes the concrete float either by using lightweight aggregate or by using air entraining agent. The conventional aggregates are replaced by light weight aggregates which makes the concrete lighter than the conventional concrete. Comparison has to be made between plain cement concrete and lightweight concrete having different proportions of aggregates, pumice stone and aluminium content by the weight of cement has been taken into account.

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INTRODUCTION

Concrete is the widely used composite material in the construction industry. Now a days more awareness has been paid to the development of light weight aggregate structure having low unit weight and sufficient strength. One of the way to reduce the weight of the structure is by using the light weight aggregate concrete which is most probable method in reducing the weight of the structure. Floating concrete is a type of light weight concrete which is light in weight and the density is also less than the density of water. In this study floating concrete are made by using light weight aggregates like pumice stone and Styrofoam having varying material proportions. Pumice stone is a light weight aggregate having low specific gravity and it is also a highly porous material which can be replaced by conventional aggregates. Pumice stone is a natural light weight aggregate which is considered as best material to be replaced by conventional aggregates so as to make the floating concrete as it gives reduces the weight and also gives good strength when compared to the other materials. It has low-density as it preserves large number of voids. It also provide resistance to the weather conditions like freezing and thawing. It has a superior characteristics of water absorption as the water is held in the interior of the pumice stone and which is not immediately available for interaction with cement which is beneficial in maintaining it for longer period of curing resulting better strength. The mixing of pumice stone is very difficult as compared to the normal aggregate. Pumice aggregates should be pre wet to attain total saturation. This will fill the internal voids of pumice aggregates with water. This pre wetting will prevent the drying of the aggregates and reduces the possibilities of shrinkage cracks. Over vibration in pumice concrete should be avoided. While over finishing the pumice concrete causes the paste to come to the top. In this study Styrofoam was also used which are collected mostly from packing boxes. Styrofoam come in various shapes of different sizes. In this study, Styrofoam are cut in square shapes of 10 mm size. Styrofoam are used in place of the aggregates and styrofoam balls can be used in place of the sand. The mixing of the styrofoam in the concrete is very difficult due to very light weight.

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MATERIALS AND METHODS

Cement: Ordinary Portland cement
Aggregates: Pumice Stone and styrofoam of 10mm to 20 mm size
Sand: Standard sand, pumice powder and styrofoam balls
Water: Tap water
Mixed Procedure: Hand Mixing
Compaction: Table vibration and by tamping rod

Curing: Curing by Ponding
Cube Size: 15cmX15cmX15cm
Testing of Cubes: Compressive test after 7 days curing
Mix Design: M20 grade with nominal mix proportion used

Casting

Pumice and Styrofoam are added in concrete in various proportions. The replacement percentage are taken with trial study using pumice and styrofoam replaced in place of sand and aggregates. For each proportions 3 samples are casted and kept for the curing.

Testing of materials

Sample 1:
Cubes: 3
Cement: 3.4 kg
Sand: 5.3 kg
Aggregates: 2.7 kg
Pumice Powder (20% of sand): 0.216 kg
Pumice Stone (40% of aggregate): 0.57 kg
Styrofoam (40% of aggregate): 0.06 kg

Table 1: Results after 7 days curing

Sr. No.	Wt. (kg)	Density kg/m^3	Avg. Density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1	5.43	1609		4.5	
2	5.38	1594	1609	4.46	4.51
3	5.48	16234		4.58	

Sample 2:
Cubes: 3
Cement: 6 kg
Sand: 3.6 kg
Pumice Powder (60% of sand): 0.89 kg
Pumice Stone (60% of aggregate): 1.73 kg
Styrofoam (40% of aggregate): 0.06 kg

Table 2: Results after 7 days curing

Sr. No.	Wt. (kg)	Density kg/m^3	Avg. Density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1	4.96	1470		3.4	
2	5	1481	1458	3.45	3.83
3	4.87	1423		3.3	

Sample 3:
Cubes: 3
Cement: 4.5 kg
Sand: 3 kg
Styrofoam (60% of sand): 6.84 g
Pumice Stone (40% of aggregate): 0.286 kg
Styrofoam (40% of aggregate): 0.032 kg

Table 3: Results after 7 days curing

Sr. No.	Wt. (kg)	Density Kg/m^3	Avg. density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1.	3.35	992.5		3	
2.	3.65	1081.5	997.53	3.2	3.03
3.	3.1	918.51		2.9	

Sample 4:
Cubes: 3
Cement: 4.5 kg
Aggregates: 0.3 kg
Sand: 0.9 kg
Styrofoam (80% of sand): 0.02 kg
Pumice Powder (20% of sand): 0.216 kg
Styrofoam (40% of aggregate): 0.094 kg

Table 4: Results after 7 days curing

Sr. No.	Wt. (kg)	Density kg/m^3	Avg. Density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1	2.49	740.74		3.2	
2	2.35	696.3	716.05	3.12	3.16
3	2.4	711.11		3.17	

Sample 5:
Cubes: 3
Cement: 6 kg
Sand: 1.8 kg
Styrofoam (40% of sand): 0.019 kg
Pumice Powder (40% of sand): 1.5 kg
Pumice Stone (60% of aggregate): 1.4 kg
Styrofoam (40% of aggregate): 0.17 kg

Table 5: Results after 7 days curing

Sr. No.	Wt. (kg)	Density kg/m^3	Avg. Density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1	2.83	838.51		3.1	
2	2.76	817.77	818.76	3.03	3.02
3	2.7	800		2.95	

Sample 6:
Cubes: 3
Cement: 6 kg
Sand: 0.68 kg
Styrofoam (60% of sand): 0.0216kg
Pumice Powder (30% of sand): 0.8 kg
Pumice Stone (10% of aggregate): 0.51 kg
Styrofoam (90% of aggregate): 0.14 kg

Table 6: Results after 7 days curing

Sr. No.	Wt. (kg)	Density kg/m^3	Avg. Density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1	2.65	785.18		2.88	
2	2.5	740.74	764.44	2.7	2.8
3	2.59	764.4		2.81	

Sample 7:
Cubes: 3
Cement: 6 kg
Styrofoam (60% of sand): 0.021 kg
Pumice Powder (40% of sand): 1.1 kg
Pumice Stone (10% of aggregate): 0.45 kg
Styrofoam (90% of aggregate): 0.13 kg

Table 7: Results after 7 days curing

Sr. No.	Wt. (kg)	Density kg/m^3	Avg. Density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1	2.6	770.37		2.85	
2	2.54	752.6	773.32	2.74	2.83
3	2.69	797		2.9	

Sample 8:
Cubes: 3
Cement: 6 kg
Styrofoam (80% of sand): 0.028 kg
Pumice Powder (20% of sand): 0.51 kg
Pumice Stone (10% of aggregate): 0.45 kg
Styrofoam (90% of aggregate): 0.13 kg

Table 8: Results after 7 days curing

Sr. No.	Wt. (kg)	Density kg/m^3	Avg. Density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1	2.5	740.74		2..78	
2	2.39	708.14	723.94	2.56	2.67
3	2.44	722.96		2.66	

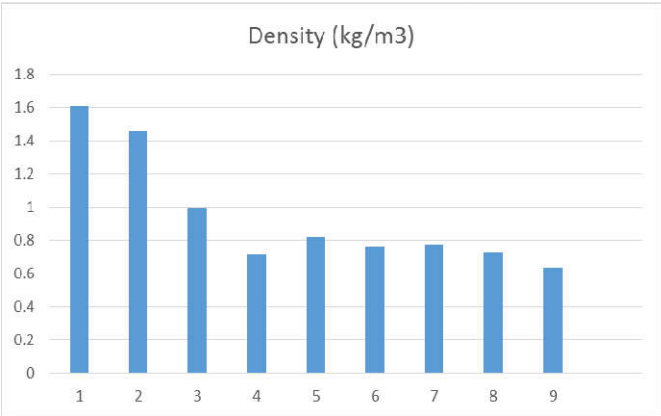
Sample 9:
Cubes: 3
Cement: 6 kg
Styrofoam (90% of sand): 0.42 kg
Pumice Powder (10% of sand): 0.36 kg
Pumice Stone (10% of aggregate): 0.45 kg
Styrofoam (90% of aggregate): 0.13 kg

Table 9: Results after 7 days curing

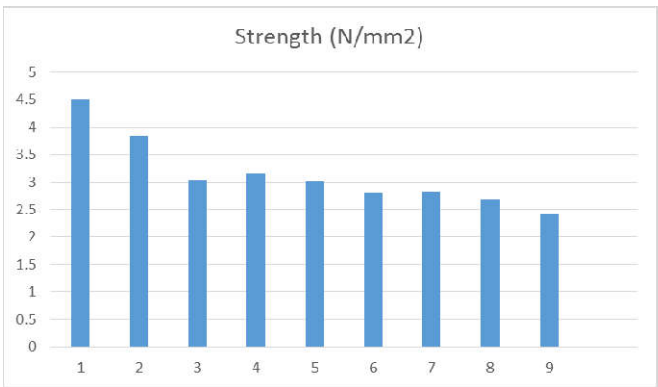
Sr. No.	Wt. (kg)	Density kg/m^3	Avg. Density Kg/m^3	Strength N/mm^2	Avg. Strength N/mm^2
1	2.21	654.81		2.48	
2	2.15	637.03	637.03	2.41	2.42
3	2.09	619.25		2.37	

Graphs of the samples

Graph 1. Average Density of all Samples

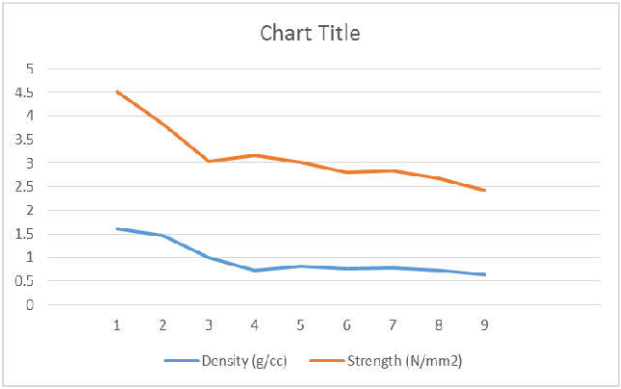


Graph 2. Average Strength of all Samples



DISCUSSION

Sample 1 gives average compressive strength 4.51 N/mm^2, which is desirable strength for light weight concrete. It also gives average density of 1608 kg/m^3, but this density is not appropriate for the floating concrete. So we have to reduce the density of the concrete nearly equal to the density of water so that it floats on the water. Sample 2 gives an average strength of 3.83 N/mm^2 and average density of 1457 kg/m^3. Aggregates are totally replaced by the light weight aggregates in this sample which results in reduction in density of the concrete. But the density is not less than the density of the water so it is needed to further reduce the density of concrete.



Graph 3. Combined graph of all samples

Figure Showing Floating Concrete

Sample 3 gives an average compressive strength of 3.03 N/mm^2 and average density of 997 kg/m^3. In this sample sand is partially replaced by Styrofoam which is more lighter material than pumice. Due replacement of sand with Styrofoam results in a concrete with very less density. With

low density this sample also gives a desirable strength. Sample 4 gives an average compressive strength of 716 N/mm^2 and average density of 3.16 kg/m^3. Aggregates are partially replaced by the Styrofoam which results in very low density as compared to when they are replaced by pumice stone. The concrete made were not having proper finishing. So we decided to increase the quantity of cement for next samples. Sample 5 gives an average compressive strength of 3.02 N/mm^2 and average density of 818 kg/m^3. In this sample better finished was there due to increased quantity of cement. Aggregates are partially replaced by the pumice stone and Styrofoam both. Sample 6 gives an average compressive strength of 2.8 $N/mm^2$and average density of 764 kg/m^3. In this sample density is reduced further by increasing the percentage of Styrofoam in the sample than pumice stone resulting in very less density. Sample 7 gives an average compressive strength of 2.8 N/mm^2 and average density of 773 kg/m^3. In this sample the pumice stone and Styrofoam as aggregates are kept constant but the sand is totally replaced by pumice powder and Styrofoam balls. This results in very low density concrete but strength is less as compared to other samples. Sample 8 gives an average compressive strength of 2.67 N/mm^2 and average density of 723 kg/m^3. In this sample replacement of sand is done by styrofoam and pumice powder. More amount of styrofoam is used than previous sample resulting in the very less density of concrete. Sample 9 gives an average compressive strength of 2.42 N/mm^2 and average density of 637 kg/m^3. In this study styrofoam quantity is increased which results in very less density. This sample also have good finishing.

Conclusion

Using different proportions of pumice stone and light weight aggregates three different light weight mixtures were produced with a satisfied strength. Aggregates size and proportion affects the unit weight and compressive strength of concrete. The results showed that it is possible to produce a floating and a satisfied strength concrete by using pumice stone as aggregate. It was also seen that light weight aggregates in concrete mixture can reduce the dead load but decreases the concrete strength. These light weight concrete does not satisfies the strength requirements for load bearing structural elements so can be used as separation walls.

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