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EXPERIMENTAL STUDY ON FLOATING CONCRETE BY USING LIGHT WEIGHT AGGREGATE AND AIR ENTRAINING AGENT

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Abstract— This Project deals with "The Experimental Study On Floating Concrete By Using Lightweight Aggregate (Pumice Stone) and Air Entraining Agent". In Design of concrete structures, light weight concrete plays a prominent role in reducing the density and to increase the thermal insulation. These may relate of both structural integrity & serviceability. The new sources of Structural aggregate which is produced from environmental waste is Natural aggregates and synthetic light weight aggregate. The use of structural grade light weight concrete reduces the self-weight and helps to construct larger precast units. In this study, an attempt has been made to study the Mechanical Properties of a structural grade light weight concrete M25 using the light weight aggregate pumice stone as a replacement to coarse aggregate and air entraining agent like aluminium powder as 2% of cement content. For this purpose, along with a Control Mix, 3 sets were prepared to study the compressive strength. Each set comprises of 3 cubes. Slump test were carried out for each mix in the fresh state. Compressive test were performed in the hardened state of concrete. The test results showed an overall strength & difference in weight for various ratios of mix and the best compressive strength is used for the floating structure.

I. INTRODUCTION

The present day world is witnessing construction of very challenging and difficult civil engineering structures. Researchers all over the world are attempting to develop low density or lightweight concrete by using different admixtures in concrete up to certain proportions. This study deals with the development of Floating concrete by using lightweight aggregate (Pumice stone) and Aluminum powder as an air entraining agent .Pumice is created when super- heated ,highly pressurized is violently ejected from a volcano.theunusal foamy configuration of pumice happens because of simultaneous rapid cooling and rapid depressurization creates bubbles by lowering the solubility of gases(including water and CO_2) that are dissolved in the lava ,causing the gases to exsolve (like the bubbles of CO_2 that appear when a carbonated drink is opened).The simultaneous cooling and depressuration freezes the bubbles in a matrix.

Floating concrete is made by introducing air or gas into concrete slurry, so that when the mix sets and hardens, uniform cellular structure is formed. Thus it is a mixture of water, cement and finely crushed sand. We mix fine powder of Aluminum to the slurry and it reacts with the calcium hydroxide present in it thus producing hydrogen gas. This hydrogen gas when contained in the slurry mix gives the cellular structure and thus makes the concrete lighter than the conventional concrete.

A. PUMICE STONE

Pumice stone is a lightweight aggregate of low specific gravity. It is a highly porous material with a high water absorption percentage. In this we do not use the conventional aggregate and replace it by the pumice stone.Pumice is the specimen of highly Porous rocks having density approximately 500-600 Kg/m3. Pumice is produced when super-heated, highly pressurized rock is violently ejected from volcano. The unusual foamy configuration of pumice happens because of simultaneous rapid cooling & rapid depressurization. Pumice has an average porosity of 60-80% and initially floats on water.

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Figure 1 : Pumice stone

1) USES OF PUMICE STONE

Pumice is widely used to make light weight concrete or insulative low density cinder blocks. When used as an additive for cement, a fine grained version of pumice called pozzolan is mixed with lime to form a light weight , smooth , plaster like concrete this form of concrete was used as far back as roman times. Roman engineers used it to built the huge dome of the pantheom and as construction material for many aqueducts. Its also used as an abrasive, especially in polishes, pencil erasers.

2) PROPERTIES OF PUMICE STONE

Pumice Stone is a volcanic rock that consists of highly vesicular or perforated volcanic glass.The hardness of Pumice Stone in Mohr scale is 6. The melting temperature of Pumice Stone is 15000º C. Pumice as an average porosity of 90% , which is extremely high for a rock material and initially floats on water.The lower thermal conductivity of pumice stone provides less heat loss.

Figure 2 : Pumice stone float on water

3) CHEMICAL COMPONENTS OF PUMICE STONE

Table 1 : Chemical components of pumice stone

COMPONENT	PERCENTAGE (%)
SiO_2	71.75
Al_2O_3	12.33
Fe_2O_3	1.98
FeO	0.02
MgO	0.12
CaO	0.70
Na_2O	3.59
K_2O	4.47
MnO	0.07
TiO_2	0.11

B. ALUMINIUM POWDER

Aluminium powder is an air entraining agent. The fine powder of aluminium reacts with the calcium hydroxide in the cementatious system produces hydrogen gas. This hydrogen gas in the mix gives the cellular structure and makes the concrete lighter than the conventional concrete. The aluminium used to generate air pockets in the concrete. Mainly used in condition of repeated freezing and thawingaction.The aluminimum content is most resistance to sulphate attacks.

1) PROPERTIES OF ALUMINIUM POWDER

Figure 3 : Aluminium powder

Table 2 : Properties of aluminium powder

SL.NO	PROPERTY	VALUE
1	Molecular formula	Al
2	Form	Powder
3	Colour	Silver
4	Melting point	660^{o}C
5	Boiling point	2467^{o}C
6	Density	2.7gm/ml @ 25^{o}C
7	Ignition temperature	760^{o}C
8	Odour	Odourless

2) USES OF ALUMINIUM POWDER

Aluminium powder is usually used to obtain autoclaved aerated concrete by a chemical reaction generating a gas in fresh mortor,so that when it sets it contains a Large number of gas bubbles.It is used as foaming agent in AAC production world wide.It is mainly used to reduce the weight of the concrete and increasing the volume of the concrete to a certain level, percentage increase in volume of concrete depend on the percentage of aluminium powder used. It also used for making the aerated bricks,light weight concrete blocks etc..,

C. CEMENT

Cement is used right from ancient periods in construction industry. In the most general sense of the word, cement is a binder, a substance which sets and hardens independently, and can bind other materials together. The word "Cement "traces to the Romans, who used the term "opus caementicium" to describe masonry which resembled concrete and was made from crushed rock with burned lime as binder. Cements used in construction are characterized as hydraulic or non hydraulic..

D. WATER

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. As per IS 456-2000 water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugars and organic materials. The water used was taken from the college campus.

II. COMPFRESSIVE STRENGTH ON CUBES – 7 DAY TEST ON CUBES

Table 3 : 7day test on cubes

SL.NO.	SPECIMEN USED	LOAD AT FAILURE (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1	CUBE	207.39	9.22
2	CUBE	185.33	8.24
3	CUBE	192.85	8.57

CALCULATION

CUBE 1

$$\text{Compressive strength} = \frac{207.39 \times 1000}{150 \times 150}$$

$$= 9.22 \text{ N/mm}^2$$

CUBE 2

$$\text{Compressive strength} = \frac{185.33 \times 1000}{150 \times 150}$$

$$= 8.24 \text{ N/mm}^2$$

CUBE 3

$$\text{Compressive strength} = \frac{192.85 \times 1000}{150 \times 150}$$

$$= 8.57 \text{ N/mm}^2$$

III. COMPFRESSIVE STRENGTH ON CUBES - 14 DAY TEST ON CUBES

Table 4 : 14 day test on cubes

SL.NO	SPECIMEN USED	LOAD AT FAILURE (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1	CUBE	264	11.73
2	CUBE	270	12
3	CUBE	267	11.86

CALCULATION

CUBE 1

$$\text{Compressive strength} = \frac{264 \times 1000}{150 \times 150}$$

$$= 11.73 N/mm^2$$

CUBE 2

$$\text{Compressive strength} = \frac{270 \times 1000}{150 \times 150}$$

$$= 12 N/mm^2$$

CUBE 3

$$\text{Compressive strength} = \frac{267 \times 1000}{150 \times 150}$$

$$= 11.86 N/mm^2$$

IV. COMPFRESSIVE STRENGTH ON CUBES - 28 DAY TEST ON CUBES

Table 5 : 28 day test on cubes

SL.NO.	SPECIMEN USED	LOAD AT FAILURE (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1	CUBE	340	15.11
2	CUBE	328	14.58
3	CUBE	335	14.89

CALCULATION

CUBE 1

$$\text{Compressive strength} = \frac{340X\ 1000}{150 \times 150}$$

$$= 15.11 N/mm^2$$

CUBE 2

$$\text{Compressive strength} = \frac{328\ X\ 1000}{150 \times 150}$$

$$= 14.58 N/mm^2$$

CUBE 3

$$\text{Compressive strength} = \frac{335\ X\ 1000}{150 \times 150}$$

$$= 14.89\ N/mm^2$$

V. MEAN COMPRESSIVE STRENGTH

Table 6: Mean compressive strength

SL.NO	DAY	SPECIMEN	COMPRESSIVE STRENGTH (N/mm^2)	MEAN COMPRESSIVE STRENGTH (N/mm^2)
1	7 DAY	CUBE 1	9.22	8.67
		CUBE 2	8.24	
		CUBE 3	8.57	
2	14 DAY	CUBE 1	11.73	11.86
		CUBE 2	12	
		CUBE 3	11.86	
3	28 DAY	CUBE 1	15.11	14.68
		CUBE 2	14.58	
		CUBE 3	14.89	

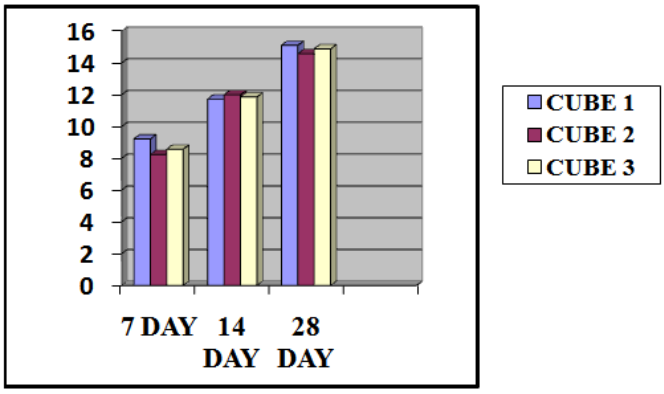

Figure 4 : Comparison of compressive strength for each days

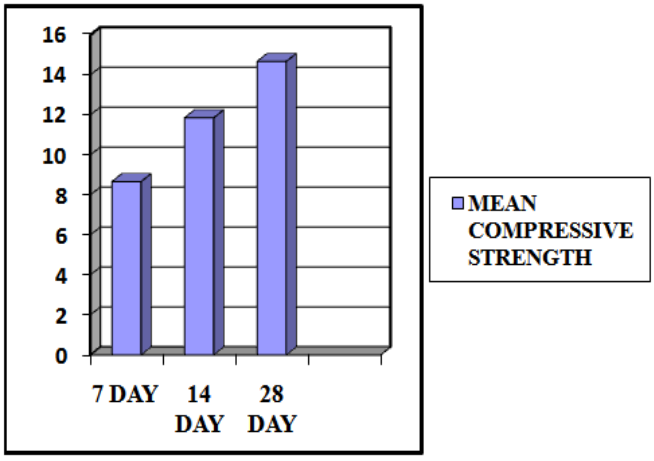

Figure 5 : Mean compressive strength for each days

VI. CONCLUSION

In this study , the influence of light weight aggregate and air enteraining agent in concrete ,the compressive strength of concrete were investigated. The density of concrete is reduced to certain level compared to conventional concrete to float on water ,the air enteraining agent is fixed percentage of 2% of cement content, then the volume of concrete increased to 10%.From this we concluded that,this type of concrete can be used mainly for non structural concrete ,because the Characteristic compressive strength of concrete is achieved by 60% only,capable of providing good thermal and sound insulation.In case, it can be used for structural purposes,by adding mineral admixture like silica fume,fly ash., to achieve the required bearing strength of concrete.

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