Study on aerated concrete using steam curing test method

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Abstract: The Accumulation of warm and moisture in building walls plays an vital role in its upkeep and power conservation. Aerated Concrete block, an environmental material gives an anticipated result to building construction. Aerated Concrete can build light weight, eco-friendly, non-structural wall, reduced dead weight concrete blocks. Aerated Concrete is developed introducing aluminium powder which reacts with the calcium hydroxide on hydration of cement. Several curing test methods are done to find out the optimum dosage of aluminium content. The Aerated concrete blocks are pre-casted by mixing Portland cement, fly ash, GGBS, quarry dust, lime stone powder, water and aluminium powder.

Keywords: Aerated Concrete, Light weight, curing, Aluminium powder.

1. Introduction

Aerated concrete production involves the addition of a foaming agent like Al powder to a mix of cement, the combination of fine aggregates and water which reacts with the lime in cement manufactures a light-weight porous material. Aerated Concrete blocks are also one of the result for brick substitute. Aerated Concrete is one of all the environmental products.

Several curing tests of Aerated Concrete were studied in this work. Several instrumented experiments were performed to characterize aerated concrete blocks. These studies include the variant of compressive strength within a typical block.

Steam curing of concrete at air pressure has the advantage of fastening the hydration reactions of portland cement. Consequently, the material develops compressive strength and reduces its porosity during a shorter time compared with standard curing under ambient conditions. under traditional ambient conditions, counting on the kind of cement and its fineness, the compressive strength will reach up to fifty 50 % of the final strength in 3 days, and 80% in ten days. Accelerated curing will increase the strength gain at early ages, even though there's typically a strength reduction at later ages compared to straightforward curing.

1.2 Objective

To study the steam curing method of the aerated concrete of optimum dosage of aluminium powder. To investigate the influence of the steam curing method on the compressive strength of aerated concrete. To carry out all the mixed proportions for the compression test. To execute the volumetric analysis of the aerated concrete.

2. Literature Survey

Jagadish vengala et al., (2019): terminated that the compressive strength of autoclaved aerated concrete blocks was drastically reduced after they are under an autoclave machine of bound pressure and temperature of 1500 degrees Celcius and suddenly they're cooled by immersing in water. Results show thirty-five % reduction in strength of autoclave aerated concrete blocks.[1]

Rana Shabbar et al. (2017) created aerated concrete by introducing gas into concrete, the quantity depends upon the necessities for strength. The aim of this study was to analyse the influence of the powder content on the mechanical properties of aerated concrete namely; compressive and flexural strengths, modulus of physical property, density, and body. The results indicated that a rise in metal content caused a decrease within the compressive

and tensile strengths. It additionally created a decrease within the modulus of physical property. Once the metal content enlarged, the density diminished and therefore the body enlarged.[4]

3. Methodology

3.2 Mix Proportions

A) Mix Proportion 1

Material	Quantity of Materials per Block (Grams)
Cement	200
Sand	400
Water	100
Aluminium Powder	0.1%, 0.15%, 0.2%
Super Plasticizer	1%

Concrete is mixed for 0.1%, 0.15% and 0.2% of aluminum powder and density is found to be from 800-1200 for different types of trails which comes under a lightweight concrete but not an accurate aerated concrete.

The concrete is again mixed with PCE superplasticizer (polycarboxylate ether) to decrease water content and to increase the workability of the concrete. Since the density of aerated concrete is more, the sand is totally replaced with lime-stone powder and quarry dust and again a separate mix-proportion was designed.

B) Mix Proportion 2

Material	Quantity of Materials per Block (Grams)
Cement	600
Quarry Dust	150
Limestone Powder	150
Water	375
Aluminium Powder	0.1%, 0.15%, 0.2%

Fig 1. Concrete After pouring into the mold

Fig 2. Concrete After 30 minutes after pouring into the mold

As the density and compression strength using limestone powder and quarry dust was found to be less, one more proportion was designed by adding fly ash, and GGBS.

C) Mix Proportion 3

Material	Quantity of Materials per Block (Grams)
Cement	250
Fly Ash	250
Quarry Dust	80
Limestone Powder	80
GGBS	80
Water	333
Aluminium Powder	0.1%, 0.15%, 0.2%

The density of the concrete replacing lime-stone powder and quarry dust for aerated concrete is found to be from 600-1000 for different trails.

The several samples of different aluminum content were taken to conduct compressive test using steam curing method.

3.3 Steam Curing Method

Steam curing is curing in vapor at atmospherically or higher pressures. once cured at atmospheric pressure, the enclosure temperatures are typically between 100 to 105°C. Steam curing is used wherever early strength gain is needed and wherever heat is required for hydration, like in cold weather. The entire mold was placed into the steam curing tank as per the procedure.

The Fig 3. below shows the sample were taken and conducted steam curing for 3 hours at 100°C.

Fig 3. Concrete Molds Placed in Steam Curing Tank.

After the curing period the samples were kept in the room temperature to cooldown the molds.

Once the Samples are cooldown, the samples were unmolded and kept in the oven for 3 hours at $100\pm 5^{\circ}\text{C}$ to reduce the water content in the concrete block.

After the water content is reduced in the concrete block, the concrete blocks are kept aside for 15 minutes to cooldown.

Fig 4. Shows the above part of the concrete is cut using hacksaw blade to form a uniform shape of $100\text{mm}\times 100\text{mm}\times 100\text{mm}$.

Fig 4. Concrete is cut in uniform shape of $100\text{mm}\times 100\text{mm}\times 100\text{mm}$. The several samples of different aluminium content were taken to conduct compressive test using steam curing method.

4. Results

4.1.1 Density of Aerated Blocks for 0.1% of Aluminium content

Sl. No	Type of Block	Density of the Blocks		
		Block 1	Block 2	Block 3
1	Proportion 1	1022	964	1152
2	Proportion 2	1010	1004	805
3	Proportion 3	907	836	988

4.1.2 Change in volume of Aerated concrete for 0.1% of Aluminium Content

Sl. No	Type of Block	Change in volume of the Blocks		
		Block 1	Block 2	Block 3
1	Proportion 1	-	-	-
2	Proportion 2	28%	37%	23%
3	Proportion 3	56%	48%	40%

Sl. No	Type of Block	Strength of the Blocks N/mm^2		
		Block 1	Block 2	Block 3
1	Proportion 1	-	-	-
2	Proportion 2	3.5	2.6	3.1
3	Proportion 3	2.6	2.8	3.4

4.1.3 Compressive Strength of Aerated Concrete for 0.1% of Aluminium Content

Sl. No	Type of Block	Density of the Blocks		
		Block 1	Block 2	Block 3
1	Proportion 1	997	1074	1241
2	Proportion 2	740	763	695
3	Proportion 3	737	855	942

4.2.1 Density of Aerated Blocks for 0.15% of Aluminium content

Sl. No	Type of Block	Change in volume of the Blocks %		
		Block 1	Block 2	Block 3
1	Proportion 1	-	-	-
2	Proportion 2	37%	44%	48%
3	Proportion 3	62%	55%	43%

4.2.2 Change in volume of Aerated concrete for 0.15% of Aluminium Content

Sl. No	Type of Block	Compressive Strength of the Blocks		
		Block 1	Block 2	Block 3
1	Proportion 1	-	-	-
2	Proportion 2	3.5	2.6	3.1
3	Proportion 3	2.6	2.8	3.4

4.2.3 Compressive Strength of Aerated Concrete for 0.15% of Aluminium Content

Sl. No	Type of Block	Strength of the Blocks N/mm^2		
		Block 1	Block 2	Block 3
1	Proportion 1	-	-	-
2	Proportion 2	3.0	2.9	2.8
3	Proportion 3	2.0	2.2	3.2

4.3.1 Density of Aerated Blocks for 0.2% of Aluminium content

Sl. No	Type of Block	Density of the Blocks		
		Block 1	Block 2	Block 3
1	Proportion 1	947	801	895
2	Proportion 2	912	973	696
3	Proportion 3	572	525	687

4.3.2 Change in volume of Aerated concrete for 0.2% of Aluminium Content

Sl. No	Type of Block	Change in volume of the Blocks %		
		Block 1	Block 2	Block 3
1	Proportion 1	-	-	-
2	Proportion 2	47%	53%	55%
3	Proportion 3	100%	80%	65%

4.3.1 Compressive Strength of Aerated Concrete for 0.2% of Aluminium Content

Sl. No	Type of Block	Strength of the Blocks N/mm^2		
		Block 1	Block 2	Block 3
1	Proportion 1	-	-	-
2	Proportion 2	2.5	2.4	2.2
3	Proportion 3	1.6	1.8	1.7

Graph Shows the Comparition of Compressive strength and Al Powder for Proportion 2

Fig 5. Compressive Strength vs Aluminum Powder.

Graph Shows the Comparition of Compressive strength and Al Powder for Proportion 3

Fig 6. Compressive Strength vs Aluminum Powder.

Fig 7. Change in volume vs Aluminum Powder.

Fig 8. Change in volume vs Aluminum Powder.

5. Conclusion

- As we can see the above Fig 5 and Fig 6 we can clearly conclude that, if we increase the aluminium content there is decrease in the compressive strength.
- By using the steam curing method, the compressive strength was found to be very low.
- We conclude that by seeing the fig 7 and fig 8 if there is increase in aluminium powder there is also increase in the volume of the concrete.
- By using the steam curing method for aerated concrete, we cannot use the concrete as a replacement of bricks.

6. Reference

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