

Experimental studies on bentonite clay as a replacement of cementitious material in cement mortar

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Abstract

This report deals with the effect of bentonite clay on cement mortar. The mortar was made with the partial replacement of cement in the percentages as follows 0%, 25% and 50%. The specimens were made with these percentages of bentonite clay along with the cement keeping the water cement ratio constant as 0.485. The specimens were tested for the compressive strength after 2 days and 7 days and the results were obtained.

Test on fine aggregate

These are the sieve analysis result performed on the fine aggregates used in the preparation of mortar specimens. Using this data fineness modulus for the sand has been calculated.

Sieve size(mm)	Weight retained(gm)	cumulative weight retained (gm)	cumulative (%) weight retained	cumulative (%) passing
4.75	2.77	2.77	0.277	99.723
2.36	4.43	7.2	0.72	99.28
1.18	21.22	28.42	2.842	97.158
0.6	84.17	112.59	11.259	88.741
0.3	812.2	924.79	92.479	7.521
0.15	57.43	982.22	98.222	1.778
pan	17.74	999.96	99.996	0.004
total	999.96			

Figure 1 : sieve analysis

$$\text{Fineness modulus} = \text{sum of cumulative \% retained} / 100 = 3058/100 = 3.058$$

Using the above data gradation curve was obtained for the fine aggregate. This gradation curve shows the fine aggregate is *uniformly graded aggregates*.

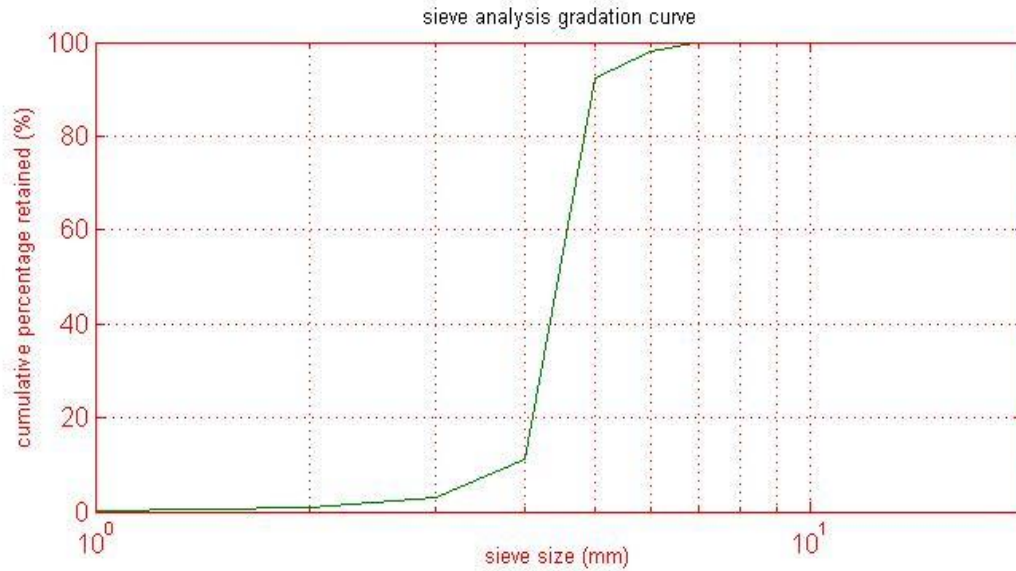


Figure 2 : Gradation curve

Preparation of specimens

This procedure was followed for the preparation of specimens

Mix design for specimens

The mix design used for the preparation of the samples are given below

Mix design for the specimens						
specimen	W/C ratio	bentonite clay(g)	cement (g)	sand(g)	water(ml)	
1	0.485	0	200	600	97	
2	0.485	50	150	600	97	
3	0.485	100	100	600	97	
4	0.485	200	0	600	97	

cementacious material : sand = 1 : 3

Figure 3: Mix design

Test results after 7 days strength

Result of test after 7 days			
s.no	Crushing load	Area	Compressive strength (C.L*2204.6/4)
	(ton)	(in ²)	(psi)
1	3.14	4	1730.611
2	2.93	4	1614.8695
3	1.36	4	749.564
4	0.56	4	308.644

Figure 4 : 7 days strength

Test result after 14 days strength

Result of test after 14 days			
s.no	crushing load	Area	Compressive strength (C.L*2204.6/4)
	(ton)	(in ²)	(psi)
1	3.82	4	2105.393
2	3.79	4	2088.8585
3	1.81	4	997.5815
4	0.74	4	407.851

Figure 5 : 14 days strength

Extrapolation of 7 days strength

The ration between the 7 days strength and 28 days strength is approximately equal to 1.2-1.7

So 7 days strength of the specimens has been extrapolated to get 28 days strength by multiplying a factor 1.5

Extrapolation of 7 days strength	
7days strength(psi)	28 days strength = 1.5*7 days strength(psi)
1730.6	2595.9
1614.9	2422.35
749.5	1124.25
308.644	462.966

Figure 6 :Extrapolation

Test results for compressive strength of the cubes

Test results of compressive strength of the cubes					
s.no	percentage of bentonite clay(%)	percentage of cement(%)	7 days strength	14 days strength	28 days strength
1	0	100	1730.6	2105.4	2595.9
2	25	75	1614.9	2088.9	2422.35
3	50	50	749.5	997.6	1124.25
4	100	0	308.644	407.85	462.966

Figure 7: Test result

Graph comparison of compressive

The following graph shows the comparison of compressive strength among various samples and for 7 , 14 and 28 days

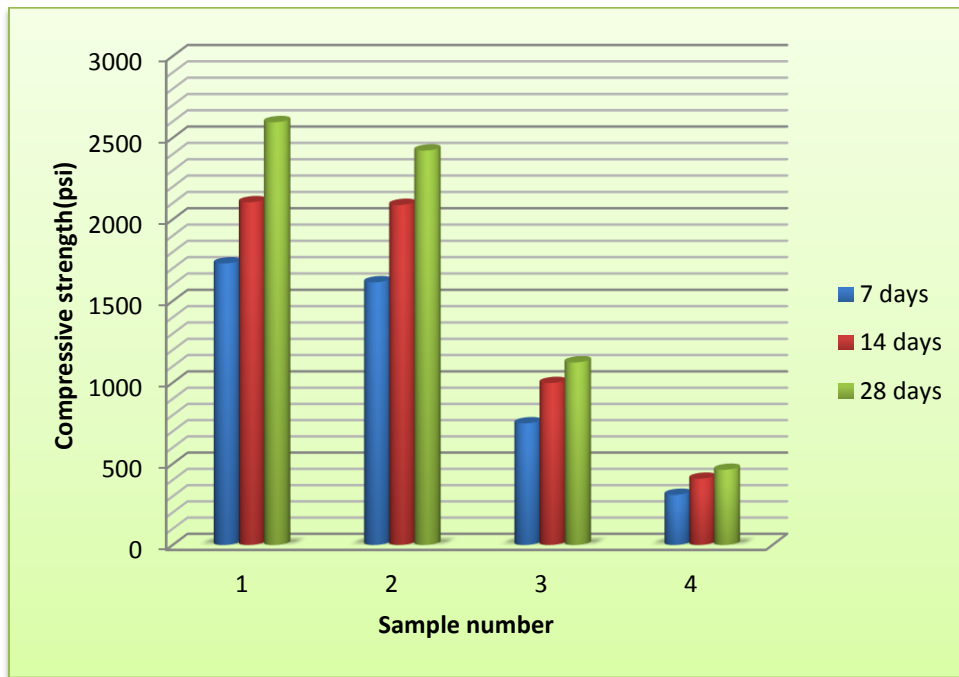


Figure 8 : Graph for comparison

conclusion

This work is concluded by achieving result that the 14 days compressive strength for the 25% replaced cement mortar by Bentonite clay is approximately equal to the 0% replaced Bentonite clay cement mortar i.e. 2089psi and 2105 psi respectively

References

Mortar testing Guide

<http://theconstructor.org/practical-guide/compressive-strength-of-mortar-cubes/1556/>

<http://www.cement.org/for-concrete-books-learning/concrete-technology>