

Effect of Bentonite on Behaviour of Mortar by Partially Replacing OPC with Coconut Waste Ash: A Review

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Abstract - Mortar is construction material a combination of sand and cement. Amount of cement production emits approximately equal amount carbon dioxide into atmosphere cement production is consuming significant amount of natural resources. To overcome the ill effect new material can be used partial replace instead of cement. pozzolanic materials in concrete and mortar will be a better solution for this problem. several studies were available for pozzolanic material like fly ash, ground granular blast furnace slag, and silica flume as a pozzolanic materials in concrete and mortar. A few literatures were available on bentonite and coconut shell ash as a construction material in concrete and mortar. coconut shell ash and bentonite is clay contains silicon amounts obeys the poozolanic properties. This paper presents the overview of research work presented on physical and chemical performances in cement mortar like consistency, setting times and compressive strength made by the bentonite and coconut shell ash as partial replacement of cement in mortar.

Index Terms - Bentonite, coconut shell ash, physical and chemical properties, partial replacement, mortar, compressive strength test.

I.INTRODUCTION

Now a days use of cement in getting increase day to day. Increase in use of cement means increase in production, which consumed more electricity and natural resources. Cement productions cause many hazards to environments. To reduce this hazard another material to be partial replace to cement which is cheaper and available in large quantities. These materials are Bentonite and fly ash. Bentonite is second largest available raw material; the production cost of the bentonite is very less compared with OPC

in India. [Roobankumar R, Niyas Ali A] Bentonite, a natural pozzolana, is composed primarily of montmorillonite. Bentonite is described as a hydrous aluminum silicate containing small amounts of alkali and alkaline earth metals [S. Ahmad S. A. Barbhuiya] Fly ash is waste product of thermal power plants. Its effect on agricultural land, surface and subsurface water pollution, soil and earth pollution. The use of Fly ash in mortar it reduces greenhouse emission. It is observed that 0.9 tons of co2 is produced per ton of cement production. [Roobankumar R, Niyas Ali A] Fly ash, contain more than Cao blast furnace slag and silica fumes. This can be used as a cement binder in mortar requires a silica, alumina and ferric oxide. [Utsev, J. T., Taku, J. K] Few research works were done by utilization of bentonite and coconut shell ash as partial substitution of cement in mortar. This paper reports the overview of the bentonite and coconut shell ash utilization in cement mortar as well as concrete.

Objectives-

- To understand the physical and chemical properties of bentonite and coconut shell ash.
- To study the compressive strength properties of Mortar with partially replacement of cement by CSA and Bentonite.
- To finding the low-cost construction material as cement.
- Optimum use of cement will make mortar economical.
- To convert waste material into useful material.

Scope of the Study

- Environmental pollution is the major issue due to emission of different environmental pollutants, during the process of manufacturing of cement thus affecting its quality.
- To reduces the pollution that caused by cement and cement factory to conserve and save the resources.
- The cost of the material is also increasing day by day when compared to other materials. So, it has become our necessity to find an alternate material for cement.
- Agricultural wastes such as coconut shell has been disposed waste to the environment. Since there is pozzolanic property in these waste materials, it can be used for the partial replacement of cement.

II.BENTONITE

Bentonite is one of the expansive clay. [G.Vamsi Krishna Reddy] Sodium bentonite expands when wet, absorbing as much as several Times its dry mass in water. The property of swelling also makes sodium bentonite useful as a sealant, low permeability barrier. [R selvaraj,R.priyanka]The karak bentonite ,heated for 3 hr and after cooling to room temperature sieved through # 325 sieve (45mm).bentonite heated high calcium content in table no.2[J. Mirja]. Based on the overview of research paper were carried out of the by researchs from different location. pakistani bentonite from Jehan gira region of Pakistan[S.Ahmad].calcium bentonite purchased from tandur, telangana.[G.Vamsi Krishna Reddy]. Bentonite from amazon region Brazil [D.J.Lima Garva]A Author use of Pakistani bentonite available from different location [S.A.Memon].

III.COCONUT SHELL ASH

Coconut shell ash which is an environment pollutant are collected and burnt in the open air for 3 hours. to produce the CSA. use as pozzolana material in partial replacement of cement. Burnt ash was collected and sieve(75microns). [Thejaswi Premarajan] and [D.R.Ummebeswari]. Chemical composition of CSA as per ASTM C 618 when SiO₂+Al₂O₃+Fe₂O₃ of a mineral admixture is

more than 70%. investigate carried out more than 70%.i.e was found as 72.34%[P.V asanthi],77.57% [Utsev.jandK.Taku (2012)], 80.64% [Joshua et al (2018)].

Physical Properties

Bentonite is generally available in various colors and form. A few authors reported about the colors and nature. Color - light yellow, Size pass from 70 microns, free swell – 60% by volume, nature - Pozzolanic [M.Karthikyan and Junaid Akharet al.(2013)]Greenish gray and browning green[Junaid Akharet al.(2013)] based on the overview of physical properties of bentonite and CSA reported by some authors. All authors reported different value. Because change in location. physical properties used in various research work show in [Table 1].

Chemical properties

[Table 2 and 3] shown the review on the chemical properties of bentonite and CSA According to authors Reported higher amount of SiO₂ Presences Al₂O₃ as second major element in bentonite and CSA. These leads to occurrences of pozzolanic reaction while hydration of process. chemical properties as per ASTM C618 most of the author reported as within the limits.

Table 1– Physical properties of bentonite used in various research work.

Sr. No	Property / Author	Specific Gravity	Average fineness percentage	Blain Fineness Cm ² /gm
1	j.mirza	2.63	17%retained 325 mesh	-
2	S.Ahmad	2.44	325retained 13.5%	2689cm ² /kg
3	Soundarya .M.k	2.2	-	-
4	Ameyatigree	3.1	9%	-
5	S. A. Memon	2.82	4.75 μm	4800

Table 2– Chemical properties of bentonite used in various research work.

Sr. No	Property Author	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Na ₂ O	K ₂ O	SO ₃	Loss of Ignition	SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃
1	Mirza	49.44	19.7	16.20	7.45	1.61	0.87	0.69	-	30.74	75.34
2	M.Karthikeyan	49.63	21.118	3.235	0.65	3.591	0.449	2.091	-	-	73.987
3	S.Ahmad	65	15	3	2.66	6.5	0.12	0.27	-	6	83
4	G.vamsiKrishna reddy	51.11	6.38	7.65	6.60	7.57	0.29	1.34	-	16.75	-

Table 3- Chemical properties of coconut shell ash used in various research work.

Sr.No	Property Author	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Na ₂ O	K ₂ O	SO ₃	Loss of Ignition	SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃
1	P.Vasanthi	38.54	19.00	14.77	5.03	1.34	-	-	-	7.96	72.34
2	Thejaswi premarajan	37.97	24.1	15.48	4.98	1.89	0.95	0.83	0.71	0.81	77.55
3	Utsev	37.97	24.12	15.48	4.98	1.89	0.95	0.83	0.71	11.94	77.57
4	Dr .r u	64.20	6.51	6.98	10.56	-	-	-	1.05	-	77.69
5	Adeala.A.J	45.02	15.08	12.38	0.55	16.19	0.45	0.52	-	19.57	72.48
6	Kumar etal.2017	37.90	24.12	15.48	4.98	1.89	0.95	0.83	0.71	11.94	77.5
7	Alif sayazanilemean	0.98	-	0.35	0.23	0.31	0.29	1.21	-	-	-

IV. EFFECT OF BENTONITE ON BEHAVIOUR OF MORTAR BY PARTIALLY REPLACING CEMENT WITH CSA

a) Normal Consistency

Normal consistency is directly proportion to bentonite addition. [M.Achyutha Kumar Reddy].75% consistency observe where as OPC attains 30-100%. [Reddy G. V. Ranga rao], observe where as 21 % bentonit – OPC mixture attain 35% consistency was reported by [S. A Memon]

b) Initial and Final setting time

Initial and Final setting time increasing by addition of bentonite to cement [Reddy G.V.Ranga rao].initial and final setting was performed as per standard procedure IS 4031. Bentonite exhibits 68 and 190 minutes were shown OPC and 43 and 125 min after addition with water. [S.A.Memon] increasing by addition of CSA to cement. CSA exhibits 326 and 442 min at 30%. [Utsev.J.K Taku].

c) Strength Activity index

Test on SAI as per standard procedure ASTM C 618 For bentonite mixes at different Temperature. higher strength SAI Observed in 1500c heated bentonite compare with other temperature. [J.Mirja] As per ASTM Standard C618 Specification except for 9000c Heated bentonite in which the SAI was below the specified limit of 75% [S.Ahmad]. J.Mirja reported that 96 and 82% SI for bentonite at the age of 7 and 28

day. Utsev. J. T Reported that 90.35, 93.30 and 92.7 percent of SI for CSA at the age of 7,14, 28 days. 30% CSA cement mixes shown better solution at 14 days. SAI Index observe the increase the CSA% decrease the SAI. [Utsev. J.T].

d) Compressive Strength Test

10 percent of CSA achieve good compressive strength. [Thejaswi premarajan] Selvraj.R Concluded that 15% bentonite Cement mixes achieve the good compressive strength normally slightly cement mortar. [Selvraj.R]. When compared to control mixture the compressive strength increased for OPC mortar containing 20 % of 1500c heated bentonite but remained slightly lower for the mortar with 20% bentonite. In 5% Na₂so₄and 2% MgSo₄ solution the greater compressive strength was observed for mortar containing 30% bentonite. [J.Mirza]

V.CONCLUSION

Plenty investigations were conducted by several authors with bentonite and coconut shell ash as supplementary material in mortar. The following conclusions were made based on the results reported the authors.

- Study aims to conduct various experimental tests on Bentonite clay with replacement of cement mortar using different binders and to arrive at an optimum percolation rate and strength.

- Compressive strength of OPC & PPC with Raw Bentonite replacement were made. It was found that significant compressive strength was achieved at 15.0 % replacement of Bentonite for OPC & 12.5% for PPC.
- Coconut shell ash and having good pozzolanic property it will improve the strength of cement mortar and concrete and also gives high workability to concrete.
- The composition of the coconut shell ash has good characteristic to be use as binder in the mortar.
- Literature study shows 10% replacement (CSA) is optimum.
- Higher C S of cement mortar were noticed by using 20% of bentonite (heated at 1500C for 3 hours) substitution to OPC.
- Based on the results We can conclude that this Pakistani bentonite could be used to replace up to 30% of cement to produce concrete with sufficient compressive strength for low-cost constructions.

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