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Rehology and Durability of Cement Mortar by using Viscosity Modifying Admixtures

M.Direka, R.Yuvanesh Kumar, K.Vinobalaji

Abstract*—*Cement mortar utilizing natural admixtures is the need of great importance for a wide scope of utilizations in the development of building structures. It is a built material for explicitapplications having superior properties like better strength, durability, and constructability. In the present consideration, create a characteristic admixture based cement mortar, admixtures like drumstick, and Ranawara resins were utilized along with normal ingredients. The nature of the natural admixture was to modify the viscosity nature of mortar. The use of natural admixtures in cement mortar enhances its properties regarding workability, strength, durability, and the economy. The extent of this paper was to investigate the effect of mineral admixtures such as Durmstick and Ranawara gums towards the execution of slab panels. Experimental results gave the effective strength on cement mortar due to the property of rheology in natural gums. This work progressively tried distinctive kinds of admixtures by casting cubes and testing them. The tests, such as sorptivity, acid test and water absorption for durability property was studied. Subsequently, the optimum result for different types of admixtures was taken to cast cement mortar slab panel along with the optimum result of admixture. Finally, the behavior of the slab panel was studied and a narrative was presented on various parameters of strength.

Keywords*—*Workability,Strength,Durability, Ranawara resin, Drumstick resin.

INTRODUCTION

For OPC mortar, the introduction to carbon dioxide condition does not bring down the chloride infiltration obstruction of mortar as estimated by RCPT, MRMT, and NaCl submersion test. In any case, the introduction to carbon dioxide essentially diminishes the chloride entrance opposition of mortar containing pozzolans. This reduction is identified with the substitution dimension of pozzolans. With introduction to an abnormal state of carbon dioxide concentration, be that as it may, the protection from chloride infiltration of mortar containing pozzolans is brought down contingent upon the sort and dimension of substitution [1]. Chloride particles, three viscosity modifiers (cellulose ether, commercial shrinkage-reducing admixture, apolypropylene glycol) are used to reduce the effective diffusivity and for one year it is used with mortars.[2]. Toset impeding water lessening admixture in cement mortarsGum Acacia Karroo (GAK) is used.Obstructing admixtures are used to counter effect the animated hydration of cement at lifted temperatures by sponsorship off the frustrating system especially in the midst of the day while cementing work is done. Setting time was assessed in bond pastes with different measurements Gum Acacia Karroo and impeding operator. There was a decrease of water demand due to physical and synthetic impacts of water the diminishing admixtures on the outside of solid particles encountering hydration [3System for showing the effect of mixture admixtures on the set lead of Portland bond mortar utilizing the Virtual Concrete and cement Testing Lab software. The exactness of entertainments for mixes containing admixtures lessened as the portion of the different admixture extended. The deviation of the desires from reality with growing estimations is an impression of the possibility of the hydration generation[4]. The VMA are essential to control the strength and cohesion of concrete with undeniable rheological requirements, for instance, self-compacting concrete, submerged cement, or shotcrete. In self-compacting concrete, high measures of fine powder materials for instance, fly slag, silica smoke, or limestone have been normally used to detachment and depleting[5].The quality typical for lime mortar with the development of natural admixtures like kadukkai and jaggery water for application in workmanship and plastering works. The testing recommendation are made for the successful usage of jaggery water 75% is perfect with no change since there is no decline in target mean strength [6]. A Strategy that has the aqueous concentrate of okra called here as bio-admixture was depicted and strove for use as a possible substance admixture in the creation of cement mortar and concrete. A couple and hardened states properties of cement mortars and concrete with and without the closeness of bio-admixture. Compressive strength of bio-admixture containing mortar are higher than that of the reference models at the investigated soothing period[7].The workability, compressive strenght and disillusionment strategy for a class of lightweight EPS concrete, organized by controlling a particular water-fastener proportion and fly fiery debris substitution[8]. Use natural gum aloe Vera, a plant-induced sap utiized as an admixture in the casting of concrete alongside the jute fiber to improve its quality properties. The properties of concrete, for instance, strength, setting time can be changed by including any additional substances, compound admixtures, polymer [9].

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M.DIREKA, PG Scholor,Dept.Civil Engineering,PSNA College of Engineering and Technology,Dindigul, T.N, India.

R.YUVANESH KUMAR, Asst.Professor,Dept.Civil Engineering,PSNA College of Engineering and Technology,Dindigul, T.N, India.

K .VINOBALAJI, Asst.Professor,Dept.Civil Engineering,PSNA College of Engineering and Technology,Dindigul, T.N, India.

EXPERIMENTAL

Materials and methods

cement is a fine, powder. It is mixed with water and materials, for instance, sand, rock, and crushed stone to make concrete. The cement and water outline a paste that integrates interchange materials.

Table 1 Composition limits of Portland cement

Ingredient	Percent, content
CaO (Lime)	60-67
SiO2 (Silica)	17-25
Al2O3(Alumina)	3-8
Fe2O3 (Iron Oxide)	0.5-0.6
MgO(Magnesia)	0.1-0.4
Alkalies	0.4-1.3
Sulphur	1.3

The ordinary cement contains two fundamental fixings to be specific argillaceous and calcareous. In argillaceous materials, dirtprevails and in calcareous materials calcium carbonate predominates. The Basic sythesis of cement is given in Table 1

In the present work, 53 grade was used for throwing cubes,slab, and cylinders for cement mortar. The cement was uniform shading for instance dim with a light greenish Shade and was free from any hard bumps. Concrete is a material that has firm and paste properties with in seeing water. Such sorts of bond are called water driven concrete. These include on a very basic level of silicates and aluminates of lime got from limestone. There are unmistakable sorts of concrete, out of that I have used OPC. OPC is the basic Portland concrete and is most suitable for use when all is said in done solid advancement. One of the basic points of interest is the faster rate of improvement of strength.

To direct the properties of cement, tests for specific gravity, standard consistency and setting time were finished. Results are given in Table 2.

Table 2 Ordinary Portland cement Properties

Test	Results
Specific gravity	3.19
Consistency	31%
Initial setting time	30 minutes
Final setting time	4.25 hours

Fine aggregate generally involve regular sand or squashed stone with most particles going through a 9.5 mm sieve. generally include regular sand or squashed stone with most particles going through a 3/8-inch strainer. Fine aggregate is sand which has been washed and sieved to empty particles greater than 5 m. The organization of sand differs, contingent upon the neighborhood shake sources and conditions, anyway the most notable constituent of sand in inland territory settings and non-tropical coastline settings is silica (silicon dioxide, or SiO2), when in doubt as quartz. The second most customary sort of sand is calcium carbonate, for example, aragonite, which has generally been made, over the past half billion years, by various kinds of life, like coral and shellfish. For example, it is the basic kinds of sand clear in districts where reefs have told the natural network for a long time like the Caribbean. The properties of fine totals are appeared Table 3

Table 3 fine aggregateProperties

Test	Results
Specific gravity	2.3
Fineness modulus	3.75
Bulk density	1469 kg/m^3

Mortar blend proportion of 1:3 with w/c 0.45 was utilized for the examination. The resins are taken from the drumstick tree and ranawara tree the mortar isblended in the proportion 1:3. Admixtures are utilized by blending with the refined water. The proportions are expanding from the base rate.Various mix proportions are given in Table 4.

Table 4 Various mix proportion

Sl.No	Systems		Mix Proportions	
1	C	C	OPC	OPC
2	M3	A3	OPC+3% DT resin powder	OPC+3% RT resin powder
3	M3.5	A3.5	OPC+3.5% DT resin powder	OPC+3.5% RT resin powder
4	M4	A4	OPC+4% DT resin powder	OPC+4% RT resin powder
5	M4.5	A4.5	OPC+4.5% DT resin poweder	OPC+4.5% RT resin powder
6	M5	A5	OPC+5% DT resin powder	OPC+5%RT resin powder

DT-Drumstick tree resin, RT- Ranawara tree resin

TESTS CARRIED OUT

Compressive test

Thetest were according to ASTM C109-16a. Mortar (1:3) cubes of size 70.6 mm × 70.6 mm × 70.6 mm were cast with various blend extents containing DT and RT. The cast specimens were demoulded and submerged 24 hours in water for relieving. The UTM having 50 tones limit, the cubes were tested for 28days of curing.

f_{ck} (N/mm^2) = load (N)/Area (mm^2)

Split tensile test

The split tensile test were to be tested according to ASTM C496-90.Mortar cylinders of size 150 mm diameter and 300 mm height were cast utilizing different types of the blend containing OPC with DT and RT. Among casting, themoulds were compacted utilizing vibrating table. The cast specimens were demoulded after 24 hours and reestablished in water for 28 days. After the curing period were over the specimens were tested with universal testing machine (UTM) of 50 tones limit.

Split Tensile strength test was calculated using the formula:

$F = 2P/\pi dl (N/mm^2)$

where P = failure load (N);

d = diameter of the specimen (mm)

and l = length of the specimen (mm).

Flexural strength

The flexural test was excuted according to ASTM C348-14. Mortar prism of size 500 mm × 100mm × 100 mm size were cast with the distinctive mixture containing OPC, DT and, RT. The castedspecimens were kept in water for relieving after 24 hours. After the predefined restoring period, the specimens were open to flexural test by applying two pointload in a universal testing machine of 40 tones limit.

Sorptivity, water absoption and permeable voids test results

The procedure defined in ASTM C 642-97 were embraced for this test. Cube specimens of size 70.6 mm × 70.6 mm×70.6 mm was used for this examination.The % of total voids and the coefficient of water absorption were resolute by adopting the following procedure.

% of total voids = $[(h_1 - h_2)/h_2] \times 100$

Where,

$h_1 = A/(B-C)$.

A= Air dried weight of the sample

B = Weight of the sample after 5hours, heated.

C = Submerged weightof specimen in water.

h_2 = specific gravity of the specimens.

The water absorptioncoefficient is measured by the rate of uptake of water or capillary of water by waterless mortar for a period of 60 min and is computed as follows:

Co-efficient of Water absorption $Ka = [Q/A]^2 \times 1/t$

where Q is the quantity of water absorbed by the oven dry specimen in time 't'; A is the surface area in total of mortar specimen through which water penetrates and 't' is 60 min.

Sorptivity is a proportion of the limit of the medium to absorb before desorb fluid through capillary activity. Cube specimens of size 70.6 mm × 70.6 mm ×70.6 mm were cast with the various different of the blend containing DT and RT. Determination of the sorptivity of mortar specimens in the laboratory was a simple technique which wants a stopwatch, a scale and a shallow pan containing water. The initial mass of the sample was taken, and at time 0, the specimen was kept partially immersed to a depth of 5 mm in water. At selected times, the specimens were disqualified from the water and overbundance water was blotted off with a paper towel and the specimen was weighted. It was then displaced in the water and the stopwatch was started again. The yield in mass per unit area over the density of water is plotted versus the square root of the passed time. The slope of the line consuming the finest fit of these points is defined as the sorptivity. The sorptivity was determined by the following formula:

$I = S\,t^{1/2}$ where, I is the increasing water absorption per unit area of inflow surface (m); S is the sorptivity ($m/s^{1/2}$); T is the time elapsed (s).

Chloride test

The chloride test was performedaccording ASTM C1218. Mortar (1:3) cubes of size 70.6 mm × 70.6 mm × 70.6 mm were cast with various blend extents containing DT and RT. After 24 hours the cast specimens were demoulded and immersed in water for restoring. The cubes are tested in the A solution of hydrochloric acid (HCl) was set up in which 5% by weight of sodium chloride was mixed with ordinary potable water. The cubes which were cured for 28 days were then restored in this solution. The cubes were then taken out from this solution after 28 days and were surface dried. The surface of the cubes was cleaned scrubbed and then final surface dry weights.

RESULTS AND DISCUSSION

A Compressive strength

Table 5 Compressive strength of various mortars.

System	DT N/mm^2	% increase in strength	System	RT N/mm^2	% increase in strength
Control	20.06	-	Control	20.06	-
M3	26	29	A3	21	4.6
M3.5	24	19	A3.5	24	19
M4	22	9.6	A4	26	29
M4.5	21	4.6	A4.5	28	39
M5	25	24	A5	23.86	18

B Split tensile strength

Table 6 Split tensile strength of various mortars.

System	DT N/mm^2	% increase in strength	System	RT N/mm^2	% increase in strength
Control	2	-	Control	2	-
M3	2.1	5	A3	2.9	45
M3.5	2.6	30	A3.5	2.2	10
M4	2.5	25	A4	2.35	17
M4.5	2.2	10	A4.5	2.7	35
M5	2.8	40	A5	2.7	35

C. Flexural strength

Table 7 Flexural strength of various mortars.

System	DT N/mm^2	% of increasing strength	System	RT N/mm^2	% of increasing strength
Control	2.7	-	Control	2.7	-
M3	2.9	7.4	A3	3	11.1
M3.5	3.5	29.6	A3.5	4	48.14
M4	3.77	39.6	A4	3.25	20.37
M4.5	3.65	35.18	A4.5	5.23	93.70
M5	5	85.18	A5	4.23	56.66

D. Total voids and Water absorption of various mortars.

Table 8 Total voids and Water absorption

System	% Total voids in DT	water absorption of coefficient	System	% Total voids in RT	water absorption of coefficient
Control	8.55	2.0826×10^{-4}	Control	9.55	3.0826×10^{-4}
M3	8.10	1.1872×10^{-4}	A3	7.24	6.4321×10^{-5}
M3.5	7.34	6.4890×10^{-5}	A3.5	6.52	6.2547×10^{-5}
M4	5.83	4.2425×10^{-5}	A4	9.25	1.3524×10^{-4}
M4.5	6.17	6.2453×10^{-5}	A4.5	5.52	4.2354×10^{-5}
M5	7.12	6.3024×10^{-5}	A5	5.12	4.0123×10^{-5}

E. Chloride test

Table 9 chloride of various mortars.

System	Dry wt	Final wt	% of lose of wt	System	Dry wt	Final wt	% of lose of wt
Control	0.778	0.769	1.15	Control	0.778	0.769	1.15
M3	0.77	0.76	1.29	A3	0.794	0.782	1.51
M3.5	0.79	0.785	0.63	A3.5	0.801	0.794	0.87
M4	0.779	0.770	1.16	A4	0.748	0.740	1.06
M4.5	0.782	0.771	0.74	A4.5	0.792	0.788	0.51
M5	0.772	0.762	1.29	A5	0.80	0.792	1

CONCULSION

i. In all age of mortar, the strength of mortar is more for M5 and A3 mix of mortar when compare to various proportions and control mix.
ii. The compressive strength of M5mix mortar and A3mix mortar is 29% and 39% not lesser than the conventional curing mortar at 28 days.
iii. The tensile strength of M5 mix mortarand A3 mix mortar is 40% and 45% not lesser than the conventional curing mortar at 28 days.
iv. The Flexural strength of M5 mix mortar and A3 mix mortar is 85% and 93% not lesser than the conventional curing mortar at 28 days.
v. Thus, in all age of cement mortar, the strength of mortar is more when drumstick resin 5% of water and ranwara resin4.5% of water is used.

REFERENCES

1. Prinya Chindaprasirt and Sumererng Rukzon (2008), 'Effect of Carbon dioxide Penetration and Chloride ion diffusion coefficient of blended Portland cement mortar', Journal of Construction and Building Materials.
2. Jeffrey M. Davis, Kenneth A. Snyder, Dale P. Bentz (2011), 'Using Viscosity Modifiers to Reduce Effective Diffusivity in Mortars', ASCE Journal of Materials in Civil Engineering.
3. Rose Mbugua, Ramadhan Salim and Julius Ndambuki(2016), ' Effect of Gum Arabic Karroo as a Water-Reducing Admixture in cement mortar', Case studies in construction materials.
4. Benjamin E. Watts, C.C. Ferraro(2016), ' Prediction of Setting for Admixture Modified Mortars using the VCCTL', Journal of Cement and concrete composite.
5. M. Palacios, R.J. Flatt (2016), 'Working mechanism of viscosity-modifying admixtures', Journal of Science and Technology of Concrete Admixtures,pp.415-43
6. P. Vijay Prabhu, S. Arther Prabhakar, R. Iyappanand M. Murugan (2016), 'Experimental Study on Mortar using Natural Admixtures', International Journal of Scientific & Engineering Research.
7. Amrita Hazarika, Indranuj Hazarika, Mumee Gogoi, Shilpi Shaya Bora(2017),'Use of a plant based polymeric material as a low cost chemical admixture in mortar and concrete preparations', Journals of Building Engineering.
8. Chao Li, Linchang Miao, Quan You, Shengkun Hu, Huanglei Fang (2016), 'Effects of viscosity modifying admixture (VMA) on workability and compressive strength of structural EPS concrete', Journal of Construction and Building Materials.
9. B.Muhu Malini (2018), 'Experimental study on the strength Properties of Natural Resin Concrete Using Jute Fibre', International Journal of Innovative Research in Science, Engineering and Technology.