

EXPERIMENTAL STUDY ON MORTAR USING NATURAL ADMIXTURES

P. Vijay Prabhu¹, S. Arther Prabhakar¹, R. Iyappan² and M. Murugan³

¹Undergraduate Students, Civil Department, V V College Of Engineering, Tamil Nadu, India.

²Assistant Professor, Civil Department, V V College Of Engineering, Tamil Nadu, India.

³Associate Professor, Civil Department, V V College Of Engineering, Tamil Nadu, India.

Abstract: Cement forms an integral part of the modern construction industry for past 100 years. Though cement mortar offers early strength, faster construction, it has number of disadvantages such as it is too strong for most of the building, the environmental impacts during its manufacture, energy consumption during manufacture. Lime is arguably the world first true green and versatile building material. With the introduction of Portland cement during the nineteenth century the use of lime mortar in new constructions gradually declined, largely due to Portland's ease of use, quick setting and compressive strength. Lime possesses greater qualities such as stickiness, ease of applications, breathability moisture resistance, natural antiseptic, self-healing, durability, low thermal conductivity, incombustible, solar production, harmonious balance. The traditional lime binder offers greater durability but less strong compared to cement. Now-a-days various chemicals are used as admixture to improve the strength and performance of concrete. The cement and chemicals used in modern construction causes environmental pollution and its effect is significant. But a variety of plants and animal products used in traditional lime mortar not only improves the strength but also proves its durability for centuries. It also helps to retrieve the traditional concept of additional of admixture to concrete. By shifting ourselves to use such eco-friendly (natural) admixtures in mortar will lead the construction industry towards sustainable development.

Keywords: Lime Mortar, Natural Admixtures, Kadukka, Jaggery water, Durability.

1. INTRODUCTION

Lime is arguably the world first true green and versatile building material. The traditional lime binder offers greater durability but less strong compared to cement. The objective of the study is to improve the strength parameters of lime. Compared to modern structures, traditional structures in India can be adopted by the people of all generation since the fundamental nature of construction is always flexible and in tune with the rhythmic forms to suit the taste of every generation. Indian traditional structures built with mortar which is more than 4,000 years old like Mohenjo-Daro are still a heritage monument of Indian civilization.

This traditional concept will definitely provide inputs to supplement modern construction methods and this will pave a flexible way by extracting the essence from ancient texts and interpret it to suit modern constructions. In recent past, attempts are being made to enhance the strength parameters by addition of chemical admixtures in cement concrete, though it is performing well in all mechanical characteristics. But the long term durability of cement has not been ascertained since cement came into existence in the past century. Lime allows the building to "breathe". Water can escape by evaporation, unlike cement where the only way the water can escape is by being adsorbed into the bricks. Lime is soft and flexible. It allows the building to move without cracking and letting water in and thus self-healing. Lime is biodegradable and recyclable.

The aim for this ongoing project is to study the strength characteristic of lime mortar with the addition of natural admixtures like kadukka and jaggery water for application in plastering and masonry works. The scope of this project is to determine and compare the strength of mortar by using different percentage of natural admixtures like kadukka and jaggery water

2. MATERIALS

The materials used for making lime and cement mortar are Lime, Cement, Jaggery water and Kadukka. Lime has the capacity to stabilize clayey soils through pozzolanic reaction. This reaction produces stable calcium silicate hydrates and calcium aluminate hydrates as the calcium from the lime reacts with the aluminates and silicates solubilized from the clay.

Kadukka is a naturally available herbal material which was used as an additive for making delicious food. From the studies carried out on Kadukka it has been observed that Kadukka has powerful binding property and desirable hardening properties for making construction material and concrete. Kadukka was extracted from Kadukka tree as a naturally available fruit and then it was dried in sunlight. The dried Kadukka was made in powder form for effective mixing with binders like cement, lime etc.

Jaggery water is extracted from palm tree and it has a very good medicinal properties and a good drinks in the summer season and it has very good bonding

characteristics. The famous sweet called “Karuppatti” was prepared from this Jaggery water. It has good binding property for making mortar and concrete mixing. In the older days the palaces of kings are constructed by using this jaggery water as a natural admixture and the buildings which are built by using jaggery water is extremely good for making the structures as thermally insulated. The properties of lime is given in Table 1.

TABLE 1. Properties of lime

Chemical Name	Calcium magnesium hydroxide, calcium carbonate, and anhydrous aluminium silicate.
Chemical Family	Alkaline earth hydroxides and carbonates and calcined kaolin.
Chemical Formula	CaMg(OH) ₄ , CaCO ₃ , Al ₂ O ₃ .2SiO ₂ .
Molecular Weight	CaMg(OH) ₄ = 132.41, CaCO ₃ = 222.13, Al ₂ O ₃ .2SiO ₂ = 100.09.
Trade Name	Bended hydraulic name, artificial hydraulic lime, synthetic hydraulic lime.
Material Use	Masonry mortar, plaster, whitewash.
Specific gravity	1.2 -3.2.

2.1. Aggregates

Fine aggregate of river sand from a local supplier were used for the present study and their properties are given in Table 2.

TABLE 2. Properties of Aggregates

Property	Fine Aggregate
Specific gravity	2.60
Fineness modulus	3.27
Bulk density	1254m ³

2.2. Jaggery water and Kadukka Powder

Kadukka is a naturally available herbal material which was used as an additive for making delicious food. From the studies carried out on Kadukka it has been observed that Kadukka has powerful binding property and desirable hardening properties for making construction material and concrete. Kadukka was extracted from Kadukka tree as a naturally available fruit and then it was dried in sunlight. The dried Kadukka was made in powder form for effective mixing with binders like cement, lime etc. Most of the monumental structures in olden days are constructed by using this naturally available material Kadukka as admixture and proved the strength gain and the increase durability properties of structures. Jaggery water is extracted from palm tree and it has a very good medicinal properties and a good drinks in the summer season and it has very good bonding characteristics. The famous sweet called “Karuppatti” was prepared from this Jaggery water. It has good binding property for making mortar and concrete

mixing. In the older days the palaces of kings are constructed by using this jaggery water as a natural admixture and the buildings which are built by using jaggery water is extremely good for making the structures as thermally insulated.

3. METHODOLOGY

The mix proportion adopted is 1:3 (lime:sand) and the water cement ratio is 0.50. Various mix proportions are arrived by varying the proportion of jaggery and kadukkai separately and also with the uses of both. The jaggery proportions are varied from 0%, 25%, 50%, 75% and 100%. The kadukkai proportions are 0% and 10%. Then the compressive strength of different proportions of cubes are compared with the compressive strength of the cube with both the admixtures.

4. RESULTS AND DISCUSSION

The cubes were tested in the compressive testing machine to determine their compressive strength at the age of 14 and 28 days from the day of casting. The compressive strength of mortar is given in terms of the Characteristic Compressive Strength of 50cm size cubes tested after 28 days of curing. The cubes are tested as per the guidelines given in IS 516 – 1979. The tests are done on an electro hydraulically operated compression testing machine.

The specimen is placed in the bearing surface of the compression testing machine and compressive load is applied on opposite faces axially, slowly at the rate of 14MPa/minute, and the result of the tested specimens are shown. From the table 3 & 4, we can observe the average strength of mortar for various percentage combination of jaggery and Kadukka is calculated and the values are tabulated in table 3 for 14 days for lime mortar.

TABLE 3. Compressive Strength of Lime Mortar at 14 Days

Sl.No	Specimen		Load (kN)	Strength (N/mm ²)	Average strength (N/mm ²)
1	K 0%	JW 0%	8	1.65	1.63
			7	1.60	
			8	1.65	
2	K 10%	JW 25%	9	1.75	1.71
			8	1.65	
			9	1.75	
3	K 10%	JW 50%	9	1.75	1.86
			10	1.92	
			10	1.92	
4	K 10%	JW 75%	9	1.75	1.90
			10	1.92	
			11	2.05	
5	K 10%	JW1 00%	9	1.75	2.03
			11	2.05	
			12	2.30	

The strength parameter such as compressive of normal mortar in different combinations of jaggery

water is initially found out by using standard Indian codal provisions. Then the Admixture used lime and cement mortar was prepared for the same mix design ratio. The jaggery water used in this project are collected from our region. After a curing period of 14 & 28 days the specimens were tested for Compression and they are checked against the conventional mortar. The figure1 shows that there is an increase in compressive strength if the curing time increases.

TABLE 4. Compressive Strength Test Results

Mortar	Strength (N/mm ²)	NA	25% JW	50% JW	75% JW	100% JW
Lime Mortar	14 th day	1.63	1.71	1.86	1.90	2.03
	28 th day	2.50	2.60	2.90	3.00	3.10
Cement Mortar	14 th day	14.88	16.47	22.15	27.15	28.00
	28 th day	22.33	24.72	33.24	41.03	42.07

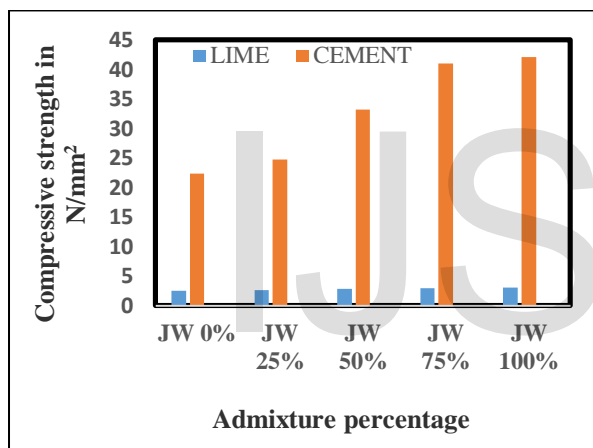


Fig.1 Variation of compressive strength at 28 days for cement and lime mortar with the addition of Kadukka and Jaggery water.

5. CONCLUSIONS

From the results obtained, various trials of 25, 50, 75 and 100 percentage of jaggery water of natural admixture with lime and cement mortar and 10% of kadukka powder are taken account in the project. In accordance with the experimental investigation the following suggestions are made for the efficient use jaggery water 75% is optimum without any modification since there is no reduction in target mean strength. Conclusions are made as per the results obtained from the experimental works and they are presented in the following subsequent pages in a neat manner.

REFERENCES

1. Abalaka A.E, "Comparative Effects of Cassava Starch and Simple Sugar in Cement Mortar and Concrete", ATBU Journal of Environmental Technology, 4, (1), 2011, pp 13-22.
2. Bazid Khan and Bulent Baradan, "The Effect of Sugar on Setting -Time of Various type of Cements", Science Vision, 8(1), 2002, pp 71-78.
3. Hasan Yildirim and Baris Altun , " Usage of Molasses in concrete as a water reducing and retarding admixture", Indian Journal of Engineering and Materials Sciences, 19, 2012, pp 421-426.
4. Mihai P and bogdan ros,ca, "characteristics of concrete with admixtures", Buletinul Institutului Politehnic Din Ias, IPublicat deUniversitatea Tehnic'a, Gheorghe Asachi" din Ias,iTomul LIV (LVIII), Fasc. 4, 2008, pp 49-53.
5. Oyekan G.L, " Effect of admixtures on the compressive strength of sandcrete blocks", 32nd conference on our world in concrete and structures, 2007, pp 28-29.
6. Oyekan G.L and O.A Oyelade, "Crushed Waste Glass as a Partial replacement of Cement in Normal Concrete Production With Sugar added as an Admixture" , Journal of Engineering and Applied Sciences , 6(6), 2011, pp 369-372.
7. Retno Susilorini M.I, Prasaja Putra Kresno Adhi S, Ardy Haryono, " Sugar Based Admixture for Promising „Green Concrete Technology“ - Improving Concrete Beam Performance with Sugar Based Admixture 0.03% of Cement Weight", Bunga Rampai "Teknologi Masa Depan dalam Perspektif Unika Soegijapranata" ISBN 978-979-1268-783.
8. Srinivasan R and K.Sathiya, "Experimental Study on Bagasse Ash in Concrete", International Journal of Service Learning in Engineering, Vol-5, (2), 2010, pp 60-66.
9. Thirumalini P, R. Ravi, S. K. Sekar2 and M. Nambirajan," Study on the performance enhancement of lime mortar used in ancient temples and monuments in India", Indian Journal of Science and Technology Vol. 4 (11), 2011, pp 1484-1487.