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STABILIZATION OF LIME AND FLY ASH MORTAR WITH THE HELP OF ADDITIVES.

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Abstract: This paper explores on the stabilization of the lime and fly ash mortar for use as a construction agent in modern construction uses with the help of different additives. Lime Mortar was a widely used material in traditional old structures. After the introduction of Portland cement in the 19th century the use of lime mortar declined a lot. But the structures made from these lime mortars have lasted for centuries. The objective of this study is to determine a way to feasibly incorporate the lime and fly ash mortar into modern construction standards by reducing the flaws of this mortar mix by using the help of additives. The end result mortar obtained should be sufficiently strong and usable in modern building and structures.

I INTRODUCTION

Lime mortar is composed of lime and an aggregate such as sand, mixed with water. The Ancient Egyptians were the first to use lime mortars. About 6,000 years ago, they used lime to plaster the pyramids at Giza. In addition, the Egyptians also incorporated various limes into their religious temples as well as their homes. Indian traditional structures built with lime mortar, which are more than 4,000 years old like Mohenjo-Daro is still a heritage monument of Indus valley civilization in Pakistan. It is one of the oldest known types of mortar also used in ancient Rome and Greece, when it largely replaced the clay and gypsum mortars common to ancient Egyptian construction.

With the introduction of Portland cement during the 19th century, the use of lime mortar in new constructions gradually declined. This was largely due to the ease of use of Portland cement, its quick setting, and high compressive strength. However, the soft and porous properties of lime mortar provide certain advantages when working with softer building materials such as natural stone and terracotta.

For this reason, while Portland cement continues to be commonly used in new constructions of brick and concrete construction, in the repair and restoration of brick and stone-built structures originally built using lime mortar, the use of Portland cement is not recommended.

Despite its enduring utility over many centuries, lime mortar's effectiveness as a building material has not been well understood; time-honored practices were based on tradition, folklore and trade knowledge, vindicated by the vast number of old buildings that remain standing. Only during the last few decades has empirical testing provided a scientific understanding of its remarkable durability.

II LITERATURE REVIEW AND ELUCIDATION

Sr. No.	Paper's Name	Name of Journal	Publication Year	Authors Name
1	Strength Behaviour of Mortar Using Fly Ash as Partial Replacement of Cement	Concrete Research Letters	2010	Md. Moinul Islam, Md. Saiful Islam
2	Experimental Study on Lime Mortar using Fly ash and Gallnut as Additives	International Journal of Engineering Research & Technology	2016	B. Dhilipkumar, M. Dhivakar Karthick
3	Compressive and flexural strength of non-hydraulic lime mortar with pfa pozzolan	International journal of science, environment and technology	2020	Ash Ahmed, Laila Mahmood, Faisal Rafiq, Colin Yates, Lee Yates
4	Compressive Strength of Cement & Fly Ash Mortar: - A Case Study	Sustainable Infrastructure Development & Management (SIDM)	2019	K. V. Madurwar, A. N. Burile, Arti M. Sorte
5	The Use of Fly Ash and Lime Sludge as Partial Replacement of Cement in Mortar	International Journal of Engineering and Technology Innovation	2014	Vaishali Sahu, V. Gayathri
6	Optimization of Lime-Fly Ash Mix	International Journal of Engineering Research & Technology	2016	Naktode P. L, Dr Choudhary S. R., Dr Waghe U. P

III APPROACHES

- In (1), An investigation was conducted on different fly ash mortars made with various level of cement replacement and cured for various curing period up to 90 days. From this investigation it was found out that the rate of gain in strength of fly ash mortar specimens is observed to be lower than the corresponding OPC mortar. Fly ash mortar provides satisfactory or higher strength as compared with OPC mortar. Fly ash mortar mix having various cement replacement level up to 50% exhibited satisfactory results for both compressive and tensile strength. The optimum fly ash content is observed to be 40% of cement. Fly ash mortars with 40% cement replacement shows around 14% higher compressive strength than OPC mortar after 90 days curing. The corresponding increase in tensile strength is reported to be around 8%. Use of high-volume fly ash in any construction work as a replacement of cement, provides lower impact on environment (reduce CO2 emission) and judicious use of resources (energy conservation, use of by-product). Use of fly ash reduces the amount of cement content as well as heat of hydration in a mortar mix. Thus, the construction work with fly ash concrete becomes environmentally safe and also economical

- In (2), This paper explains the use of lime as a construction agent when mixed with fly ash and gallnut as an additive. According to environmental impacts and high cost of cement in modern times there is a clear requirement of an alternate protective binder such as lime mixed with fly ash. The Composition of fly ash and Lime Mortar (Lime: Pozzolana: Sand) with its ratio 1:1:2 as per IS:4098-1983 can be used for construction. For the better improvement with regarding of workability and tensile strength, the extracts of kadukkai (Gallnut) and palms jaggery in the proportion of 5%,10% and 15% of the weight of Binder can be used. The addition of above element in the binder improves its workability and increase tensile strength as well as compressive strength about 55% compared to nominal lime mortar. These admixtures modify the fresh and hardened property of the lime mortar. This mortar can be used for repairing and restoration of historical or ancient monument. In buildings it satisfies eco-friendly structures and sustainable development criteria.

- In (3), From this research paper it was found that lime-based mortars have 30% lower embodied CO2 in comparison to cement mortars, they also offer greater flexibility and improved damp resistance. As the cement industry emits up to 10% of the global CO2 emissions which is three times greater than the aviation sector, there are serious environmental implications regarding the use of cement-based products. The main drawback with lime-based mortars is the slow setting time, however, this can be overcome by adding PFA pozzolan. Non-hydraulic lime (putty) mortar with as little as 2.5% PFA addition (by weight) significantly accelerates the setting time with strengths comparable to cement mortars. The strengths achieved for all lime putty mortars with PFA are in accordance with the minimum strength specified for designations of cement mortars from the IS Code 2250-1981. Non-hydraulic lime mortars with PFA offer a more sustainable alternative to cement based mortars with lower embodied CO2.

- In (4), In this research paper, the specimen for each cast with different percentage of Fly Ash with gradual increase of fine fly ash 0%, 5%, 10%, 15% and 20% for replacing with cement by weight. Three specimens, preferably from different batches, are made for testing at each selected age. The testing for compressive strength carried out for 7, 14 and 28 days of age. From the results obtained from the test it is clear that the M15 mix and further addition up to M20 mix i.e., replacement of cement shows nearly same result than other replacement of mixture. It is also observed that strength gain by the replacement of fly ash is lower than the plane mortar. i.e., fineness of fly ash with replacement of cement in mortar gives better workability but the strength is decreases as the percentage of fly ash increases. Used of Fly ash helps in reducing the environmental air pollution during the disposal of excess Fly ash. Due to low specific gravity of fly ash which leads to reduction in density, hence including it with some percent of components of concrete i.e., Cement, Sand and Aggregate reduces the lifeless load on the structure. Cement is expensive material, so the partial replacements of these materials by way of fly ash reduce the value of concrete. Based on the results introduced above, Compressive strength will increase with the reduction in the proportion of Fly ash but workability increase combines proportions and fineness also affect the strength of mortar.

- In (5), This study helped us to understand that the Beneficial utilization of fly ash and lime sludge in mortar mix presents an opportunity to achieve sustainable utilization of natural and/or conventional resources. Fly ash and lime sludge can be gainfully exploited as building materials in construction. Continue refinement of optimum content, long term strength, durability studies, and leachate analysis of the composite could provide a way to effectively utilize these waste materials as an economic and sustainable development strategy. The large amount of silica and alumina available in fly ash and rich content of calcium oxide in lime sludge, make them compatible with each other and can replace cement also. The addition of gypsum showed positive effect on strength due to accelerated pozzolanic reaction. For type I mortar, the highest strength of 6 N/mm2 was observed for 1% gypsum after 28 days curing period. The strength was increased continuously with curing period

- In (6), From this study it was observed that for optimization of the smix, fly ash proportion was varied from 0.75, 1.00, 1.25 and 1.50 and sand proportion was varied from 2.0, 2.5 and 3.0. Lime proportion was taken constant at 1.0. Thus, following combinations of mix proportions of Lime: Fly Ash: Sand were decided as: - (1:1.5:2), (1:1.5:2.5), (1:1.5:3), (1:1.25:2), (1:1.25:2.5), (1:1.25:3), (1:1:2), (1:1:2.5), (1:1:3), (1:0.75:2), (1:0.75:2.5), (1:0.75:3). The combinations are chosen with a view to get optimum proportion of Lime and Fly Ash, as a full replacement of cement in mortar. Water required based on consistency test was worked out. The samples were casted for all above combinations and tested at 7 and 28 days of age. Procedure as detailed in IS 2250-1981, IS 4098 – 1983 was followed while casting the cubes. Various specimens were tested for different mix proportions is presented. It was found that the mixture of 1:1:3 (Fly Ash: Lime: Sand) would be the best for the mortar mix and it would give the required compressive strength to the mix. 1:1:3 gives a compressive strength of 1.036 at 7 days and 1.571 at 28 days.

IV CONCLUSION

After Studying all the previous papers, it is observed that lime has some very useful properties which can be very beneficial to modern structures but it is not useable on its own, hence the addition of fly ash is necessary for it to be useful as a replacement for modern Cement Mortar Mixes. Lime is a workable material, prevents water penetration and has good water retention properties but it lacks strength, Hence, we also studied the different properties of fly ash and found some examples of how to properly mix these two components together. The papers studied provided us with the different properties which make lime such a versatile material and how to make the best use of these properties while trying to minimize its disadvantages such as poor durability, low compression strength and inconsistent hardening rate. The addition of fly ash should be able to counteract these flaws and it should also be able to provide a considerable increase to the early strength of the Mortar making the mortar mix much safer and desirable to use. Henceforth high fineness and low carbon fly ash will be used to increase to early strength.

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