IMPROVING THE STRENGTH OF CONCRETE BY CURING IN WATER/LIME SOLUTION

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Abstract *Concrete is the single most extensively used man made material in the world. It has been used for construction of buildings, bridges, dams, systems, etc. One of the most important properties of concrete its compressive strength. It is a major indicator of its quality. Curing is one process that facilitates the maximization of its potential strength. Lime has from previous observation and experiments improved the compressive strength of concrete over the years. Curing ensures that concrete experiences continued hydration, leading to its continued strength gain. Curing is also a process by which moisture loss is prevented at a particular temperature to enhance the hydration process of cement. The curing process not only increases the strength of the concrete and durability but also decreases the porosity of the concrete.*

There are various methods of curing concrete after casting. The most common method is curing by immersing in a water curing tank. This study involved the curing of concrete cubes in water/lime solution of water/lime as in the proportions 100%:0%, 80%:20%, 60%:40% and 40%:60%. Cubeswere cast at water/cement ratio of 0.5. The concrete cubes were tested after 7, 14, and 28 days respectively to determine their compressive strength. . The concrete cylinders were tested after 7and 28 days respectively to determine their compressive strength.

Key words: concrete, strength, water lime solution, compressive strength

1 INTRODUCTION

Concrete is a highly heterogeneous material produced by mixture of finely powdered cement, aggregates of various sizes and water with inherent physical, chemical and mechanical properties. A reaction between the cement and water yields calcium silicate hydrate, which gives concrete strength and other mechanical properties, as well as some more by-products including calcium hydroxide (CH), 'gel pores', Aft (Ettringite), Afm (Monosulfates) etc. Despite the hydrated cement and their by-product materials are available everywhere in the concrete, the reactions within the concrete during setting (fresh state) and hardening (gain strength) are difficult to control and this is an ongoing problem in the concrete industry. The American Society of Testing and Materials (ASTM) defines1 pozzolan as a siliceous or alumino-siliceous material that in itself possesses little or no cementitious value, but in finely divided form and in the presence of moisture will chemically react with alkali and alkaline earth hydroxides at ordinary temperatures to form or assist in forming compounds possessing cementitious properties.

Concrete is a widely used construction fabric for various sorts of systems due to its structural stability and strength. The everyday Portland cement (OPC) is one of the main components used for the manufacturing of concrete and has no alternative in the civil creation industry. Sadly, manufacturing of cement entails emission of big quantities of carbon dioxide gasoline into the ecosystem, a main contributor for inexperienced residence impact and the worldwide warming. Hence it's far inevitable either to search for another fabric or in part placed again it by means of some different fabric. The search for one of these cloth, which can be used as an opportunity or as a supplementary for cement ought to lead to worldwide sustainable improvement and lowest viable environmental impact.

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maximization of its potential strength. Lime has from previous observation and experiments improved the compressive strength of concrete over the years. Curing ensures that concrete experiences continued hydration, leading to its continued strength gain. Curing is also a process by which moisture loss is prevented at a particular temperature to enhance the hydration process of cement. The curing process not only increases the strength of the concrete and durability but also decreases the porosity of the concrete. To ensure that there is satisfactory development of strength during hydration process, it is necessary to prevent moisture loss. Aside accelerating the strength gain of concrete, curing also improves its durability, water-tightness, abrasion resistance and volumetric stability.

Lime water solution

Limewater is the common name for a dilute aqueous solution of calcium hydroxide. Calcium hydroxide, $Ca(OH)_2$, is sparsely soluble at room temperature in water (1.5 g/L at 25 °C[1]). "Pure" (i.e. less than or fully saturated) limewater is clear and colorless, with a slight earthy smell and an astringent/bitter taste. It is basic in nature with a pH of 12.4.

Limewater may be prepared by mixing calcium hydroxide ($Ca(OH)_2$) with water and removing excess undissolved solute (e.g. by filtration). When excess calcium hydroxide is added (or when environmental conditions are altered, e.g. when its temperature is raised sufficiently), a milky solution results due to the homogeneous suspension of excess calcium hydroxide. This liquid has been known traditionally as milk of lime.

Objectives of the study

From this study the following conclusions were made

1. To study the workability of concrete for M40 Grade of concrete
2. To determine the compressive strength of concrete by curing the cube specimens in different percentages of lime water.
3. To study the optimum value of compressive strength for 7days, 14 days and 28 days of curing.
4. To compare the test results with normal water curing method.
5. To improve the resistance under loading conditions.
6. To determine the workability of concrete in different curing conditions.

2 LITERATURE REVIEW

Ramesh Singh, Yashwanth Rahtore, et al.,(2018) This research involved the curing of concrete cubes in water/lime solution of water/lime as in the following proportions: 100%0%, 80%20%, 60%40% and 40%60%. 108 concrete cubes, with equal numbers of 36 each were cast at water/cement ratio of 0.4. 0.5and 0.6 for the 4Nos water/lime curing medium. The mix ratio used for the experiment was 1:2:4. The concrete cubes were crushed after 7, 14, and 28 days respectively to determine their compressive strength. From this study it was concluded that the optimum compressive strength was obtained at 40%60% water' lime curing solution for all water/cement ratios and for all curing ages. For water/cement ratio of 0.4, a maximum of 22% compressive strength increase obtained after 28 days at 40%60 water/lime curing solution.

S Mahesh, V Rajesh Kumar, et al.,(2017) This study is to investigate the setting time and strength properties of cementitious composite mortars blended with silica fume by the replacement of 10, 20 and 30% of cement with two types of lime water. Concurrently, cement pastes for each of the above mix proportion are prepared to study the hydration kinetics by using XRD analysis. The ordinary potable water has been completely replaced with two types of lime water for all the samples except control samples. The results of setting time experiments show that there is a considerable reduction in the initial and final setting times for both the cases of lime water and silica fume blended cement pastes compared to control sample.

Dr. Sanjiv Desai, Dr. Dinesh Kumar, et al.,(2017) Industrial byproducts can be utilized to enhance the strength and water permeability characteristics of High Performance Concrete (HPC). The utilization of these industrial by products is becoming popular

throughout the world because of the minimization of potential hazardous effects on environment. This study is planned to investigate the properties of Portland cement mixtures containing silica fume and mixed with saturated lime water. From this paper it was concluded that Using Lime Water as a mixing solution delays both initial and final setting times for Portland cement based materials as well as mixes containing SF.

3 MATERIALS AND METHODOLOGY

Cement

The raw materials required for make of Portland cementare calcareous materials, for example, limestone or chalk, and argillaceous material, for example, shale or clay. There are two procedures known as wet and dry procedures relying on whether the blending and crushing of crude materials is done in wet or dry condition.

Aggregates

Aggregates are the main constituents in concrete. They offer body to the concrete, diminish shrinkage and impact economy. Aggregates are inactive granular materials, for example, sand, rock or smashed stone that are a final result in their own crude materials. They are additionally the crude materials that are a fundamental fixing in concrete.

Aggregates are divided into two categories from the consideration of size.
i).Coarse aggregate ii) Fine aggregate

Coarse aggregates

Coarse aggregates are particles more note less that 4.75mm however for the most part run between 9.5mm to 37.5mm in measurement. They can either be from essential, auxiliary or reused sources. Essential or virgin aggregates are either land or marine-won. Rock is a coarse marine-won total, arrive won coarse aggregates incorporate rock and smashed shake. Rock constitute the dominant part of coarse aggregate utilized in concrete with pulverized stone making up the greater part of the rest of.

Fine aggregate

Fine aggregates are fundamentally sands won from the land or the marine condition. Fine aggregates by and large comprise of normal sand or smashed stone with most particles going through a 4.75mm sieve.

Water

Water is a vital element of concrete as it effectively takes an interest in the compound response with bond. Since it shapes the strengthen giving concrete gel, in the amount and nature of water is required to be investigated deliberately. C3S requires 24% of water by weight and C2S requires 21%. It has additionally been evaluated that on a normal 23% of water by weight of bond is required for substance response with Portland concrete intensifies .This 23% of water synthetically joins with bond and, consequently, it is called bound water. It has been additionally evaluated that 15% by weight of concrete is required to top off the gel-pores.

Lime

Lime is a calcium-containing inorganic mineral composed primarily of oxides, and hydroxide, usually calcium oxide and/or calcium hydroxide. It is also the name for calcium oxide which occurs as a product of coal-seam fires and in altered limestone xenoliths in volcanic ejecta. The word lime originates with its earliest use as building mortar and has the sense of sticking or adhering.

These materials are still used in large quantities as building and engineering materials (including limestone products, cement, concrete, and mortar), as chemical feedstocks, and for sugar refining, among other uses. Lime industries and the use of many of the resulting products date from prehistoric times in both the Old World and the New World. Lime is used extensively for wastewater treatment with ferrous sulfate

Mix Design of Concrete

Final trial mix for M40 grade concrete is

1:1.63:2.54 at w/c of 0.45

CEMENT	FINE AGGREGATES	COARSE AGGREGATES	WATER
438 kg/m3	717.12 kg/m3	1115 kg/m3	197 kg/m3
1	1.63	2.54	0.45

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4 EXPERIMENTAL INVESTIGATION

Casting of cubes and cylinders

Throwing of concrete shapes and barrels as improved the situation M25 and M30 review concrete, the blend extent is for which we are cubes, cylinders and prisms for ordinary cement, with the incomplete substitution.

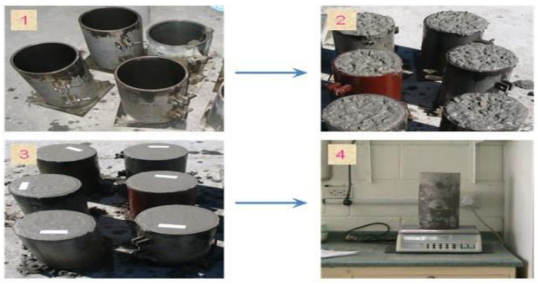
Filling the mould (for 150 mm cube 3 equal layers)

Compacting with compacting bar

150 mm molds ought to be filled in three around break even with layers (50 mm profound). A compacting bar is accommodated compacting the solid. It is a 380 mm long steel bar, weighs 1.8 kg and has a 25 mm square end for smashing. Amid the compaction of each layer with the compacting bar, the strokes ought to be disseminated in a uniform way finished the surface of the solid and each layer ought to be compacted to its full profundity.

Compacting the concrete in the cube mould (For 150 mm cube at least 35 tamps per layer)

Finishing



Cylindrical moulds

Curing

The solid samples were restored utilizing six unique procedures until when their compressive strengths were resolved at ages 7, 28 days and 56 days.

Curing of cubes and cylinders

Tests to be conducted on concrete

Tests to be conducted on fresh concrete

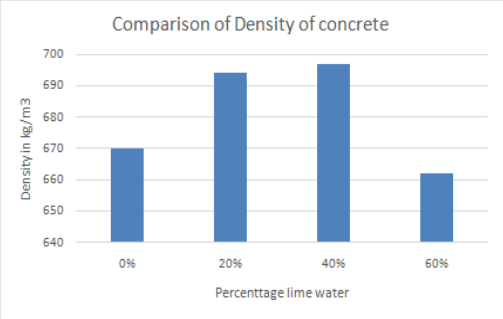
1. Slump cone test
2. Compaction factor test

Tests to be conducted on Hardened concrete

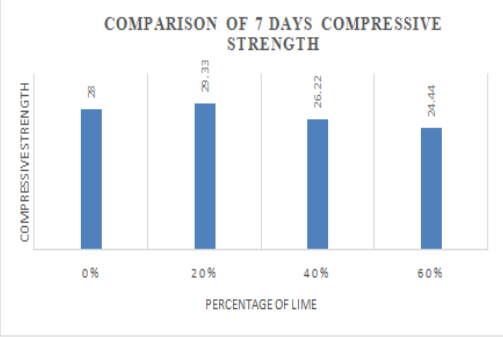
1. Compressive strength of concrete
2. Split tensile strength of concrete
3. Flexural strength of concrete
4. Durability of concrete

5 RESULTS AND ANALYSIS

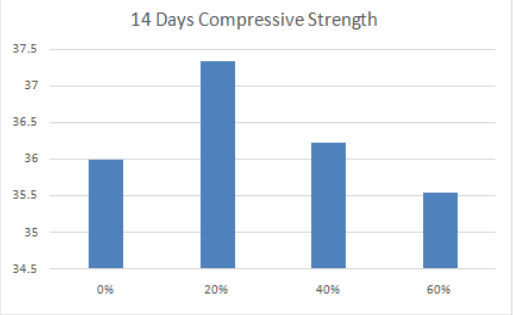
Density of concrete



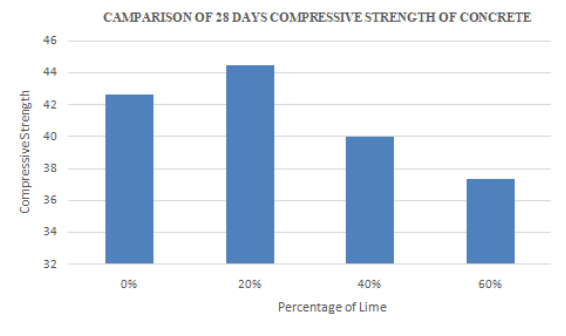
Compressive strength of concrete



Comparison of 7days compressive strength



Comparison of 14days compressive strength



Comparison of 28days compressive strength

6 CONCLUSIONS

From this study the following conclusions were made

1. The value of slump cone was obtained as 25mm and compaction factor was found as 0.92.
2. The maximum value of density of concrete cubes after curing in lime water solution is obtained at 40% lime water and minimum value is obtained at 60% lime water solution.
3. The maximum value of compressive strength was observed at 20% lime water solution for 7days, 14days and 28 days curing period.
4. The maximum value of split tensile strength was observed at 20% lime water solution for 7days, 14days and 28 days curing period.
5. The early high compressive strength gain at 7 days is due to the fact that the heat generated from the exothermic reaction between lime and water is higher at the early stage of curing.
6. The general increase in compressive strength for all water/cement ratios and for all curing ages is as a result of the exothermic reaction mentioned above.

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