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A Study on Cement Partially Replaced with Chalk Powder and Coconut Fiber Ash with the Addition of Asbestos Fiber

Mohd. Atul[1], Sourabh Lalotra[2]
[1]*PG Scholar,* [2]*Assistant Professor, Sri Sai College of Engineering and Technology, Pathankot, India*

Abstract: ***Concrete can be defined as a building material that can be composed by mixing gravel or broken stone, sand, cement, and water. The mixture can be poured into any shape, size of mould, which on hardening gives a solid stone like mass, the strength of hardened solid mass can be increased by adding admixtures. The main aim of the admixtures is to enhance the properties to some extend of the desired solid mass. In common man language concrete can be defined as mixture of paste and aggregates. The partial replacement of aggregates is need for the future generation of concrete structures for the environment supportable. The depletion of the natural resources gets exhausted. We have think over the alternate replacement of the materials. In present work the cement partially replaced by Chalk Powder, Coconut Fiber Ash with the addition of Asbestos Fibres. Optimum value of strength in compression, split tensile and flexure came at 18% replacement with 0.6% addition the strength is higher than conventional concrete. The workability of mixture increases and after that there is decrease in the workability of the concrete when we increase the percentage of Chalk Powder, Coconut Fiber Ash. A series of experiment were carried out to measure the compressive strength, split tensile strength and flexural strength of the concrete. The results showed that the compressive strength, split tensile strength and flexural strength increases with the adding of the Chalk Powder, Coconut Fiber Ash with the addition of Asbestos Fibres***

.Keywords: CP (Chalk Powder), CFA (Coconut Fiber Ash), workability, compressive strength, Split Tensile strength, Flexural strength.

I. INTRODUCTION

Concrete can be defined as a building material that can be composed by mixing gravel or broken stone, sand, cement, and water. The mixture can be poured into any shape, size of mould, which on hardening gives a solid stone like mass, the strength of hardened solid mass can be increased by adding admixtures. The main aim of the admixtures is to enhance the properties to some extend of the desired solid mass. In common man language concrete can be defined as mixture of paste and aggregates. Concrete is not only strong, it is economical and also it can be turned into any hardness mass shape, it can be poured in any shaped of desired choice to obtain hardened mass. To every advantage there is always a disadvantages too. Previously it has been noticed that the concrete can be vulnerable to disintegration, unless we take proper precautionary measures during preparing the design mix and production. To overcome this issue about the disadvantage, what best we can do is that we need to know the various effects of the components that are used in the concrete mix, so that the concrete that is made is durable and does not easily get affected in a bad way.

A. Coconut Coir Fiber Ash

The use of coconut fibers which is the most versatile in class of other natural fibers has a great significance as reinforcing material in concrete. It is easily decomposable and therefore having less influence on environmental condition and replacing them with cement is the best way to dispose of the coconut fiber. Using the natural fiber as the replacement in concrete has reduced the main factor of civil industry which is High Cost. Coconut coir fiber ash in concrete construction is an alternative of cement, coconut fiber ash has a good tendency when uses as a partial replacement for cement. According to the research by various universities, the coconuts are widely grown in all the tropical regions and contributes to the economy of many tropical areas. Coconuts are renewable, unlike other manmade fibers. Coconut fiber usually comes in two colors- brown colored fiber and white colored fiber, the brown colored fiber is obtained from the matured coconuts, while the white colored fiber is obtained from the coconuts that are immature.

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The fiber obtained from mature are usually thick, have high strength and have high scrapping opposition, whereas the white fiber obtained from immature coconuts are usually smooth, fine but are weak in nature when compared to the brown colored one. The length of both brown as well as white fiber ranges from 4-12 in (10-30 cm). Fibers whose length is approximately 20 cm are known as bristle coir fiber, and the fibers which are shorter in length and are fine are termed as mattress fibers. Coconut fiber ash is the product which is developed after the coir or fiber has been thoroughly burnt.

B. Chalk Powder

Chalk used is a fine whitish colored powder composed of calcium carbonate (CaCO3), a form of limestone and is obtained by fine grinding of limestone present at Manasbal area. It can also be obtained from sedimentary rocks and marble waste powder. The chemical formula for chalk is CaCO3, and having molecular weight equal to 100.0869 amu. Chalk is the most popular material among all. In schools, colleges chalk is used to deliver lecture on a black color board. Chalks that are used in schools and universities usually comes in the form of cylindrical sticks. These chalk sticks easily crumbles and leaves the particles that have the capability to stick loosely on the rough surface, hence permitting it to write on the rough surface which can be easily erased. These writings on the rough surface when erased give the chalk in the form of powder. In India, in almost every colleges and school teachers deliver the lesson on black board using chalk, as this method is economical as well as easy.

In agriculture, chalk is used on soil that has high acidic nature for rising the pH of that soil. The two common forms of chalk are - CaCO3 (calcium carbonate) and CaO (calcium oxide).

C. Asbestos Fibre

The word asbestos is derived from a Greek word meaning "indestructible." It is the common name for a group of fibrous silicate minerals, the most common of which are chrysotile, crocidolite and amosite. Asbestos can extinguish fires even at extremely high temperatures and is extremely flexible and durable. Crude minerals are just a piece of rock or stone. It has indeed been called the crystal of the circle and the crystal, stretching and wrinkling, but it can be carded and twisted to be woven and woven like wool, flax or silk. and it has feathers like eiderdown, it is still as thick and heavy as a rock like it. Extreme heat fails to break it down, acids affect the strength of its fibres despite their flavor; its weight of only a few ounces in a square yard. it makes it resistant to rot under any circumstances

II. LITERATURE REVIEW

(Ali 2010) in research paper entitled “Coconut Fibre- A Versatile Material and its Applications in Engineering” describes the adaptability of coconut fibre as the most flexible material and its uses in different streams of engineering, especially as a building material by not only studying the physical, mechanical and chemical of the coconut fibre but also studied the properties of composites (cement paste, mortar and/or concrete) in which coconut fibre was used as reinforcement. His main aim was to grow knowledge of coconut fibres to be used as a building material in civil engineering.

.Basker R (2012) examined the use of asbestos fibre in a reinforced beam. Reinforced concrete is an effective building material where the main use of fibres to seal cracks becomes concrete.

The main objective was to conduct a comparative study on the extent of fractures in Reinforced Cement Concrete (RCC) beams without the addition of fibres. By providing a moderate amount of volume of a fraction of the asbestos fibres, studies of the cracked behaviour of the Asbestos Fibre Reinforced Concrete (AFRC) beams are made of concrete under flexibility. Experimental research was conducted to study the performance of the RC template with asbestos fibre and to determine the maximum volume of asbestos fibre (AFRC). Test results obtained from fixed loads were used to determine parameters such as tension relationships, momentary curvature relationships and the extent of fractures on both RCC beams and AFRC beams. This paper only worked with the width of the crack. It has also been found that an increase in the volume fraction of asbestos fibres has led to a reduction in the extent of cracking..

Bouharoun, et al (2014) aimed to study the feasibility of using fibre-cement asbestos waste instead of standard Portland cement to produce mud. Fibre-cement particles were dipped in the mud to partially add cement, with replacement rates in quantities of 5 and 20%. The level of Cement hydration, efficiency, total deceleration, access slope and water-based mortar and mortar systems were measured compared to the control structures attached to the cement (free by fibrecement). The results showed that fibre-cement availability increased 5-10% of the remaining binder hydration time, compared to that of Portland cement, depending on the replacement rate shown. In addition, within 28 days, 5 and 20% fibre-cement replacement caused a 14-35% decrease in compressive strength, compared to the cement production of reference.

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This drop was greater than what was seen in the mud containing limestone filler with the same level of cement. However, the available energy was acceptable in the use of the building.

(Singh T et al 2016) in his research paper entitled "Experimental Studies on Replacement of Cement with Chalk Powder and Coconut Fiber in Conventional Concrete" aims to check whether there is a possibility of using the coconut fiber and chalk powder as partial replacement of cement in concrete and to study the strength properties. In this research study the deformation properties of concrete cubes under static loading condition and the behavior of structural components in terms of compressive strength for conventional concrete (CC), chalk powder reinforced concrete (CPRC) and coconut fiber reinforced concrete (CFRC) has been studied. For the experimental tests, 21 cubes were casted out of which 3 are CC, 3 CPRC (1%), 3 CPRC (2%), 3 CPRC (3%), 3 CFRC (1%), 3 CFRC (2%), 3 CFRC (3%). To determine the effects on workability, workability tests such slump cone test was conducted on the cubes prepared by conventional concrete, chalk powder and coconut fiber. The standard cubes for 8 CC, CPRC and CFRC were also tested under CTM (compression testing machine). Hence, concluding that there is a decrement by 4.4% in compressive strength of CP (1%) when compared to CC. There is a decrement by 2.8% in compressive strength of CP (2%) when compared to CC. There is a decrement by 8.4% in compressive strength of CP (3%) when compared to CC. There is a decrement by 2% in compressive strength of CF (1%) when compared to CC. There is an increment by 1.7% in compressive strength of CF (2%).

III. MATERIALS

A. *Cement*

In this research work the main binding material that was used was the Ordinary Portland Cement of 43 grade. The OPC-43 grade used is a sulphate resistant binder with produces average amount of heat when hydrated. The cement used in this research was purchased from a local cement store, and the cement used was Khyber Cement.



Pic. No. 1 : cement

B. *Coarse Aggregates*

The coarse aggregates used in this research The coarse aggregate is an unreactive substance which when passed through sieve gets retained on 4.75mm sieve size. Coarse aggregates are dolomite aggregates used widely in construction industry. The coarse aggregates are mainly classified on the basis of size rather than mechanical or chemical properties. Following test were performed to check the quality of the coarse aggregates used

C. *Fine Aggregates*

The best natural river sand used in this research Clean fine aggregate has been used to perform this research. Fine aggregates are mostly obtained from river called river sand or from machine called machine sand. The following test were performed on the sand, so to determine its properties as well as the quality

D. *Coconut Fiber Ash*

The Coconut Fiber Ash used in this research was purchased directly from the coconut growers from Chennai. Since, the south of India is well know from cultivation of coconuts the fiber was easy to purchase from there.

Table 1 : Properties of Coconut Fiber Ash

Properties	Values
Length/ Breadth Ratio (L/B)	95
Fineness	35
Fracture Load (kg)	0.45
Firmness	20
Flexural Rigidity (dynes/cm^2)	200
Density (g/cc)	1.40
Porosity	40 %

E. Chalk Powder

Chalk Powder used in this investigation research was obtained from village Mansbal located in Ganderbal, Jammu and Kashmir. Chalk Powder is white in color and mainly derived from line stone. The quantity of lime present in chalk is higher than other constituents. Chalk being a base can be used as an antacid, because of the huge properties it can be used in number of ways.

Table 2 : Properties of Chalk Powder

Particular	Proportion
Silicon Dioxide (SiO_2)	6.50
Aluminum Oxide (Al_2O_3)	0.11
Ferric Oxide (Fe_2O_3)	0.06
Titanium Dioxide (TiO_2)	0.01
Calcium Oxide (CaO)	86.94
Magnesium Oxide (MgO)	0.04
Sulphur Trioxide (SO_3)	1.20
Potassium Oxide (K_2O)	0.72

F. Asbestos Fibre

Asbestos is a common term referring to six types of naturally occurring mineral fibres used or commercially used. These fibres belong to two groups of minerals: serpentine and amphiboles. The serpentine group contains one type of asbestiform: chrysotile. There are five types of asbestiform amphiboles: anthophyllite asbestos, grunerite asbestos (amosite), riebeckite asbestos (crocidolite), tremolite asbestos, and actinolite asbestos. Usually, the word asbestos is used only for those types used for commercial purposes. That does not prevent the occurrence of other minerals such as asbestos, however. Asbestiform-based Magnesioriebeckite was excavated in Bolivia and an asbestiform potassium winchite was found in western Texas. In addition, richterite asbestos has been compiled into a laboratory

IV. METHODOLOGY

A. Mixing Concrete

All the ingredients of concrete are mixed together however this mix should be homogenous and uniform in color and consistency. The mixing can either be done by hand or with the use of mixer.

B. Mixing Concrete

Thorough mixing of the materials is essential to produce uniform concrete. The mixing should make sure that the mass become homogeneous, uniform in consistency and colour. There are two methods adopting for mixing concrete one is hand mixing and other is machine mixing.

C. Curing

Before removing the mould, it is dried for 24 hours, and then specimens are placed in a water tank made to cure specimens. The specimens must be marked for identification so that there must not be any error. The specimens are removed from the tank and dried before putting in the testing machine. The specimens are kept in the tank for 3,7,28 days.

D. Workability Test

It can be used in site as well as in lab. This test is not applicable for very low and very high workability concrete. It consists of a mould that is in the form of frustum having top diameter of 10cm, bottom diameter of 20cm and height of 30cm.

The concrete to be tested if fitted in the mould in four layers. The each is compacted 25 times with the help of tamping rod. After the mould is completely filled it is lifted immediately in the vertically upward direction which causes the concrete to subside.

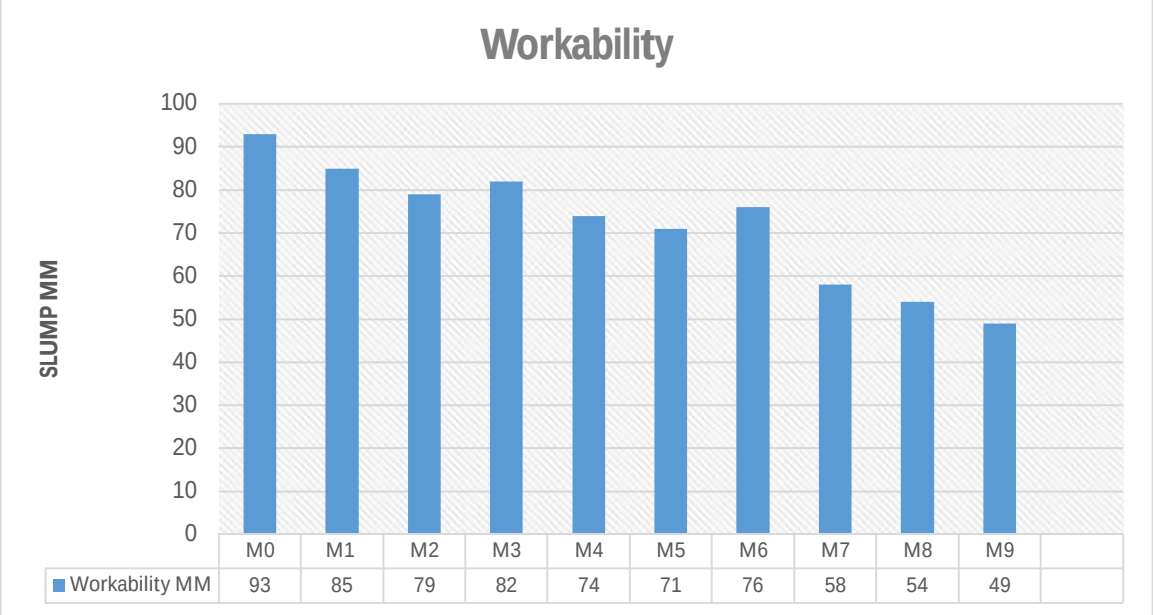


Fig -1: SLUMP CONE TEST

E. Compressive Strength Test

Then fresh concrete is filled in mould in 4 layers and after filling each layer tamping should be done 35 times in case of cube and 25 times in case of cylinder by using standard tamping rod. Once the mould is filled then leveled top surface of concrete with trowel. After the day the mould will removed and specimen are dropped in the curing tank under standard temperature of 27±2° c. After 7,14 days and 28 days in this research.

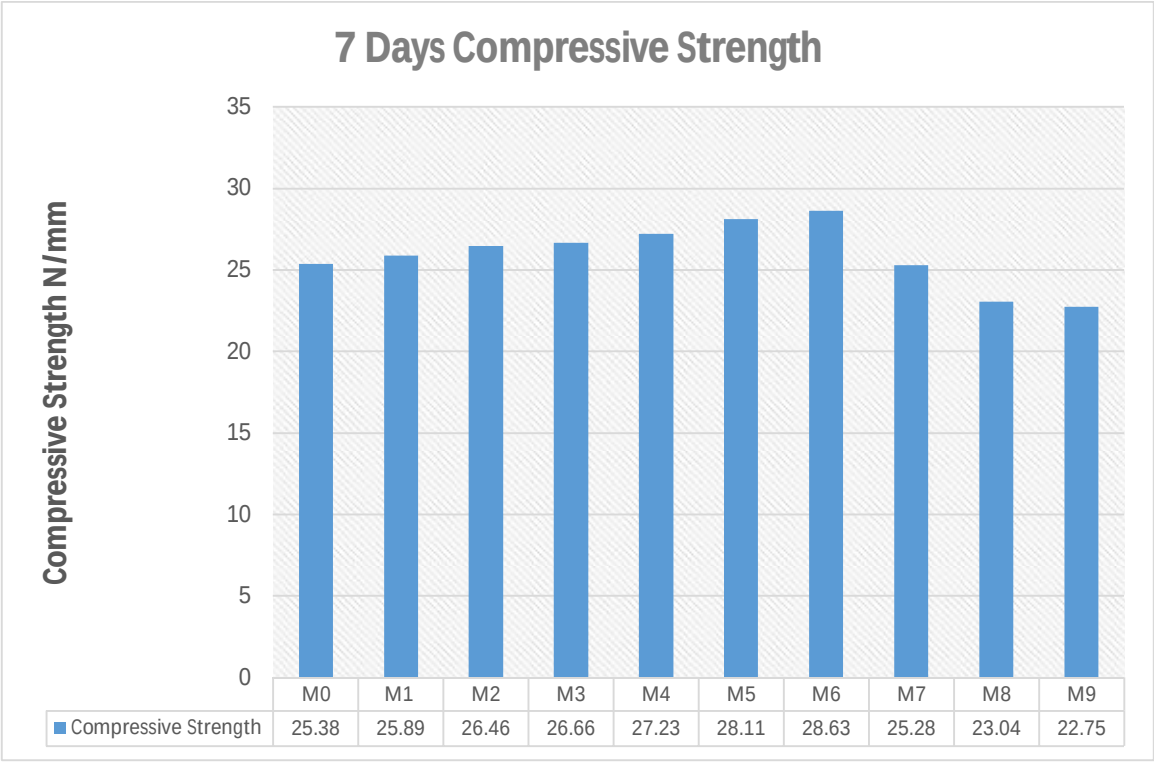


Fig -2: COMPRESSIVE STRENGTH TEST 7

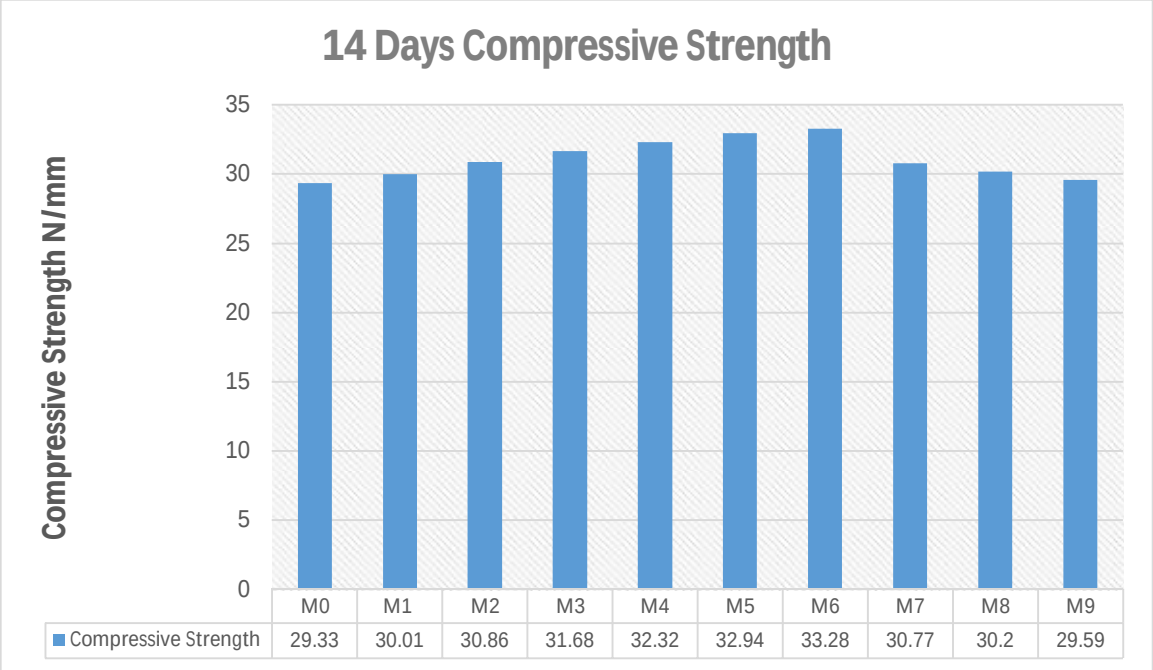


Fig -5: COMPRESSIVE STRENGTH TEST 14

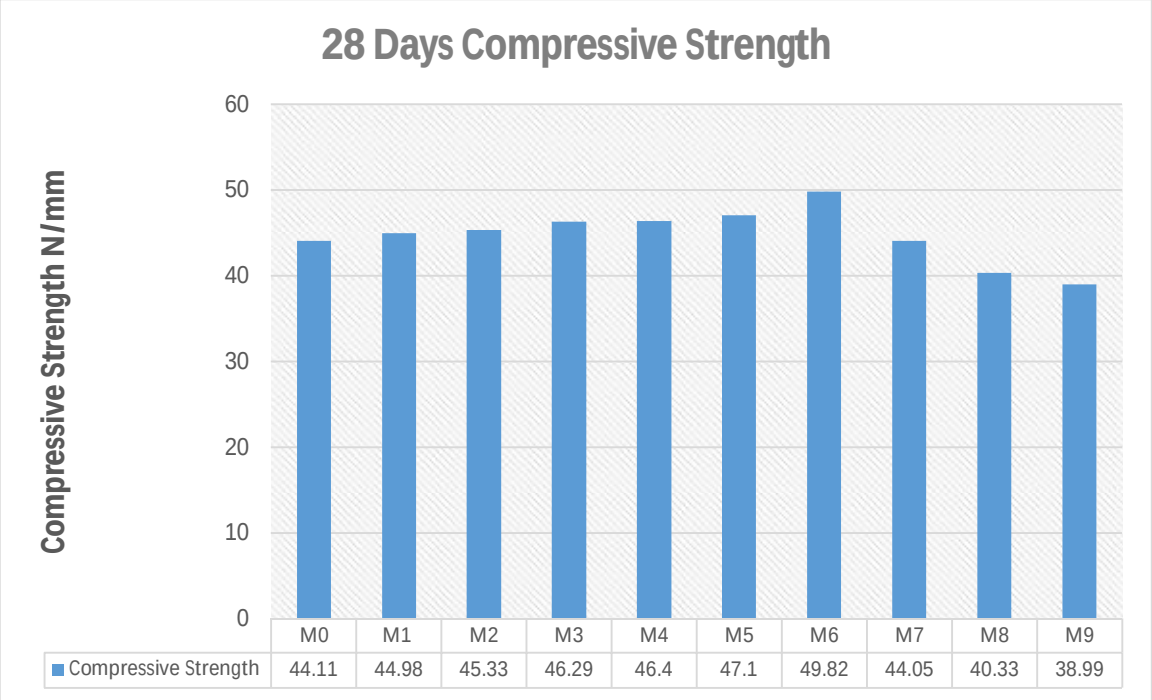


Fig -3: COMPRESSIVE STRENGTH TEST 28

F. Split Tensile Strength Test

The specimen used for this test is cylindrical and its dimension is 150 mm in diameter and 300mm in length. The instrument used for this testing is universal testing machine. The fresh concrete is prepared in according to the required grades and respective mix proportion. The fresh concrete is filled in mould in layers and each layer is tamping with standard tamping rod with 25 blows for each layer. After the day the mould is removed and specimen is placed in the curing tank for 7,14 days and 28 days in this research at the temperature 27+ 2°c. Then draw the line on the specimen.

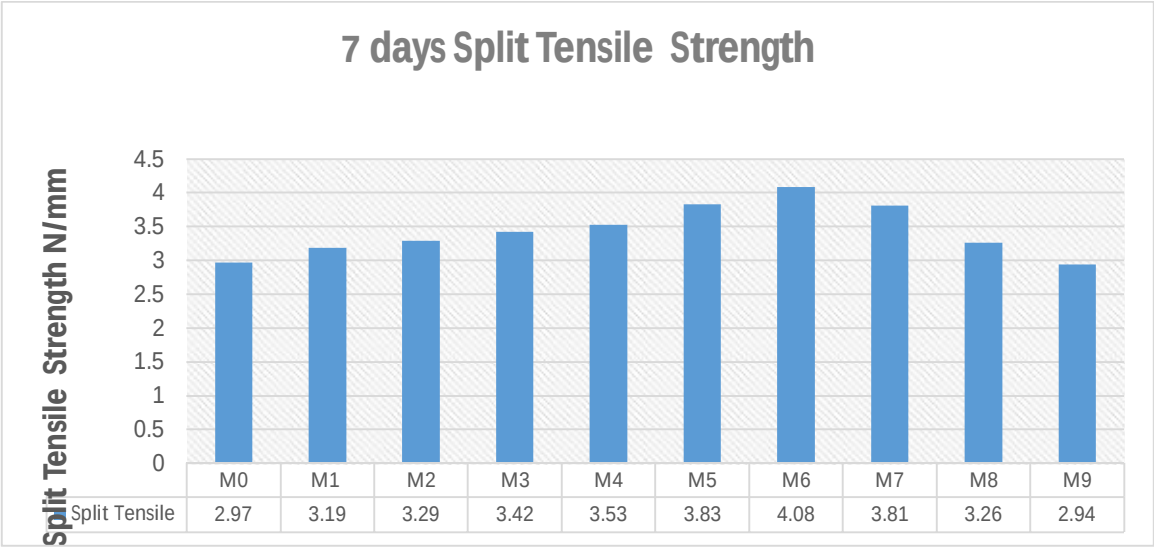


Fig -4: SPLIT TENSILE STRENGTH TEST 7

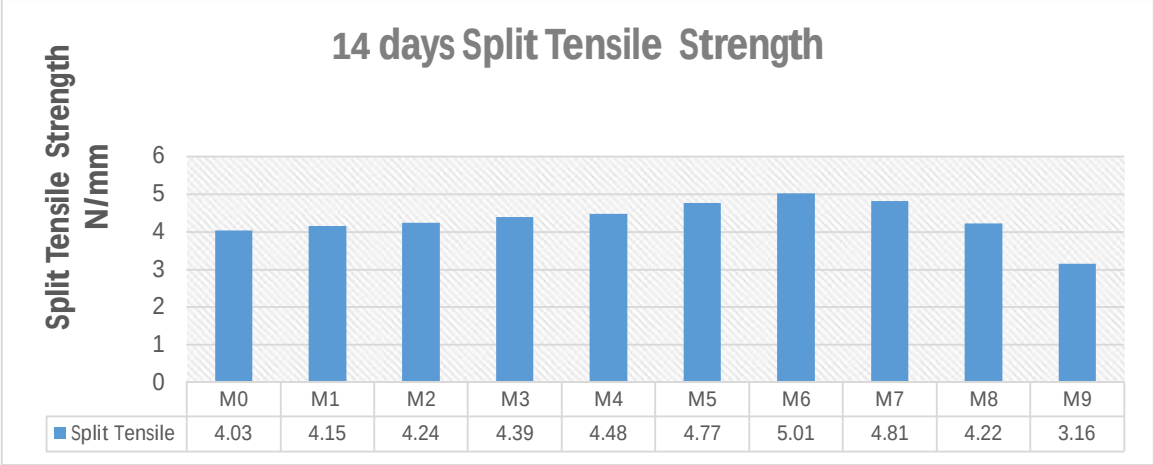


Fig -5: SPLIT TENSILE STRENGTH TEST 14

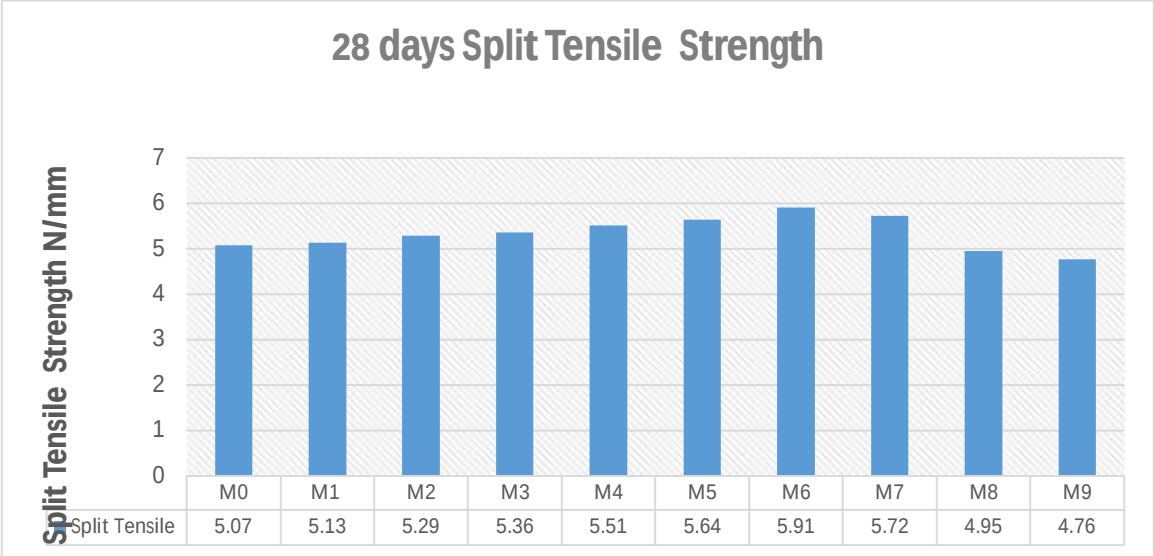


Fig -6: SPLIT TENSILE STRENGTH TEST 28

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G. Flexural Strength Test

The concrete is prepared at required rate of mass element the mould is filled with concrete in layers and blows 25 times with standard tamping rod. After the day or we can say 24 hours the mould is removed and specimen placed in the water tank for curing at a temperature of 27 + 2 C. Depending upon the requirement the test specimen is removed from the water tank and wipe it properly for 7,14 and 28 days for testing.

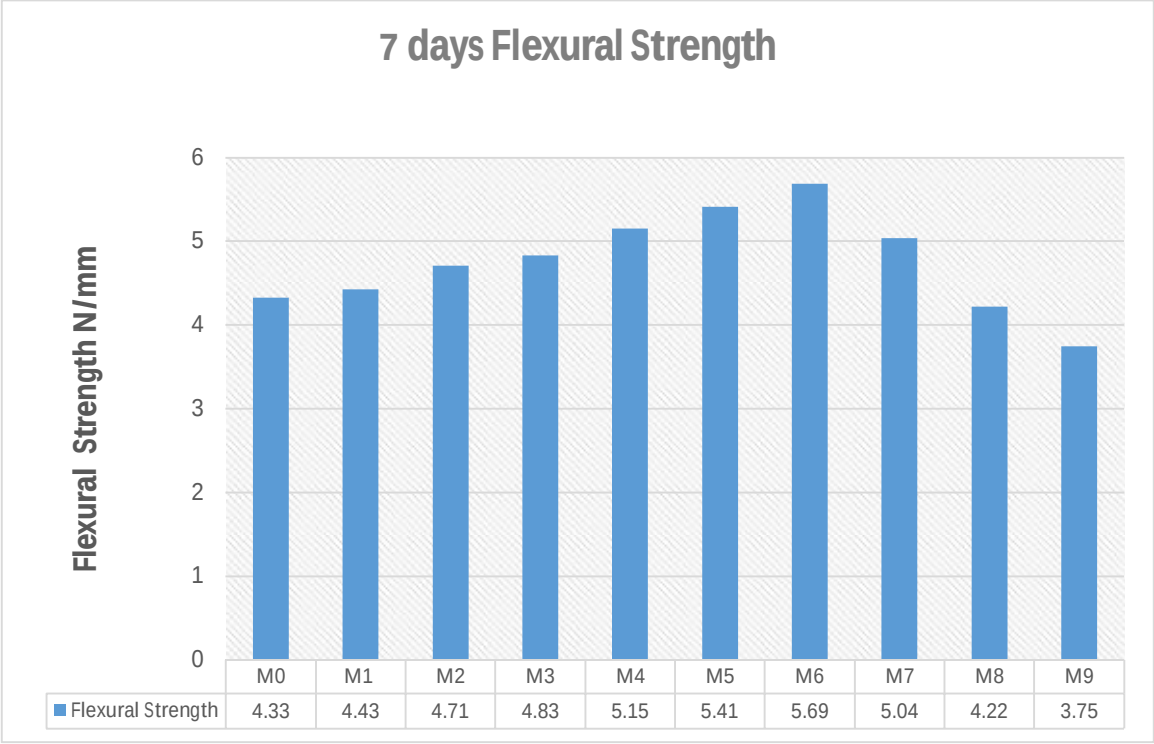


Fig -7: FLEXURAL STRENGTH TEST 7

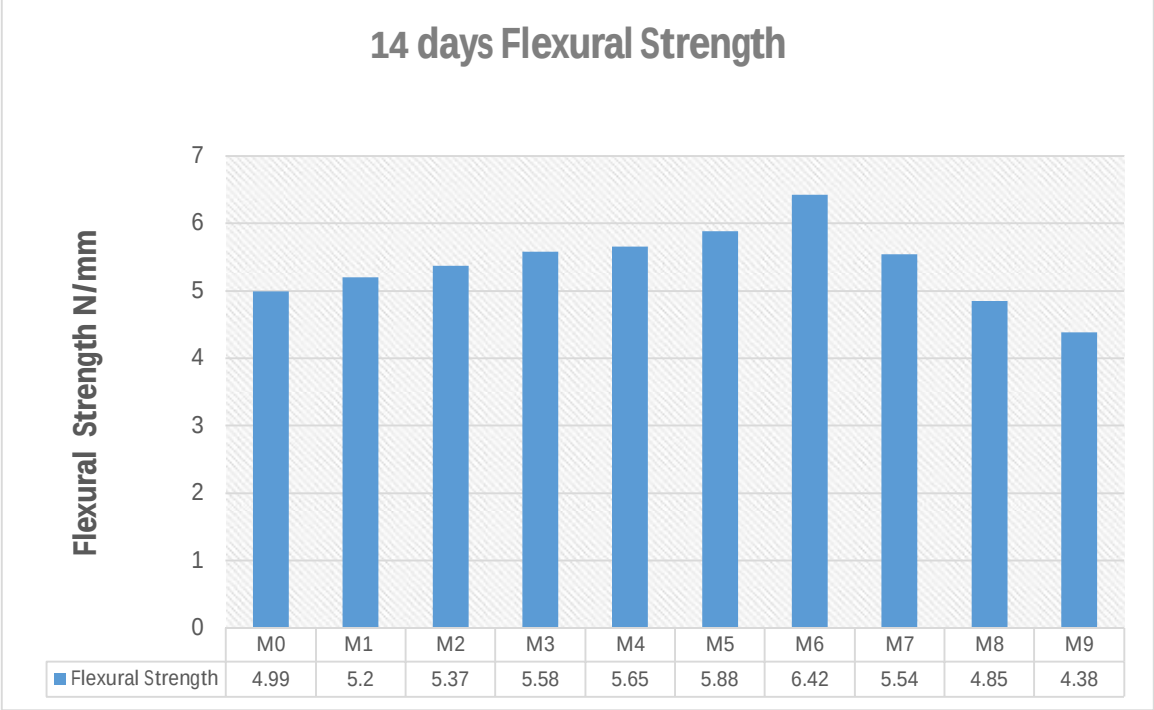


Fig -8: FLEXURAL STRENGTH TEST 14

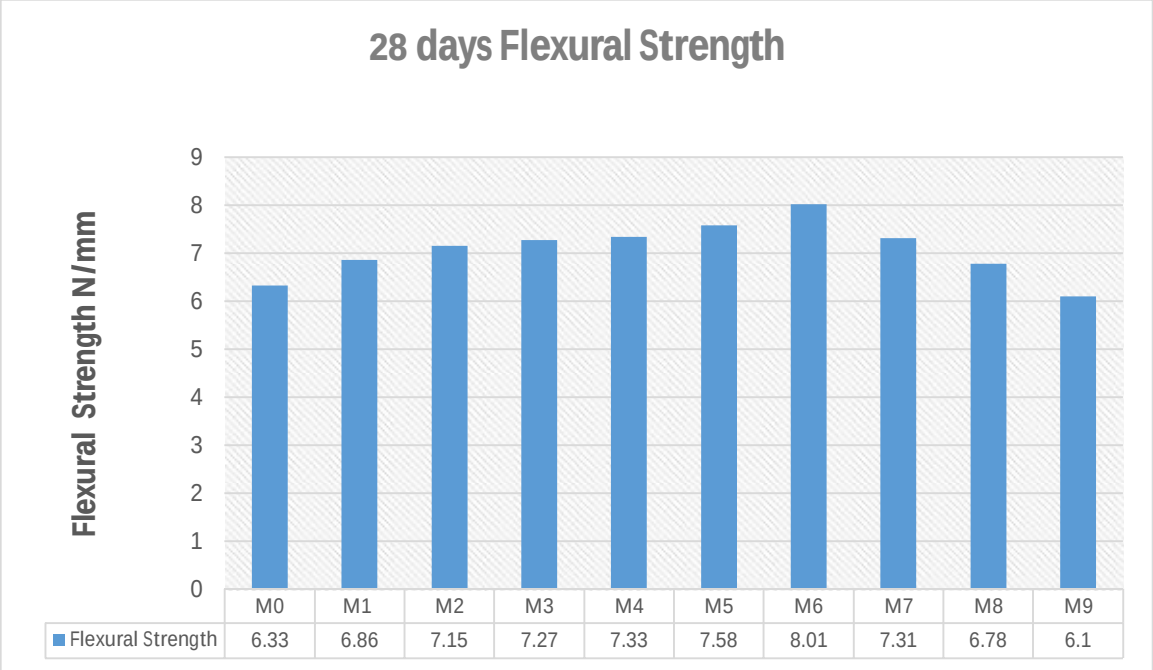


Fig -9: FLEXURAL STRENGTH TEST 28

V. CONCLUSION

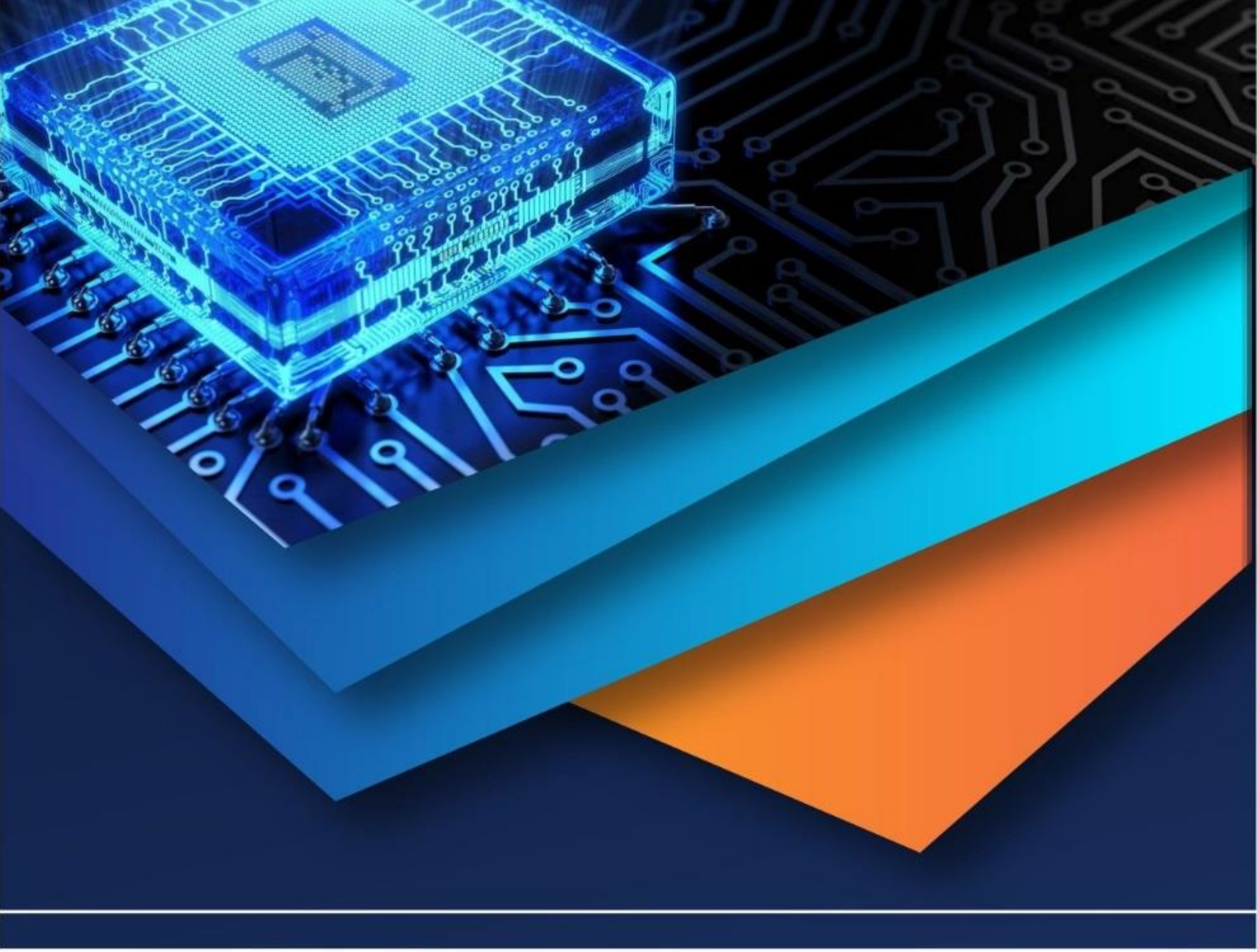
1) By replacing the cement with the Chalk Powder & Coconut Fiber Ash and addition with Asbestos fibers strengths get increased, also the replacement can be taken into consideration up to certain percentage workability factors gets enhanced as well..
2) In case of compressive strength test conducted on cubes of size 150 x 150 x 150 mm, the compressive strength increases up to certain replacement and later on starts to get decreased as well.
3) The compressive strength of the concrete on comparing with conventional concrete gets increased till 18% of cement was replaced Chalk Powder & Coconut Fiber Ash and for reinforcement 0.6% of asbestos fiber was used. The strength obtained at 7^{th} day is 28.11 N/mm^2.
4) After 14 days of curing, the maximum compressive strength obtained was 33.28 N/mm^2 for same replacements and addition.
5) After 28 days of curing, maximum compressive strength obtained was 4.89 N/mm^2.
6) In case of compressive strength, the optimum percentage that was noticed, was at 18% of replacement with Chalk Powder & Coconut Fiber Ash and with 0.6% of addition with asbestos fiber.
7) The flexural strength of the concrete on comparing with conventional concrete gets increased till 18% of cement was replaced with Chalk Powder & Coconut Fiber Ash and for reinforcement 0.6% of asbestos fiber was used. The maximum strength obtained at 7^{th} day is 5.69 N/mm^2.
8) After 14 days of curing, the maximum flexural strength obtained was 6.42 N/mm^2 for same replacements and addition.
9) After 28 days of curing, maximum flexural strength obtained was 8.01 N/mm^2.
10) In case of flexural strength, the optimum percentage that was noticed, was at 18% of replacement with Chalk Powder & Coconut Fiber Ash and with 0.6% of addition with asbestos fiber.
11) After 7 days of curing, the maximum tensile strength obtained was 4.08 N/mm^2 for same replacements and addition.
12) After 14 days of curing, the maximum tensile strength obtained was 5.01 N/mm^2 for same replacements and addition
13) After 28 days of curing, maximum tensile strength obtained was 5.91 N/mm^2.
14) In case of tensile strength, the optimum percentage that was noticed, was at 18% of replacement with Chalk Powder & Coconut Fiber Ash and with 0.6% of addition with asbestos fiber.

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