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To Study the Partial Replacement of Cement with Sugarcane Bagasse and Wood Ash with Addition of Aramid Fiber

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Abstract: Concrete is widely considered for its strength to withstand heavy loads and that"s why this matrix is used for construction purposes. The growth in population has placed an enormous need for more and more infrastructure and it keeps growing. The outcome of this demand is the increase in production of cement. Massive amount of waste materials and byproducts are produced by manufacturing enterprises such as silica fumes, wood ash, and mineral slag and so on. As a result, waste management has become a huge problem for our environment. There are several minerals in wood ash, which can be extracted for further use. A big ingradient calcium carbonate, which is 25% or even 45% (depending on feedstock and burining condition). Less than 10 percent is potash and less than 1 percent is phosphate; there are some elements of iron, manganese, zinc, copper and some metal parts. These numbers however, vary as combustion temperature is an important element for the determination of wood ash. Many of these are in the form of oxides, mainly. If we mix the ashes to water the insoluble silica and calcium carbonate will settle to bottom and sodim salt and soluble potassium will dissolve. Sugarcane is commonly used to produce sugar and ethanol. After sugar juice is extracted from sugarcane, sugarcane bagasse is produced, which is about 50% of the sugarcane level. Bagasse is widely used as a fuel in combining steam production and power generation. In this process, sugarcane ash (SCBA) remains the last waste in the sugar production chain.. However, SCBA is generally disposed of in landfills in India The experimental investigations are carried out for compressive strength, split and flexural strength for curing period of 7, 14 and 28 days. The experimental results show that the for a combined replacement percentage of 8&8%, which includes 8% SCBA and 8% WOOD ASH with addition of aramid fiber 1.2% the values of compressive strength, flexural strength and split tensile strength were higher when compared to other replacement percentages The result shows that concrete workability is fine and within limits after replacing cement with SCBA, WOOD ASH with addition of aramid fiber. However, workability gets reduced at higher replacement of materials. The strength parameters such as compressive strength, flexural strength, and split tensile strength also increase and show an optimum value at 8&8% cement replacement and 1.2% Addition of aramid fibers respectively.

Keywords: SCBA (SUGARCANE BAGASSE ASH), WA (WOOD ASH), AF (ARAMID FIBER), workability, compressive strength, Split Tensile strength, Flexural strength

I. INTRODUCTION

Decreasing the content of cement concrete is one of the continuing problems of 21st century global sustainability. Of all the concrete ingredients (which are the main ingredients in cement, additives that make up cement, water, and fine aggregates), cement has the biggest steps when it comes to carbon dioxide emissions and energy consumption. While the prevalence of high levels of caterpillar (greater than 50%) cement replacement by fly ash, a by-product of coal-fired residues, has been demonstrated in the laboratory and in practice, questions remain about the stability of high-level fly ash availability local deficits experienced in recent parts of the U.S. Similarly, high slag replacement compounds have shown good performance, but global supply of slag is limited compared to the annual demand for concrete for new construction and renovation. Many researches are being made in which researcher aim to partially replace the cement with any product that is easily available and has impact on the environment also. These materials that researcher is trying to use instead of cement can cause environmental hazard in coming time and hence need to be taken care of at earliest. Many researches have been conducted by replacing cement with brick kiln powder, waste agricultural leaves, coconut fibre, bamboo ash, chalk powder, marble waste and much more.

A. Wood ASH

Wood ash contains all the trace minerals from inside a trees wood, which are the building blocks needed for plant health. Although it does not contain nitrogen or carbon, those are a ready supply from compost. The University of Vermontre commends approximately five gallons of ash from wood per 1000 square feet of garden. Since wood ash can increase the soil's pH and therefore not good for crop like potatoes and blueberries. Wood ash is generated as residual/waste from combustion done in boilers at pulp and paper mills, steam power plants, and other thermal power generating facilities. Since wood is a renewable resource for energy and an environmentally friendly material, there is an increased requirement of using waste wood for the purpose of energy production thus leading to formation of more wood ash waste. The study focuses on incorporation of wood ash in combination with ordinary Portland cement while using it for various structural works. Saw dust from the Wood polishing unit in the state of Tamil Nadu, India was selected to evaluate its suitability as ash for OPC replacement. The Wood Ash (WA) was obtained from open field burning with average temperature being 700 °C. The material was dried and carefully homogenized. An adequate wood ash particle size was obtained by mixing wood ash and coarse aggregate together for a fixed amount of time. This mixing was done to facilitate easy pozzolanic reaction and reduced water content due to uniform size distribution.

B. Sugarcane Bagasse ASH

During sugar manufacturing, sugarcane is crushed to extract juice. The fibrous residue is called bagasse and is used as a fuel source to feed the boiler. Sugarcane bagasse ash (SCBA) is thus a residue obtained from the burning of bagasse in the sugar industry. Sugarcane is commonly used to produce sugar and ethanol. After sugar juice is extracted from sugarcane, sugarcane bagasse is produced, which is about 50% of the sugarcane level. Bagasse is widely used as a fuel in combining steam production and power generation. In this process, sugarcane ash (SCBA) remains the last waste in the sugar production chain. Each ton of burnt bagasse can produce 25-40 kg of bagasse ash and, after that, a large amount of SCBA can be produced. With the growing demand for sugar and ethanol in recent years, the effects of SCBA have increased dramatically. In China alone, there may be 1.25-2 million tons of SCBA produced annually. After mixing with sugarcane cake or vinasse, SCBA is widely used as a fertilizer in sugarcane fields in Brazil and China. However, SCBA is generally disposed of in landfills in India.

C. Aramid Fiber

Aramid kevlar fiber is known as the aromatic polyamides because they are the totally man-made polymers organic. They produced from the chemical liquid blend. This aramid kevlar fiber are contains properties range are very wide and they having that are low density. But they are well impact resistant. Now aramid kevlar fiber molecules present are characterized by the chain of rigid polymers they are powerful hydrogen bond to link. Aramid kevlar fiber is treated in commercially way in the foam of meta-aramid fiber in 1960. They have high strength properties used for different-different various applications.

II. LITERATURE REVIEW

Batt and garg (2017) Wood ash is produced as a byproduct of burning wood in boilers, paper and pulp mills, steam power plants, and other thermal power generating facilities. Wood is an environmentally beneficial material and a renewable energy source. the rise in the demand for using waste wood to produce energy, which results in an increase in the amount of ash waste produced from wood. The study focuses on adding wood ash to regular Portland cement when applying it to different structural projects. The comprehensive investigation into the sieve analysis, consistency, water absorption, setting time, and slump tests of wood ash yielded significant findings that highlighted the meticulous study methodology. When wood ash is utilized as a partial cement substitute, uncontrolled sawdust burning to create it changes its in this manner, both chemical and physical qualities. These qualities are found to be somewhat similar to fly ash. Amorphous wood ash, which has a grain size of less than 75 microns, is added to the concrete mix in proportions of 5%, 10%, 15%, 20%, 25%, and 30% by weight of cement. The goal of this study is to ascertain how the consistency or workability of concrete has changed.

Mehnaza Akhter (2017) The present thesis deals with the findings of experimental studies on effects of wood ash on compressive strength and setting time of cement and concrete. Influence of wood ash on cement and concrete compressive strength by varying percentage of wood ash 0% 10%, 20%, 30%, and 40% by weight of cement. The wood ash in this paper as partial replacement of cement in concrete is used and its effects on concrete properties was achieved. For the compressive strength test, cubes measuring 70.6mm 70.6mm x70.6mm Cubes of size were used and specimens of size 150 mm X 150 mm X 150 mm for compressive strength test of concrete. Water cured all the specimens and processing is performed for 7 days and 28 days.The result of compressive strength of cement and concrete with wood ash were observed and compared with the results of normal concrete and concrete

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showed the significant improvements in the results of compressive strength. The optimum percentage of various agro waste replacement is obtained.

Khalil, et al[5] (2021) reviewed Concrete is one of the most important materials used in the construction industry. Rapid depletion of natural resources, high energy consumption, and environmental degradation involved in cement production have prompted researchers to investigate other appropriate ways to apply cement partially or partially. A study conducted over the past two decades on the use of Bagasse Ash (SCBA) sugarcane as a cement for the production of concrete is summarized in this paper. First, general information about SCBA production, the effect of heat dissipation on the SCBA structure, the physical and chemical properties of SCBA and the SCBA response mechanism are briefly discussed. Subsequently, the influence of SCBA is introduced on the structures of the new state and finally, the enhanced state features namely strength and level of energy gain, durability mode, chloride ion penetration and aggressive environmental effect on SCBA concrete are introduced.

Ratan Kharatmol et al. (2014) Investigated the beams strengthening by the using of reinforced polymers carbon fiber. Because carbon fiber strengthening range is very wide so this fiber used to ours structure strength is obtained and carbon fiber reinforced concrete structure is extra-long agger. Because this types of material used to our structure strength is so many amount in increased. But give a best result of strengthing they will used in tension face of the beam as compared to other place. So the conclusion is the using of carbon fiber increased the durability, compressive strength and flexural is to be also the increased.

N. S. Badiger et al. (2014) Investigated the bending analyses of the RC beams. The rectangular strengthened of RC beam designed by the material of steel mesh fiber composite. The fiber direction is also control and the RC beams span reactions of the reinforcement and the power are ultimate of the beam investigates after design wrapping the RC beam. Now it has been used of fiber reinforcement plastics explained that can considerably augment of the stiffness in the addition to the RC beam ultimate strength and power. Same as now the fiber reinforcement plastics similar layers of the beams strength and ultimate strength by the help of steel mesh reinforcement beam design much superior base of the toughened by plastics fiber reinforcement beam on the both sides

III. MATERIALS

A. Cement

Ordinary Portland cement ambuja cement of grade 43 satisfying the requirement of IS 8112: 1989 was used in the investigation because OPC is maximum used in the all construction project. Because cement is adhesive in nature, a material that hardened and can be used to bind one material with other.

B. Coarse Aggregates

The particles which retains on the sieve and are larger than 4.75mm are referred to as coarse aggregates. For making a good mix of concrete aggregates need to be hard, clean and strong particles which are free of coatings of clay or any absorbed chemical and other fine materials that could cause the deterioration of concrete. Coarse aggregate are rounded or irregular gravel stones. Crushed stone make up the majority of the small particles of coarse aggregate. Coarse aggregates should be carefully handled to avoid dirt contamination. It should be clean and dry.

C. Fine Aggregates

Sand is the most important material in the mixed concrete. Because they are so helpful for filling a concrete void space and if I was taking the sand from local river, because they are providing me easily. And these market price value is very low as compared other material like cement, sand, and one more most of the important reason is used the local river sand. Because this sand water absorption capacity is very low. So this sand used to we are controlled the many of harmful decides like lack and cracks.

D. Wood ASH

Wood ash is the residue powder left after the combustion of wood, such as burning of wood in a home fire place or an industrial power plant. There are several minerals in wood ash, which can be is separated out for further use. Calcium carbonate is the major component, representing 25 or even 45 percent (depending on feedstock and burn conditions). Less than 10 percent is potash, and less than 1 percent phosphate; there are trace elements of iron, manganese, zinc, copper and some heavy metals. However these number can differ as, combustion temperature is an important variable in determining wood ash combustion. All of these are primarily, in the form of oxides. If we add ashes to the water , the soluble potassium and sodium salt will dissolve, while the insoluble silica and calcium carbonate will settle to the bottom.

Table no. 1 Properties of CP

COMPONENT	MASS%
SiO2 31.8	31.8
Al2O3	28
28 Fe2O3	2.34
CaO	10.53
NaO	6.5
K2O	10.38
MgO	9.32
P2O5	1.17
Loss of ignition	27

E. Sugarcane Bagasse ASH (SCBA)

Sugarcane is commonly used to produce sugar and ethanol. After sugar juice is extracted from sugarcane, sugarcane bagasse is produced, which is about 50% of the sugarcane level. Bagasse is widely used as a fuel in combining steam production and power generation. In this process, sugarcane ash (SCBA) sugarcane remains the last waste in the sugar production chain. Each ton of burnt bagasse can produce 25-40 kg of bagasse ash [1] and, after that, a large amount of SCBA can be produced. With the growing demand for sugar and ethanol in recent years, the effects of SCBA have increased dramatically. In China alone, there may be 1.25-2 million tons of SCBA produced annually. After mixing with sugarcane cake or vinasse, SCBA is widely used as a fertilizer in sugarcane fields in Brazil and China. However, SCBA is generally disposed of in landfills in India.

F. Aramid Kevlar Fiber

Aramid kevlar fiber is known as the aromatic polyamides because they are the totally man-made polymers organic. They are produced from the chemical liquid blend. This aramid kevlar fiber are contains properties range are very wide and they having that are low density. But they are well impact resistant. Now aramid kevlar fiber molecules present are characterized by the chain of rigid polymers they are powerful hydrogen bond to link. Aramid kevlar fiber is treated in commercially way in the foam of meta-aramid fiber in 1960. They have high strength properties used for different-different various applications.

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 7,14,28 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.

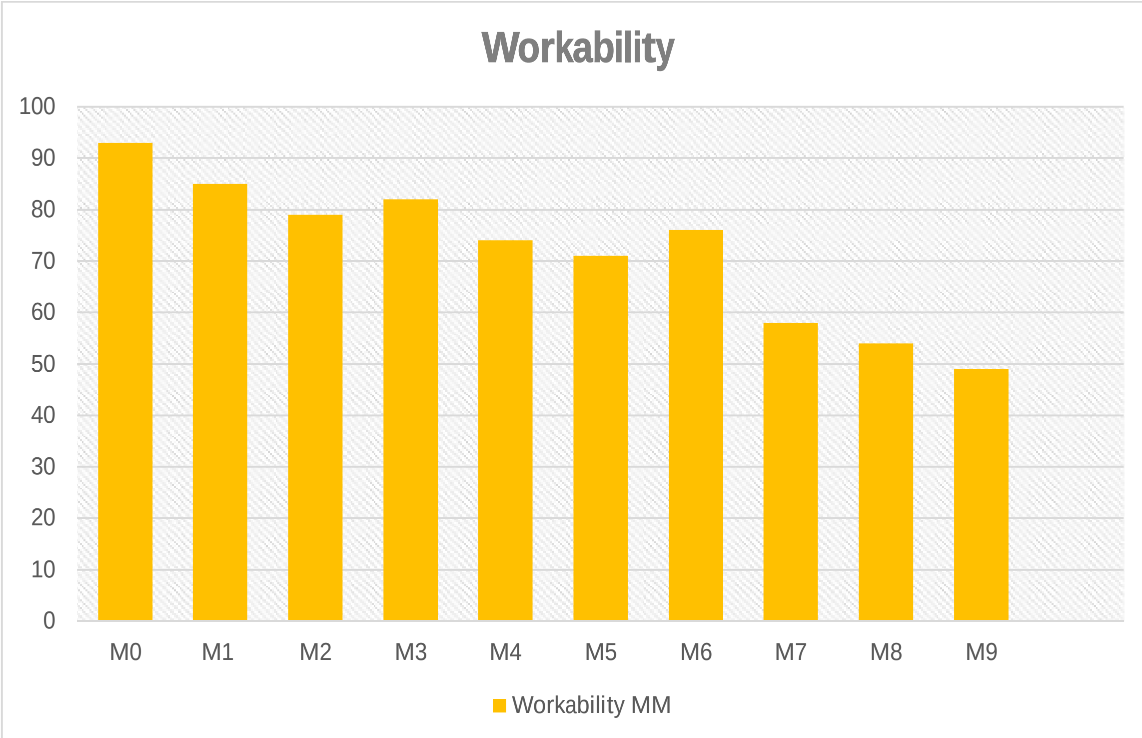

Fig -1: Slump Cone Test

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.

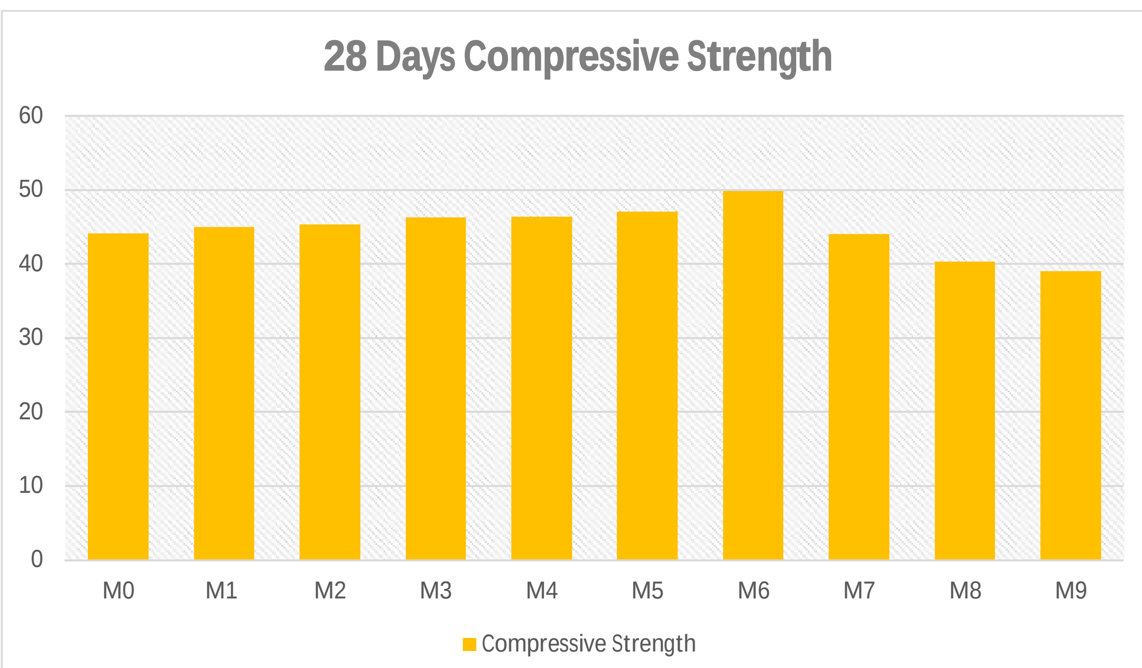

Fig -2: COMPRESSIVE STRENGTH TEST 28

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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.

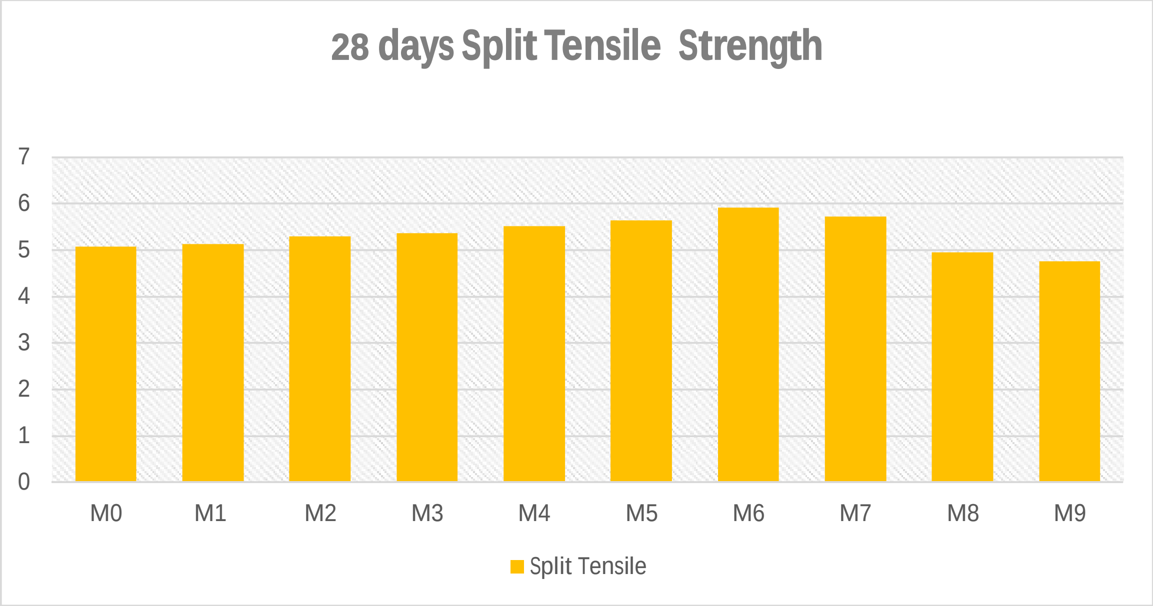

Fig -3: Split Tensile Strength Test 28

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.

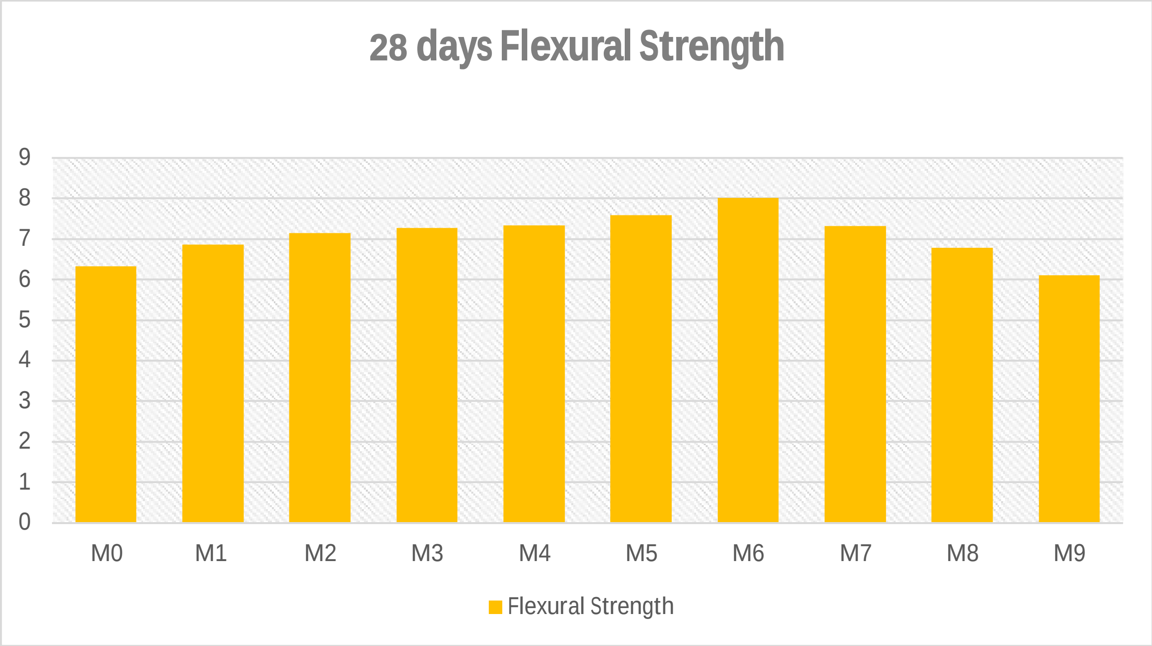

Fig -4: FLEXURAL STRENGTH TEST 28

V. CONCLUSION

1) By replacing the cement with the SCBA, WA and addition with Aramid fibers strengths get increased, also the replacement can be taken into consideration up to certain percentage workability factors gets enhanced as well.
2) Aramid fiber acted as a reinforcement and hence acted as resistance to the cracks, thus increasing the flexural strength.
3) The compressive strength of the concrete on comparing with conventional concrete gets increased till 8&8%, which includes 8% SCBA and 8% WOOD ASH with addition of aramid fiber 1.2% was used.
4) The flexural strength of the concrete on comparing with conventional concrete gets increased till 8&8%, which includes 8% SCBA and 8% WOOD ASH with addition of aramid fiber 1.2% was used was used.
5) In case of tensile strength, the optimum percentage that was noticed, was at 8&8%, which includes 8% SCBA and 8% WOOD ASH with addition of aramid fiber 1.2% was used was used

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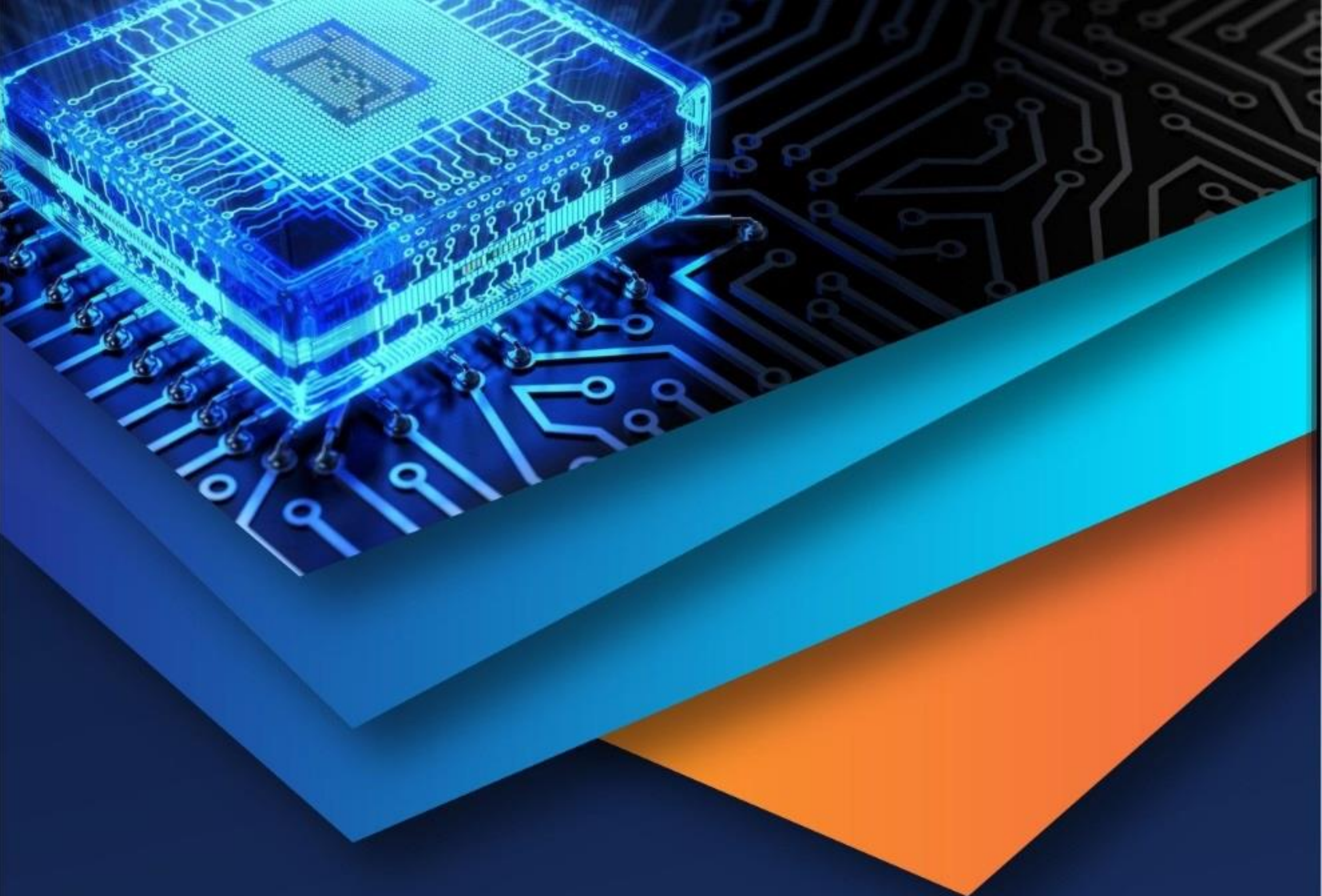

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