iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 Issue: IX Month of publication: September 2022

DOI: https://doi.org/10.22214/ijraset.2022.46747

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

An Experimental Study on the Behavior of Concrete by Using Tobacco Waste Ash and Spent Fire Bricks

Choudhary Asif Ali[1], Sourabh Lalotra[2]
[1]PG Scholar, Sri Sai College of Engineering and Technology, Pathankot, India
[2]Assistant Professor, Sri Sai College of Engineering and Technology, Pathankot, India

Abstract: Nowadays, there is an increasing curiosity within the development of eco-friendly materials. Tobacco waste ash displays properties such as fineness, amorphous form and high silica content and thus needs to be investigated with its potential to show high pozzolanic activity The usage or replacement of fire bricks is periodical in nature in metallurgical based industries. The fire bricks cast out off after use are called as Spent Fire Bricks. The Spent Fire Brick which are the waste should be through properly without causing environmental problematics in the vicinity of dump. Usually the waste materials are cast out by land filling. In the analogous manner the spent fire bricks are also used as land filling material degrading the environment. Certain materials of mineral origin are also added to concrete to enhance their strength and durability properties of concrete materials such as Spent Fire Bricks and other by TWA. 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 partial replacement of the TWA with the Cement and the fine aggregates is partially replaced by the Spent Fire Bricks. Optimum value of strength in compression, split tensile and flexure came at TWA12%SFB24% replacement of the TWA with the Cement and the fine aggregates is partially replaced by the Spent Fire Bricks. The workability of mixture increases and after that there is decrease in the workability of the concrete when we increase the percentage of TWA and Spent Fire Bricks. 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 Spent Fire Bricks and TWA.
Keywords: TWA (TOBACCO WASTE ASH), SFB (SPENT FIRE BRICK), workability, compressive strength, Split Tensile strength, Flexural strength.

I. INTRODUCTION

Today Ordinary Portland cement(OPC) is considered as foremost construction material across the globe.
Portland cement is the conformist material used in buildings that in fact is accountable for roughly about 5% - 8% of corbon dioxide emissions globally. Cement which is known to be used mostly second after water all over the world and generating so much amount of carbon dioxide in the atmosphere requires an alternate that can replace the cement completely or even if a substitute is capable of replacing cement partially by providing the requisite amount of strength the material should be valued. As there is exponential increase in the demand of cement , the enviromemtal effect of it might increase considerably. Investigators throught out the globe today are concentrating on different ways for the use of either industrial or agricultural waste, as key materials for industry. Being not only cost effective but may helps us in environmental pollution control. The Portland cement industry are examining substitutes to produce green building materials. Industrial wastes, such as blast furnace slag, fly ash and silica fumes are being used as additional cement replacement materials.

A. Tobacco Waste ASH

One of the residues from a cigarette factory is the Tobacco stem, and it is easy to collect as its production is concentrated in cigarette factories. This has led to a serious waste of resources and environmental problems as more than 95 % of the tobacco stems end up in landfills or incineration. Thus there is a need to dispose this residue in a way which is environmental friendly. Tobacco waste ash is produced by burning these unwanted tobacco stems. Tobacco waste ash displays properties such as fineness, amorphous form and high silica content and thus needs to be investigated with its potential to show high pozzolanic activity. The ashes are not pozzolanic material, they have pozzolanic activity, but this activity is less than that in pozzolanic material.

The ashes exhibit the "filler effect", which is composed of two phenomena, the nucleation and packing effects that primarily depend on the fineness of the materials. The nucleation effect occurs when the small particles are spread in blended cement paste, leading to an enhanced hydration reaction, while the packing effect occurs when the voids in pastes are filled with fine particles. Tobacco waste ash is not a pozzolanic material but it has been known to display some pozzolanic activities.

B. *Spent Fire Bricks*

A fire brick, or refractory brick is a block of refractory ceramic material used in lining furnaces, kilns, fireboxes, and fireplaces. A refractory brick is built primarily to withstand high temperature, but will also usually have a low thermal conductivity for greater energy efficiency.Fire bricks are the products manufactured (as per IS: 6 and IS: 8 specifications) from refractory grog, plastic, and non plastic clays of high purity. The different raw materials are properly homogenized and pressed in high capacity presses to get the desired shape and size. Later, these are fired in oil-fired kiln at a temperature of 1,300°C. Crushed bricks in the form of aggregates finer or coarser are called crushed brick aggregates. Bricks are very easy available material. Because natural sand is limited natural resources thus a replacement need occurred. Brick aggregates are very low and its result in concrete is very good. Researcher has tested the aggregates bricks the got the higher compressive strength at 20% partially replaced the fine aggregate of bricks with fine aggregates of concrete. But some researcher found the decrease in the strength up to 40%.

II. LITERATURE REVIEW

S.celikten, M. Canbaz 2017) In a paper entitled "A Study on the Usage of Tobacco Waste Ash as a Mineral Admixture in Concrete Technology" studied the effects of partial replacement of cement with tobacco waste ash. The tobacco waste ash was taken from two sources and the tests were carried out on each of the specimen of the two tobacco waste ash. The partial replacement was done in the percentage of 10, 15 and 20 by weight. The mortar samples were then tested. The tests that were done included compressive strength and flexural strength test. From the results of these tests unit weight, ultrasound pulse velocity, dynamic modulus of elastic values of the mortar specimen was calculated. There was seen a decrease in the values of these results as the percentage of tobacco waste ash was increased. On comparing the values of the specimen with the control specimen there was a decrease in both compressive and flexural strength, though in the case of compressive strength the decrease was more. Thus the author came to the conclusion that with the partial replacement of 10 percent cement with tobacco waste ash there are ecological and economic benefits.

R.Subramanian K.KalaiPandian In this research the values of compressive strength for different replacement levels of CSFB (0%, 10%,20%,30% and 40%) at the end of the curing periods (7 days and 28 days) are taken. These values are plotted in figs. This shows the variation of compressive strength with fine aggregate replacement at different curing ages respectively. It is evident from figure, that compressive strength increases upto 30% replacement of sand to CSFB. The compressive strength will be decreased in 40% replacement.

Turgut Öztürk, Muzaffer Bayrakl 2005) In a paper entitled "The Possibilities of Using Tobacco Wastes in Producing Lightweight Concrete" studied the possibility of using tobacco waste ash in lightweight concrete. The limit of the use of tobacco waste ash was fixed at 40 percent, since the use of organic materials decrease the compressive strength of the concrete. The organic material ratio of tobacco waste ash is 66.2 percent. In the experiment following tests were conducted compression test, slump test and thermal conductivity. The unit weight of the concrete was also calculated. The author came to the conclusion that the light weight concrete made form partial replacement of cement with tobacco waste ash cannot be for load bearing but it can used as coating and dividing material because of its insulating features. Paalo Moreno 2018 In this study, ash obtained from tobacco waste (TWA) was studied as a sustainable partial replacement for cement in hydraulic concrete. The TWA was reduced to a particle size of less than 75 μm and was characterized by X-ray florescence. A central composite design was used to study the influence of the ash replacement percentage of cement and the water/binder (w/b) ratio on the compressive strength at 28 days. The results show that it is possible to replace 10% of the cement with TWA using a 0.5 w/b ratio and obtain a 51% higher compressive strength than the control mixture at 28 days. Moreover, the experimental results demonstrated an improvement of 86% in the 7-day compressive strength when TWA was used

N.Ramkumara Dr.M.Manikandan The main objective of this investigation is to examine the properties of CSFB concrete. Partial or full replacement of fine aggregates by the other compatible materials like fly ash, crushed rock dust, quarry dust, glass powder, and recycled concrete dust. "Spent Fire bricks" (SFB) for partial replacement of fine aggregate in concrete Fire bricks are the products manufactured from refractory grog, plastic, and non plastic clays of high purity. M25 grade of concrete is designed as per code. Conventional concrete is taken as control mix CSFB is to be added in various proportions and concrete specimens are casted.

From the results we observe that the maximum strength is achieved by 30% of CSFB replacement in concrete. The 40th % of CSFB replacement in concrete indicates there is no strength gaining after increasing the proportion. The compressive strength of partial replacement of CSFB aggregate concrete is marginally higher than that of the river sand aggregate concrete at age 7 days, 14 days, and 28 days respectively,

III. MATERIALS

A. Cement

The study used a simple Portland cement brand name Satyam Cement confirming IS 1489 (Part 1) - 1991 with grade 43. Cement production date is 07 September 2021. The specific gravity of cement was 3.15. The initial setting time of cement is 35 minutes and the final setting time is nine hours.

B. Coarse Aggregates

The coarse aggregates used in this research are crushed aggregates (locally available) with a maximum size of 20mm. Coarse aggregates have a specific gravity of 2.72 and a water solubility of 0.67 percent. It was set in accordance with the 1963 Indian Standard Setting IS: 2386 (Part 3).

C. Fine Aggregates

The best natural river sand used in this research was locally available from the "Chenab" river in Reasi district. The specific severity was determined by the pycnometer test. The result of the sieve analysis on the fine aggregates is shown in Table 3 and the grading of the fine aggregate as per IS 383-1970 is found to be that it is zone II compliant and the fineness modules are 2.88 i.e. medium coarse sand.

D. Spent Fire Brick

Fire bricks are the products manufactured (as per IS: 6 and IS: 8 specifications) from refractory grog, plastic, and non-plastic clays of high purity. The different raw materials are properly homogenized and pressed in high-capacity presses to get the desired shape and size. Later, these are fired in oil-fired kiln at a temperature of 1300°C.

Constituent	Spent fire bricks	Sand
Sio2	58.2	90-95
Al2O3	34.2	0.005-0.01
Fe2O3	2.29	2.68-8.25
CaO	2.50	0.92-1.80
MgO	0.95	0.02-0.7
SO3	4.33	1.36
K_2O	0.25	0.01-0.10
NaO	0.72	0.01-0.40

E. Tobacoo Waste ASH

The Tobacco wash ash that was used in the experiments was made by purchasing tobacco stems and then burning them and the ash that was obtained was sieved through a 425 µm sieve to remove any undesirable particles. The ashes were further rounded in the Los Angeles machine to reduce the size of particles to 60 µm. The amount of silica in the tobacco waste ash depends on the burning temperature and the amount of time for which the burning is done. Thus from different sources of tobacco stems, we get different composition. The total amount of silicon dioxide, aluminum oxide and ferric oxide is less than 70 percent, which is the minimum value required for a material to be considered as pozzalonic.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

Particular	Percentage
Silicon Dioxide (SiO_2)	25.67
Aluminum Oxide (Al_2O_3)	0.16
Ferric Oxide (Fe_2O_3)	0.31
Sodium Oxide (Na_2O)	0.49
Calcium Oxide (CaO)	25.54
Magnesium Oxide (MgO)	4.6
Sulphur Trioxide (SO_3)	7.04
Potassium Oxide (K_2O)	17.84

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.

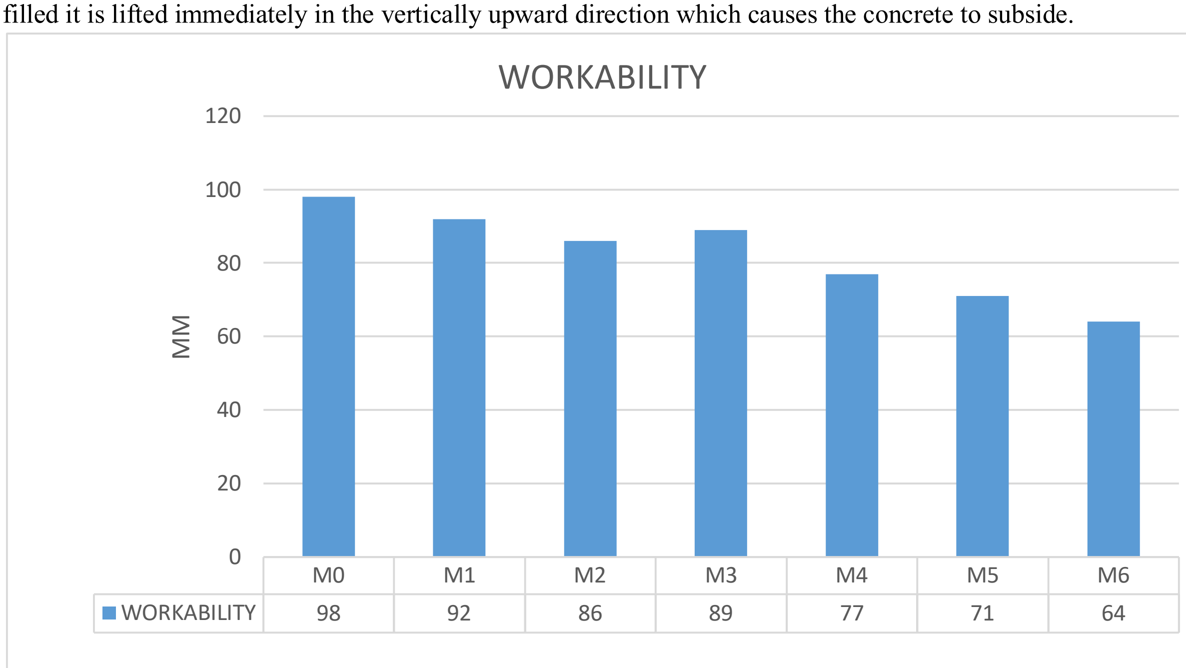

Fig -3: SLUMP CONE TEST

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

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.

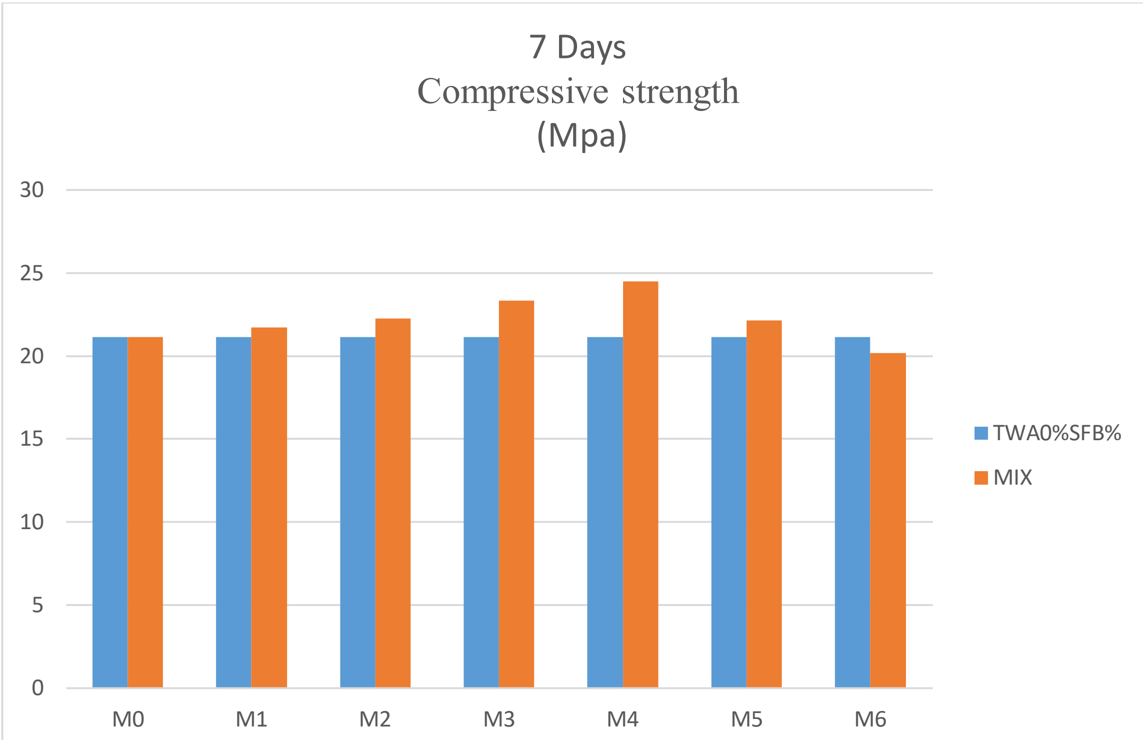

Fig -4: Compressive Strength Test 7

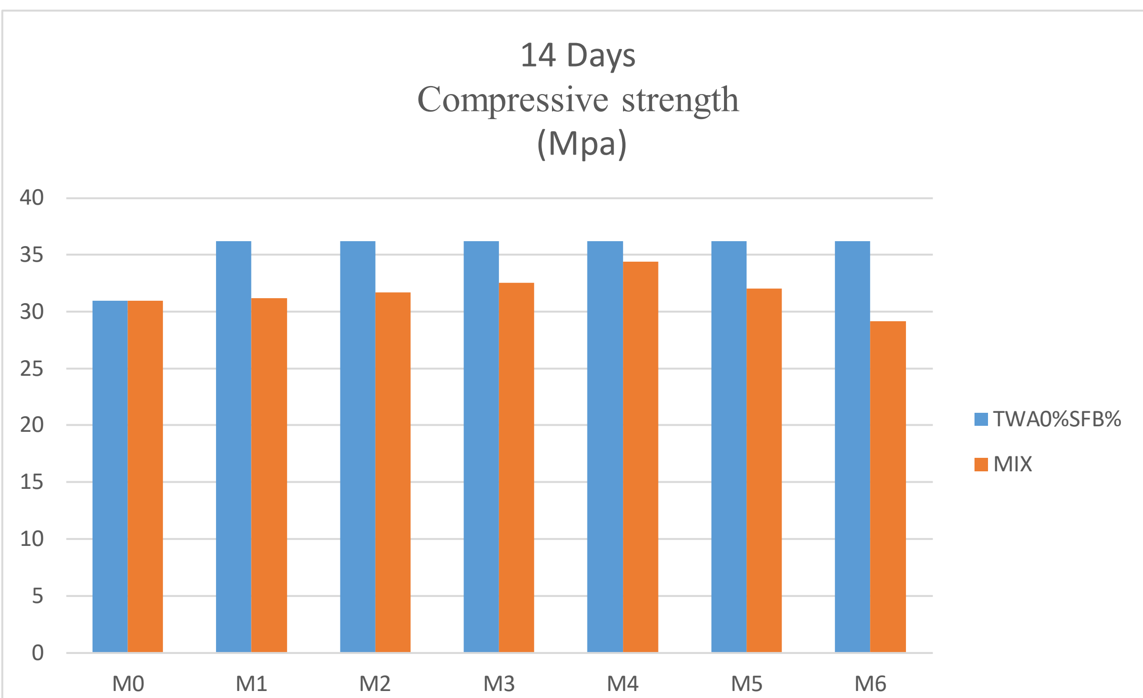

Fig -5: Compressive Strength Test 14

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

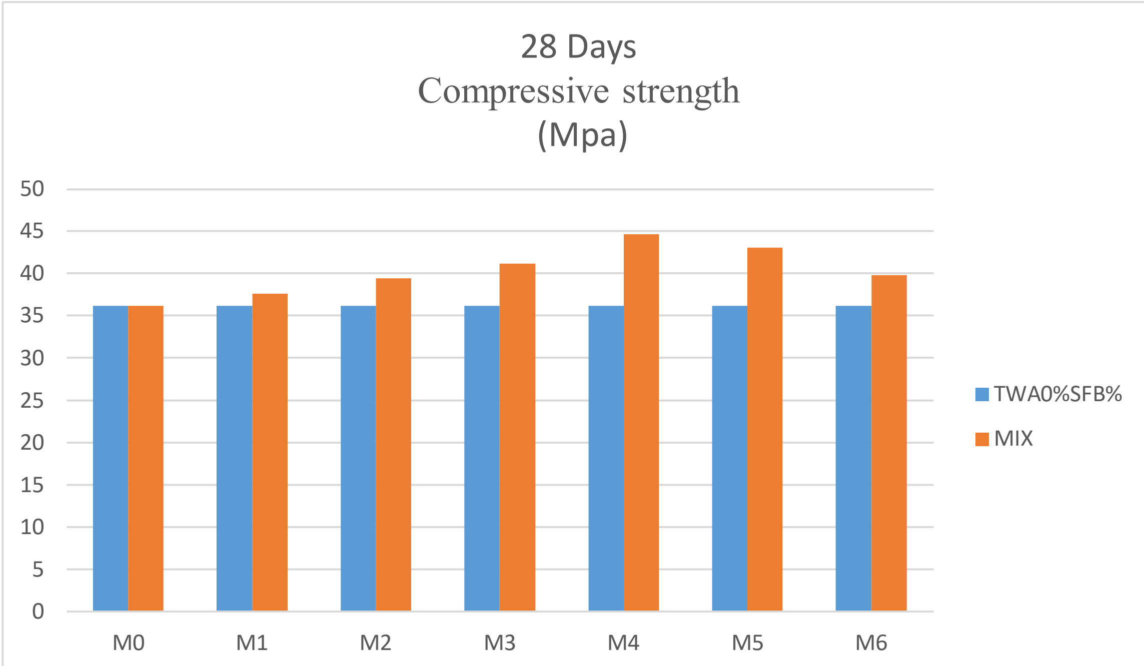

Fig -6: Compressive Strength Test 28

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.

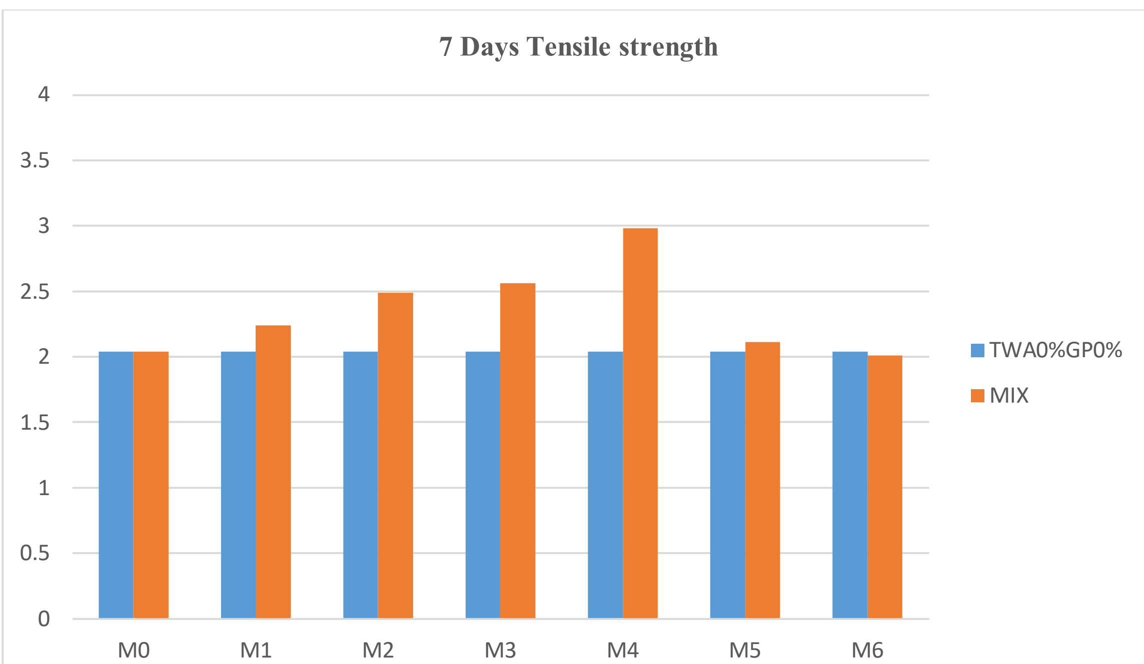

Fig -7: Split Tensile Strength Test 7

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

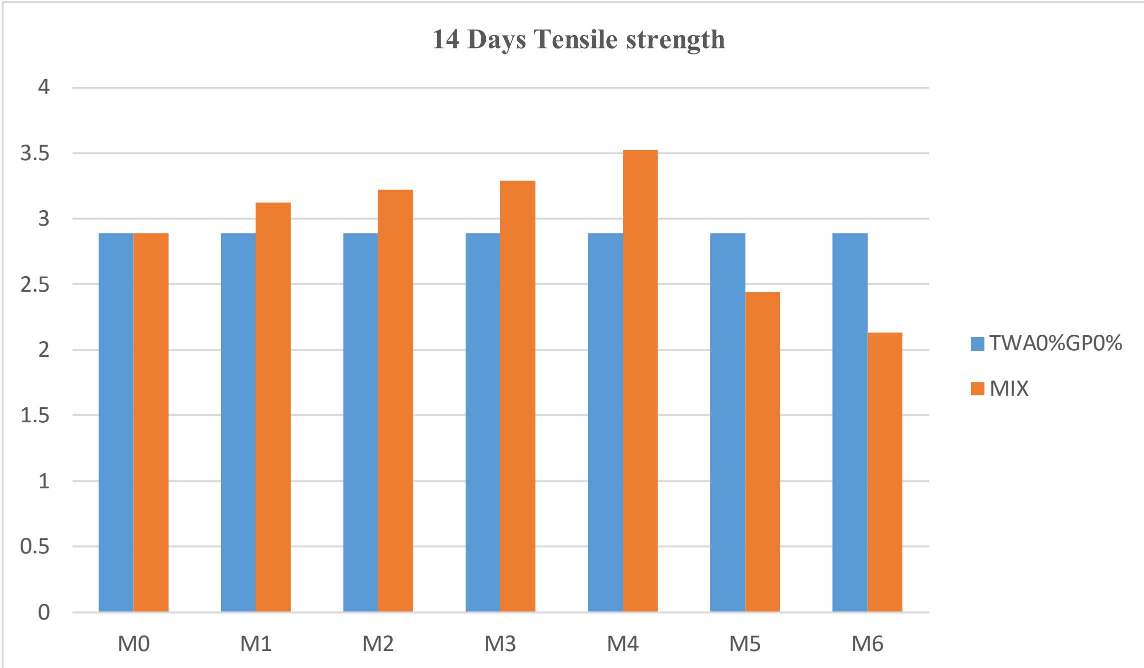

Fig -8: Split Tensile Strength Test 14

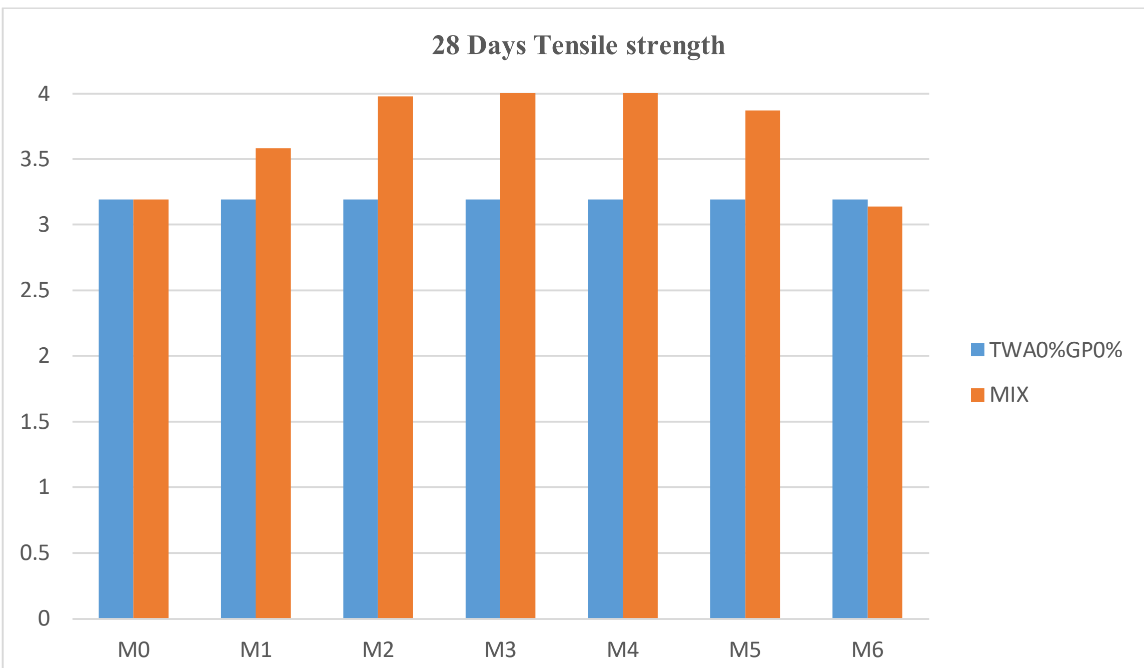

Fig -9: Split Tensile Strength Test 28

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.

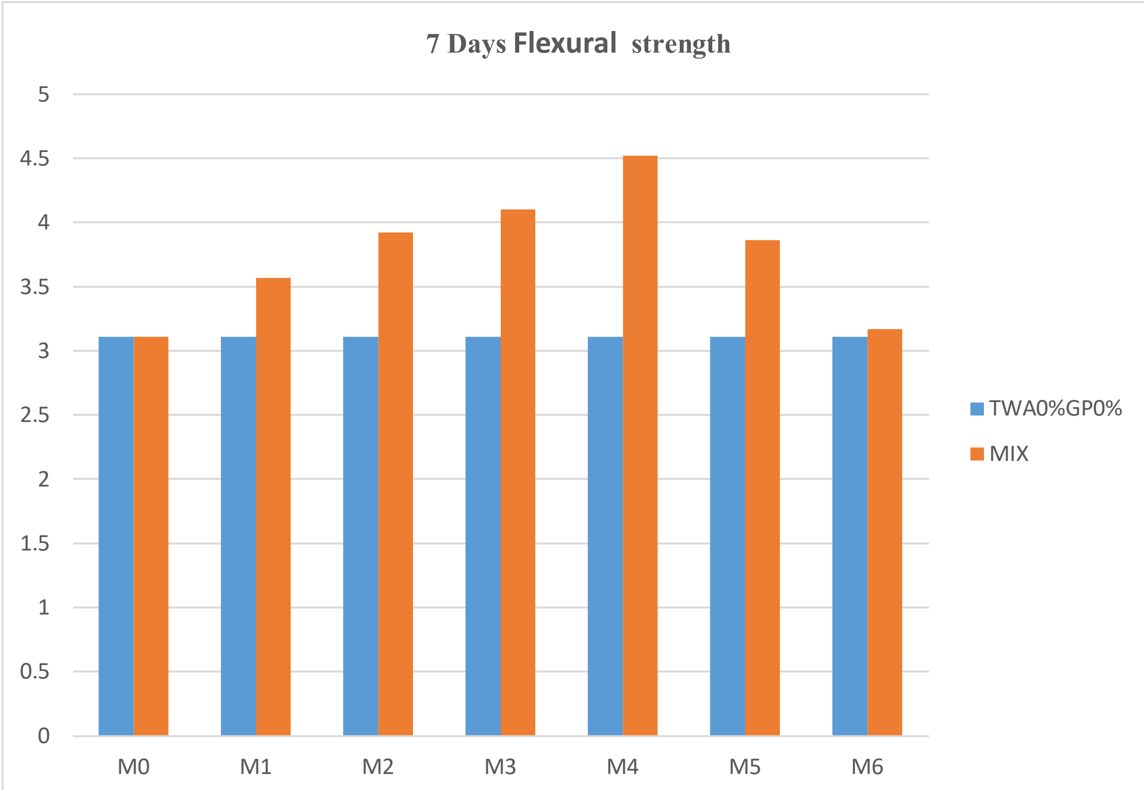

Fig -10: Flexural Strength Test 7

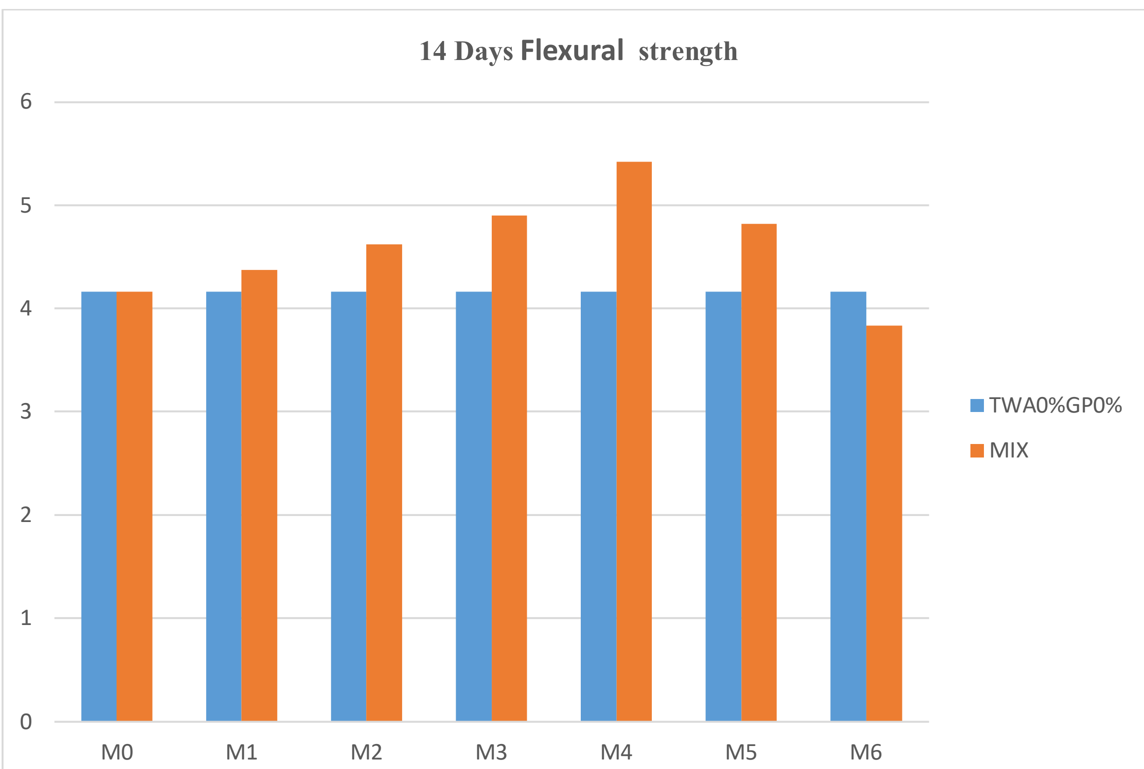

Fig -11: Flexural Strength Test 14

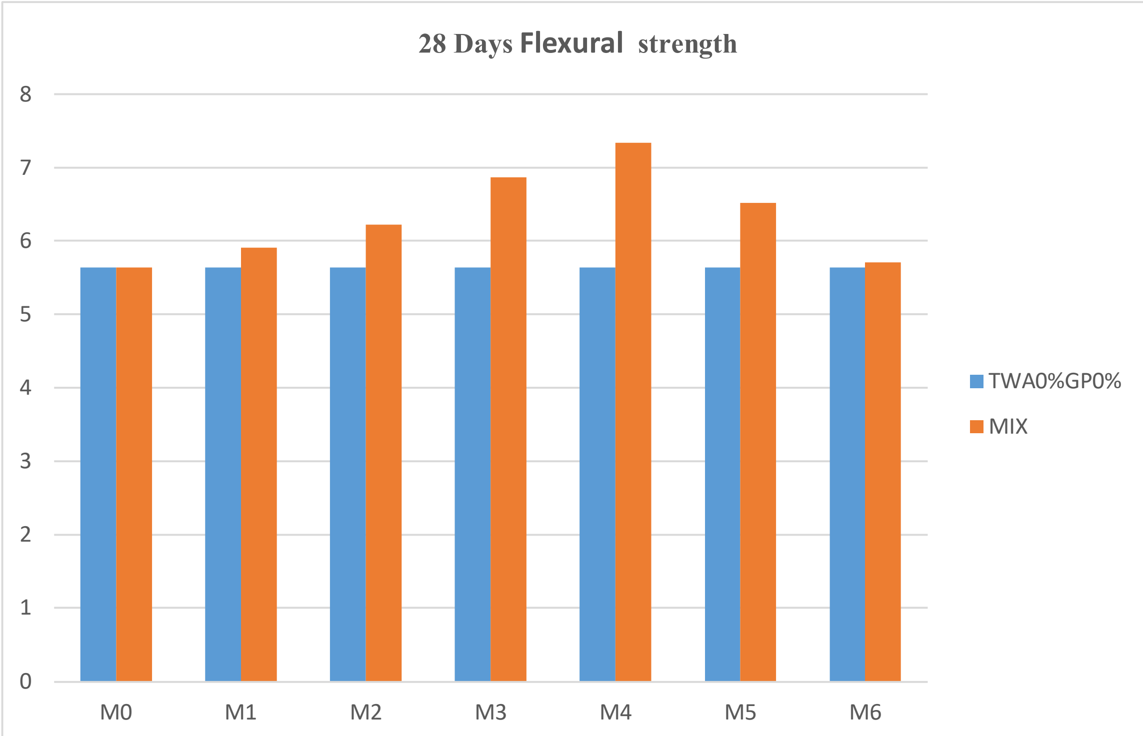

Fig -12: Flexural Strength Test 28

V. CONCLUSION

1) The use of TWA and Spent fire brick as partial replacement of cement and Fine Aggregate respectively should be taken up for acceptable and environmentally friendly construction.
2) By using these easily available left overs and agricultural waste materials in construction, we can greatly decrease the cost of construction up to a certain level and also not compromising much on the quality while also overcoming the environmental hazards.
3) In general, it was also observed in the experiment that the workability of concrete decreases with the increase in the percentage of TWA and Spent fire brick the concrete was less workable.
4) This investigation has also established that the use of TWA and Spent fire brick by a certain percentage can produce positive results when cement and fine aggregate. Thus can be used in construction purpose.
5) It is observed that by replacement of cement with TWA up to 12% by weight of cement and Spent fire brick up to 24%, there is an increase in compressive strength, Flexural strength and Split tensile strength of concrete after which there is a drastic decline in the strength of concrete.
6) The max compressive strength is achieved by replacement of fine aggregate with Spent fire brick up to and replacement of Cement with TWA in combination on 28th day as 44.67Mpa.
7) In the case of replacement of fine aggregate with Spent fire brick and replacement of Cement with TWA in combination, it is found out that there is an increase in all the three strengths compressive, split tensile and flexural. The increase is up to a percentage replacement of 12% of TWA and 24% of Spent fire brick in combination by weight of cement and fine aggregate respectively.
8) The max split tensile strength is achieved by replacement of fine aggregate with Spent fire brick and replacement of Cement with TWA in combination on 28th day as 4.93 Mpa.
9) As it was observed that TWA overall gains strength in the later days due to its pozzolanic activity and hence is a good enough material as the replacement material of cement.
10) The max flexural strength is achieved by replacement of fine aggregate with Spent fire brick and replacement of Cement with TWA in combination on 28th day as 7.34 Mpa.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

REFERENCES

[1] R.Srinivasan (2010): “Experimental Study on Bagasse Ash in Concrete” International Journal for Service Learning in Engineering Vol. 5, No. 2, pp. 60-66, Fall 2010 ISSN 1555-9033.
[2] Prashant O Modani ,M R Vyawahare (2012) **:** “Utilization of Bagasse Ash as a Partial
[3] Replacement of Fine Aggregate in Concrete”Procedia Engineering 51 (2013) 25 – 29
[4] Ali A. Aliabdo (2013): “Utilization of crushed clay brick in concrete industry”
[5] Jayminkumar A. Patel , Dr. D. B. Raijiwala (2015): “Experimental Study on Use of Sugar Cane Bagasse Ash in Concrete by Partially Replacement with Cement” ,,international journal of innovative research in science, engineering and technology.
[6] Bahurudeen, Deepak Kanraj, V. Gokul Dev, Manu Santhanam
[7] (2015):“Performance evaluation of sugarcane bagasse ash blended cement in concrete” Cement & Concrete Composites 59 (2015) 77–88.
[8] Veerni Lakshmi (2016): **“**An Investigation on Flexural Behaviour of Concrete with Fine
[9] Aggregate Partially Replaced with Grog” International Journal of Innovations in Engineering and Technology (IJIET).
[10] R.Subramanian (2017): “An Experimental Study On Partial Replacement Of Crushed Spent Fire Bricks As Fine Aggregate” Vol-3 Issue-5 2017 IJARIIE-ISSN(O)-2395-4396.
[11] N. Shafiq and M. F. Nuruddin (2017): **“**Sudanese Sugar Cane Bagasse Ash: A Useful by-
[12] Product for Concrete” International Journal of Structural and Civil Engineering Research Vol. 6, No. 4, November 2017.
[13] Manoj Kumar (2018): “Partial Replacement Of Fine Aggregates Of Fire Bricks With Fine
[14] Aggregates In Concrete” international Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 3, pp. 961–968, Article ID: IJCIET_09_03_096