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# To Investigate the Behavior of Concrete by Partial Replacement of Stone Dust with Fine Aggregates and Tobacco Waste Ash with Cement

Syed Ali Iman[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:*** ***Concrete is considered to be as a composite material consisting of cement, fine aggregate, and coarse aggregate, and demand for concrete is increasing day by day due to large scale constructions. The industrial waste contains many inorganic and toxic substances far away the acceptable limit which cause an impact on the environment. Scarcity of the const. materials used the natural resources like sand aggregates and stone aggregate. 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. Certain materials of mineral origin are also added to concrete to enhance their strength and durability properties of concrete materials such as Stone Dust 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 Stone Dust. Optimum value of strength in compression, split tensile and flexure came at TWA12%SD44% replacement of the TWA with the Cement and the fine aggregates is partially replaced by the Stone Dust. 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 Stone Dust. 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 Stone Dust and TWA.***
***Keywords: TWA (TOBACCO WASTE ASH), SD (STONE DUST), workability, compressive strength, Split Tensile strength, Flexural strength.***

## I. INTRODUCTION

The most commonly used material in the world is concrete. The annual consumption of concrete is more than ten billion tones. It is ranked at second position after water based upon its global usage. Therefore, its increased consumption is also increasing its costs. Hence in order to find an alternative to concrete, cement has been partially replaced with TWA and fine aggregate has been replaced with stone dust.

### *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. Stone Dust*

Once, stone dust was considered waste material as it was simply the byproduct of crushing other stones. However, it was realized that this byproduct had the potential to be used in several useful ways. The most common use for stone dust is as a base layer or setting bed for laying stone pavers. Homeowners who undertake projects such as laying a patio, flagging a driveway, or creating a garden path may use stone dust as one of the materials for the project. The main reasons why it is used for this purpose are that it is something that you can lay flat and smooth and that it can support the significant weight of the pavers. You can also use stone dust between pavers as filler material to fill the gaps and create an even surface. Similarly, you can use rock dust to fill potholes in concreted areas around your home.

## II. LITERATURE REVIEW

Naveen Kumar A, Vivekananthan, Chithra In a paper entitled "Study the Effects of Tobacco Waste Ash and Waste Glass Powder as a partial replacement of cement on Strength Characteristics of Concrete" partial replacement of cement with tobacco waste ash and waste glass powder was done. The replacement with tobacco waste ash was done in the percentage of 5, 7.5, 10 and 12.5 while the replacement with waste glass powder was done in the percentage of 5, 10, 15 and 20. The tests which were done on the specimen included compressive strength, flexural strength and split tensile. The results of these test showed that he compressive and split tensile tests values of the specimens increases by adding at 10% of Waste glass powder and 10% of tobacco waste ash , whereas flexural strength test values increases at the 12.5% of waste glass powder and 12.5 % of tobacco waste ash. The author finally concluded that the presence of silica from the glass waste powder increased the strength of concrete it further made the concrete more durable and also increased its toughness. The use of tobacco waste ash made the concrete more workable thus reducing the amount of water required.

S.celikten, M. Canbaz 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.

Ashish Kumar Patel, Department of Civil Engineering, Bhilai Institute of Technology, Durg, CG, India Aim of this experiment is the effect of stone dust on mechanical property like compressive strength, workability, split tensile strength by samples were prepared by six samples of concrete in which first sample was prepared by replacing 100%fine aggregate by stone dust. Other samples were prepared by replacing 10%, 20%, 30%, 40%, 50% and 100% replacement of coarse aggregate by ceramic scrap. Conclusion of this experiment is stone dust can be used as an additive in concrete preparation.

Workability of concrete increases with the use of stone dust. Stone dust can be used as an alternate material of fine aggregate both in lean concrete as well as in high strength concrete.

Bhiksham V. , Aim of the experiment shows that they worked on concrete of M40 grade. They prepared standard cubes and under reinforced concrete beams of size 150*230*1500mm for their experiments. The essential parameters for their study area were compressive strength, ultimate load carrying capacity, moment carrying capacity and deflection of RCB (Reinforced Concrete Beam). In their experiments, authors used OPC of 53 grade, stone dust and superplasticizer to reduce w/c ratio. Cubes and under reinforced beams were casted by replacing fine aggregate 25%, 50%, 75% and 100% by stone dust and test have conducted for their relevant parameters. Conclusion from the experiments that replacement of sand by stone dust improved the strength of concrete by 20%. It also decreased total deflection of beam. From the economical point of view, concrete preparation became cheaper by eight percent.

Abbas S.Y., done their research on the M25 concrete. They carried out their work using PPC cement of grade 43. Stone dust was obtained from local stone crusher mill of Mirzapur, India. Cube sample of size 150mm size was prepared and compressive strength at 7 days and 28 days were obtained. Conclusion of research is that optimum percent of replacement of fine aggregate by stone dust is 60%. Replacement of 60% of fine aggregate by stone dust gave better strength at 7 days as well as at 28 days. They also specified that increase in strength might be due to change in the composition of matrix of concrete.

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## 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. Stone Dust*

Stone dust is a fine layered of pulverized stone in this experiment Gray stone dust was collected from the local stone crushing units of Chenab Crusher, Reasi J&K. 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.

| S.No. | Test | Values Obtained |
|---|---|---|
| 1. | Specific Gravity | 2.7 |
| 2. | Fineness Modulus | 2.83 |
| 3. | Free Moisture | 1% |
| 4. | Bulk Density (poured) | 1386 kg/$m^3$ |
| 5. | Bulk Density (tapped) | 1607 kg/$m^3$ |

### *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.

| 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.

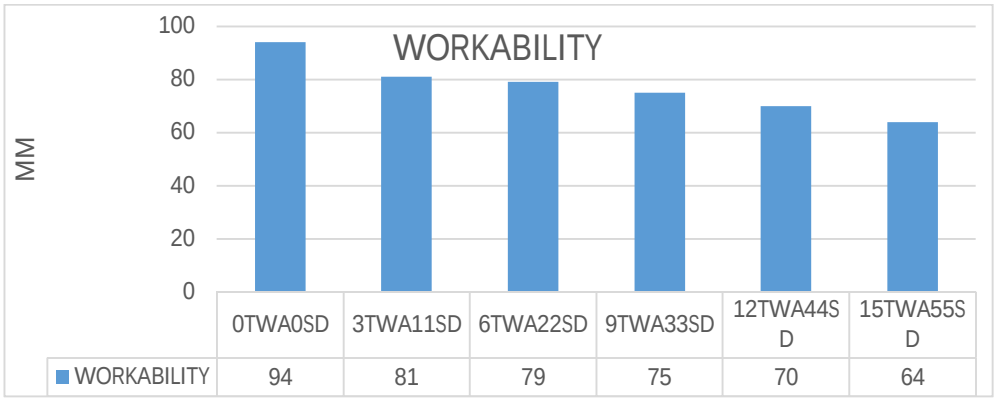


Fig -3: Slump Cone Test

### 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.

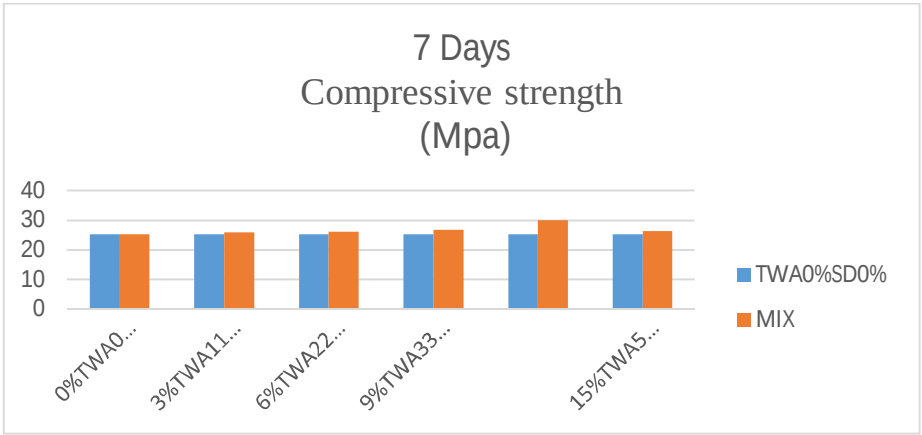


Fig -4: Compressive Strength Test 7

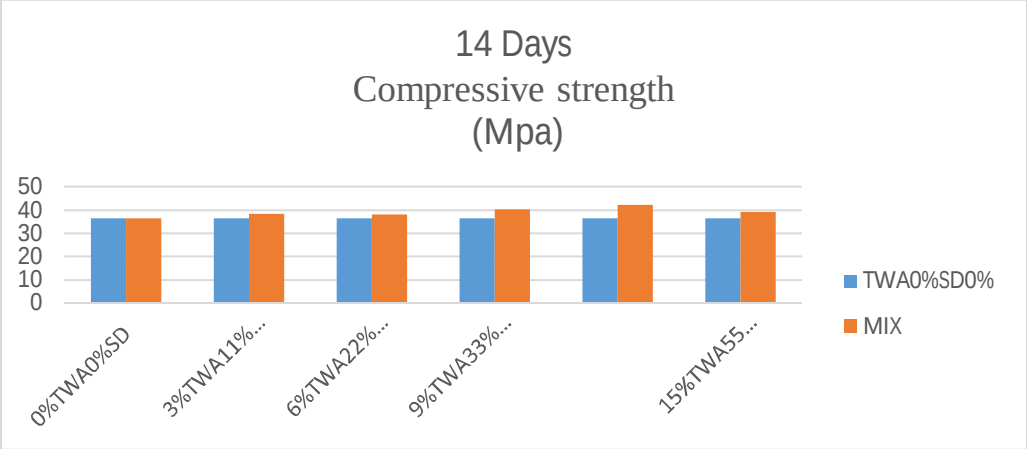


Fig -5: Compressive Strength Test 14

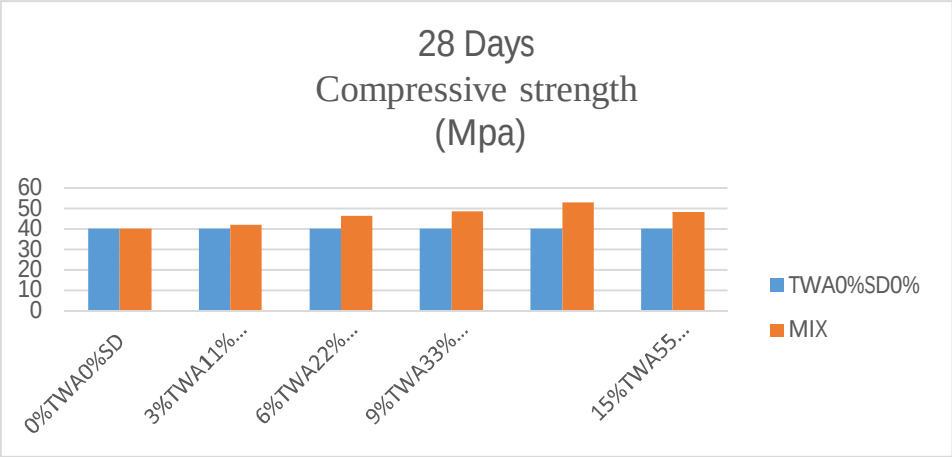


Fig -6: Compressive Strength Test 28

*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.

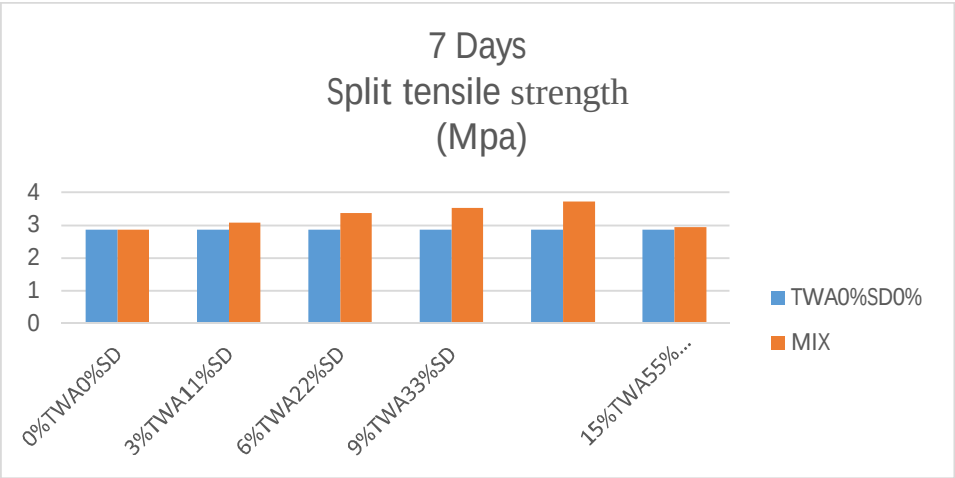


Fig -7: Split Tensile Strength Test 7

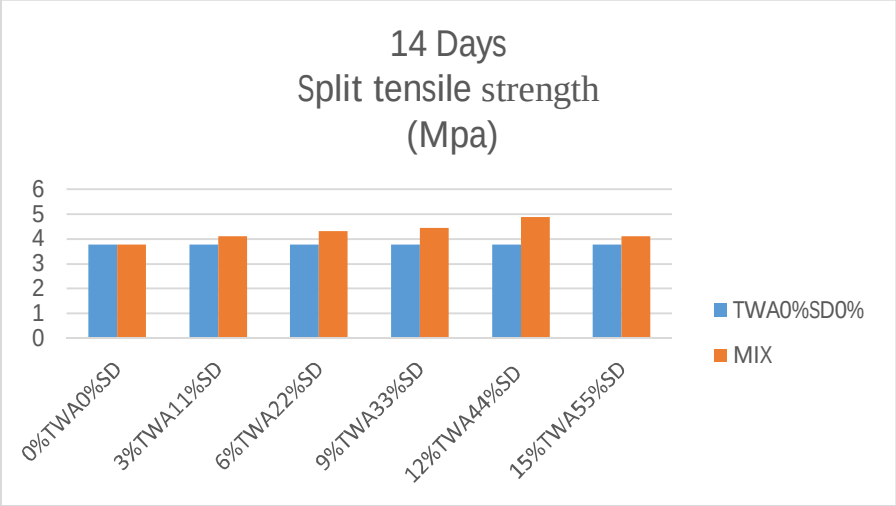


Fig -8: Split Tensile Strength Test 14

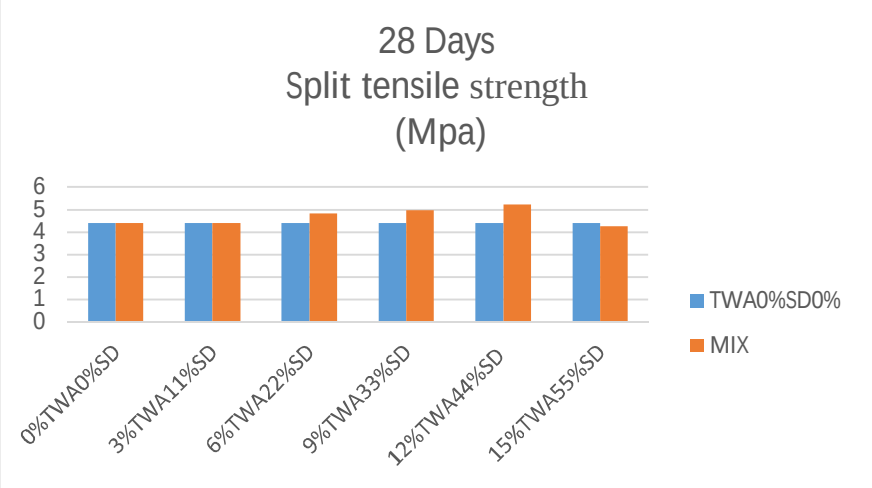


Fig -9: Split Tensile Strength Test 28

*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.

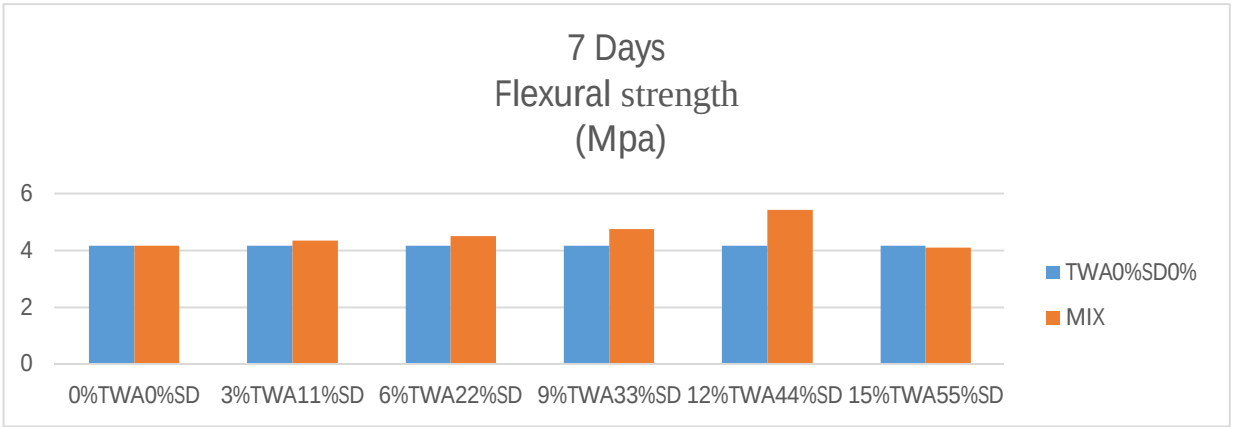


Fig -10: Flexural Strength Test 7

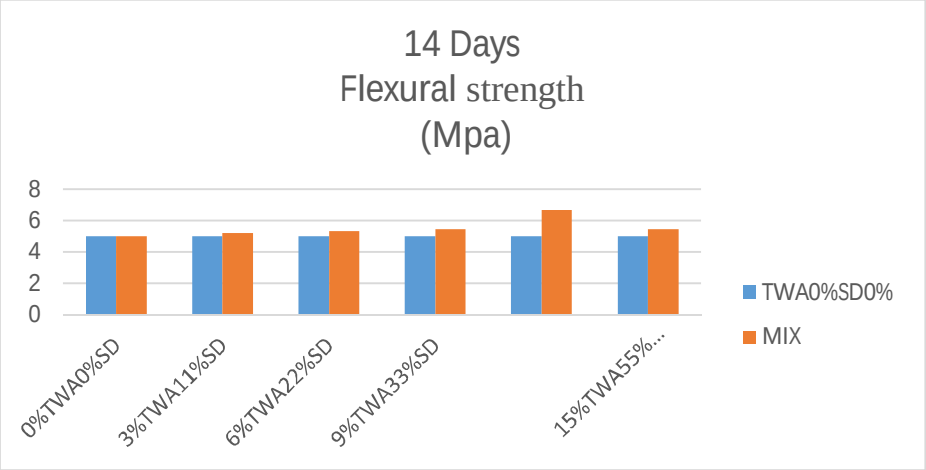


Fig -11: Flexural Strength Test 14

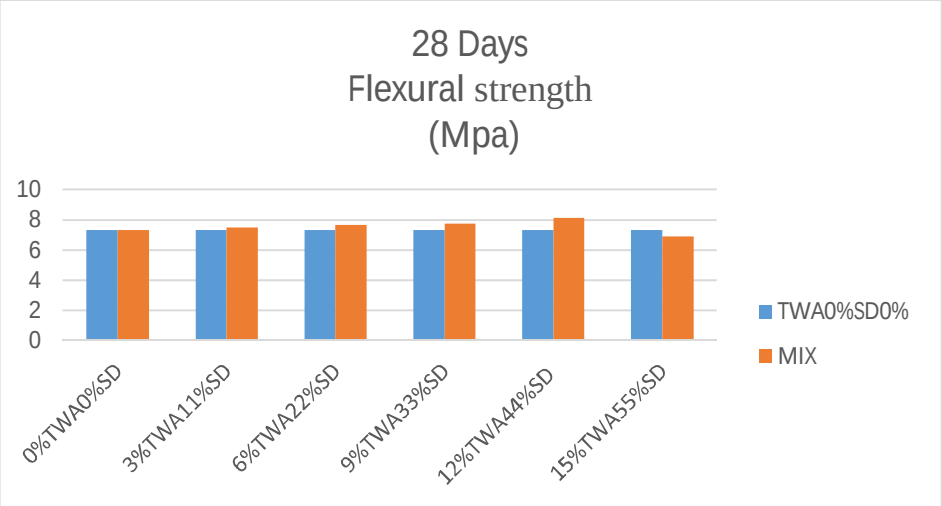


Fig -12: Flexural Strength Test 28

## V. CONCLUSION

The following conclusions of investigation are derived on the basis of results and discussions above:

*1)* The use of TWA and Stone dust 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 Stone dust the concrete was less workable.

*4)* This investigation has also established that the use of TWA and Stone dust 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 Stone dust up to 44%, 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 Stone dust up to and replacement of Cement with TWA in combination on 28$^{th}$ day as 52.91Mpa.

*7)* In the case of replacement of fine aggregate with Stone dust 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 44% of Stone dust in combination by weight of cement and fine aggregate respectively.

*8)* The max split tensile strength is achieved by replacement of fine aggregate with Stone dust and replacement of Cement with TWA in combination on $28^{th}$ day as 5.23 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 Stone dust and replacement of Cement with TWA in combination on $28^{th}$ day as 8.14 Mpa.

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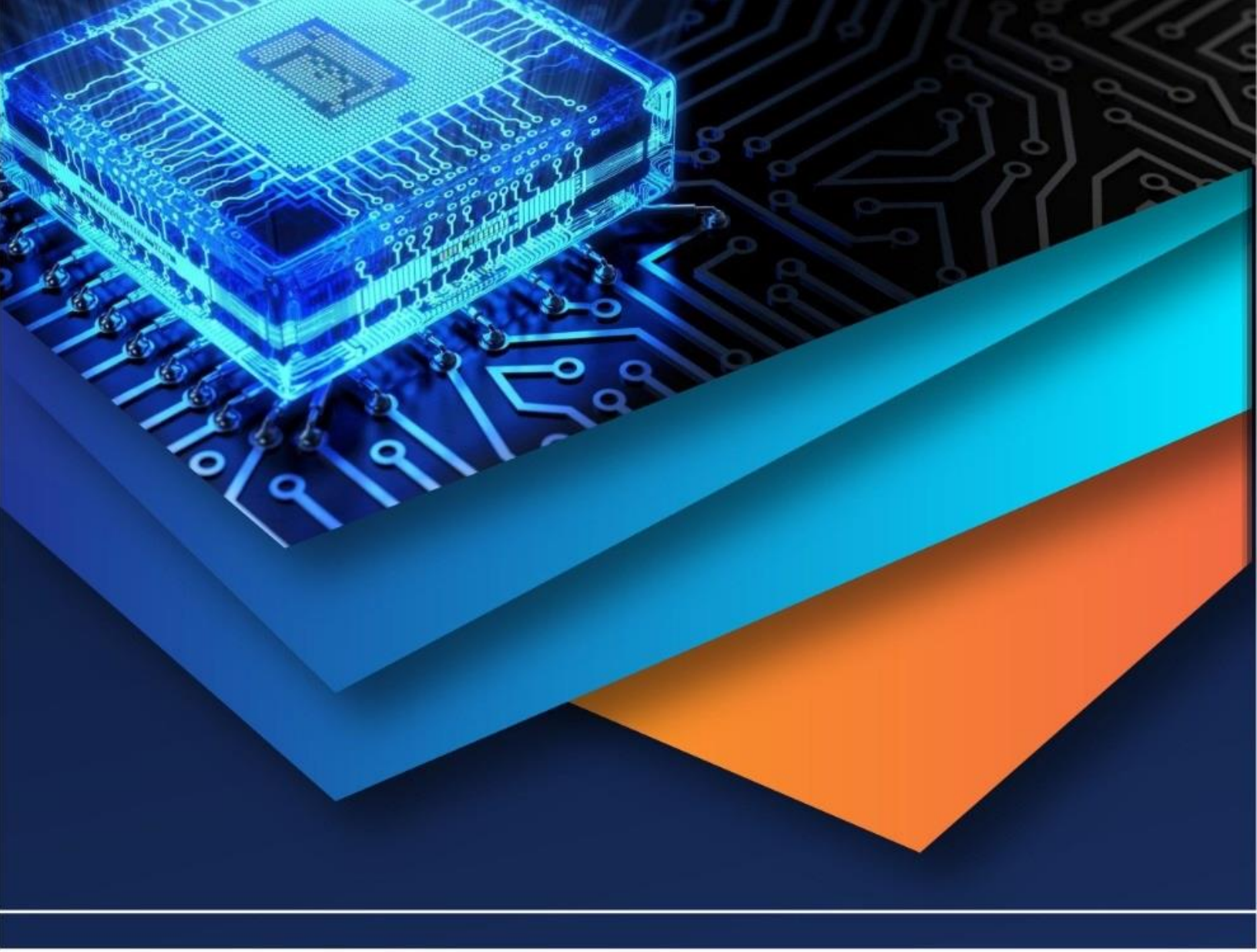

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