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EXPERIMENTAL INVESTIGATION ON CONCRETE WITH REPLACEMENT OF FINE AGGREGATE FROM SCRAP TYRE RUBBER DUST

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Abstract
Concrete is the most widely used construction material in the world in which cement and aggregates are the main constituents. This has led to continuous and increasing demands of natural materials used in there construction. Present study aims to explore the potential utilization of scrap tires rubber in various Portland Cement Concrete categories for the production to study the structural behavior of concrete, and to help partially solving environmental problem produced from disposing waste tires. Raw materials of coarse and fine aggregate used in present study were tested, fine aggregate (sand) was replaced by scrap tire rubber dust of size 595µ, 250µ and 195µ with 5%, 10% and 15% respectively for three grades of concrete (M25, M30 and M35). Compressive strength test was done on hardened concrete and conclusions.

Introduction
Concrete is the major material for the construction of the building. In this time, waste materials available easily. Fly ash, coconut shell, silica fume, plastic waste and waste tyreetc. materials present in the bulk quantity. These materials are hazardous for the environment so to reduce these quantities of the materials, use it in the concrete. Concrete is the mixture of coarse aggregate, fine aggregate, cement and water but use this type of materials to get the optimum strength. By using these materials, its beneficial for the environments and reduce the cost of the concrete. These materials are waste materials so the cost of the materials is also less. If the concrete makes with these material so the cost of the concrete is also less as comparison to the normal concrete. Using the waste tyre material, which can be used either in the road pavement or concrete, is beneficial for the consumption of the wastes. This material uses in the present study and check the effect on the mechanical strength of the concrete.

Material used

1. Cement
The cement taken was Ordinary Portland Cement (Abuja cement) of 43 grade of uniform consistency, conforming to IS 8112- 1989. The test for specific gravity, standard consistency, initial and final setting time and 28 day compressive strength have been conducted Table 1

Table 1: Physical Properties of Ordinary Portlandcement

Sr.No.	Characteristics	ValuesObtained	StandardValues
1.	SpecificGravity	3.21	-
2.	NormalConsistency	32%	-
3.	Initial SettingTime	92 minutes	Not to be less than 30minutes
4.	Final SettingTime	200 minutes	Not to be greater than 600minutes

2. Rubber Aggregate

Finely grounded tyre rubber from which the fabric and steel belts have been removed has a granulartexture and ranges in size from very fine powder to sand-sized particles were used as fine rubberaggregate. The size of rubber aggregates were 595 μ, 250 μ and 177 μ.

3. **Fine Aggregate**

The fine aggregate (river sand- Badarpur) used in the experimental work is locally procured. Sieve analysis of the fine aggregate was carried out in the laboratory as per IS 383-1970, and the results are tabulated in Table 2.

Table2: Physical Properties of Fine Aggregate

Characteristics	Type	Specificgravity	FinenessModulus	GradingZone	Water absorption
Value	NaturalSand	2.72	2.59	II	1.07%

4. Coarse Aggregate

The aggregates which are retained over IS sieve 4.75mm are called as coarse aggregate. The coarse aggregate used in the present study was locally available crushed stones of maximum size of 10 mm. Specific gravity and other physical properties of coarse aggregates are given in Table 3.

Table3: Physical Properties of Coarse Aggregate

Characteristics	Colour	Shape	Maximum Size	Specific Gravity	FinenessModulus	Water absorption
Value	Grey	Angular	20 mm	2.65	6.66	.95%

5. Super Plasticizer

Workability of concrete decreased with the increase in pond ash content, which is incorporated by using super plasticizer. In this study Forsook SP430 super plasticizer is used.

Concrete mix design

The mix design of conventional concrete having the design procedureas per given in IS 10262:2000 adopted for the M-40 grade of concrete. Theratio of the ingredients material is 1:2.07:2.65andthe water/cement ratio is 0.40the for all the mix proportions. The concrete specimens are prepared with pond ash forthe M 40grade of concrete. Three cubes of each variation of pond ash are casted and the average of three test results is taken for the accuracy of the results.

Table 4: Mix Design of Concrete

Material	M25	5% replacement	10% replacement	15% replacement
Cement(kg)	330.00	330.00	330.00	330.00
Fine aggregates(kg)	804.31	764.09	723.88	683.66
Coarse aggregates(kg)	1255.80	1255.80	1255.80	1255.80
Water(ltr)	148.50	148.50	148.50	148.50
Super plasticizer(kg)	1.65	1.65	1.65	1.65
Rubber(kg)	NIL	40.22	80.44	120.65

Compressive strength of concrete

The compressive strength is calculated from the failure load divided by the area resisting the load and reported in Megapascals (MPa) in SI units. In this study the compressive strength of the concrete cubes are determined after 28 days and 56 days of normal curing. From the results of compressive strength it can be seen that the decrease in strength for M25 grade of conrete after 5% replacement of fine aggregate is 9.3%, 11.4% and 18.9% for scrap tyre rubber. There are three types size of aggregate which are No 1 for 595 μm, No. 2 for 250 μm, and No. 3 for 177 μm.

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Table 5: Strength of M25 mixes with 5% tyre dust of different sizes

SL no.	Sample	Grade of concrete	% tyre rubber dust	28 days strength(MPa)	56 days strength(MPa)
1.	Set 1-1	M25	0	26.76	33.47
2.	Set 1-2	M25	5	24.48	30.61
3.	Set 1-3	M25	5	23.95	29.91
4.	Set 1-4	M25	5	21.36	27.41

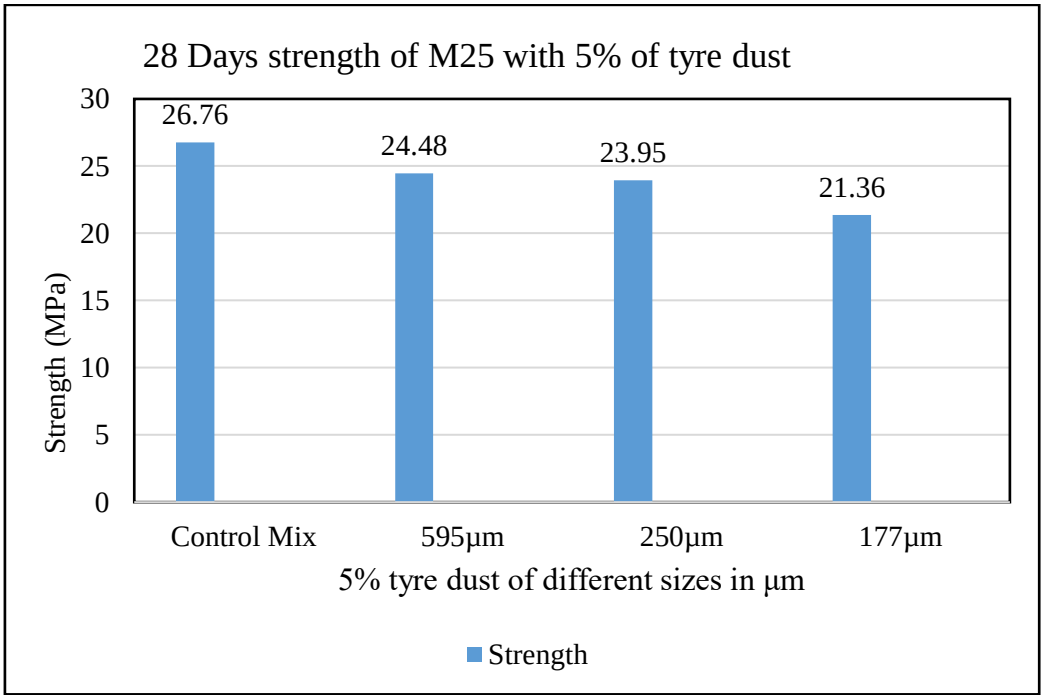

Figure 1: 28 Days strength of M25 with 5% tyre dust of different sizes

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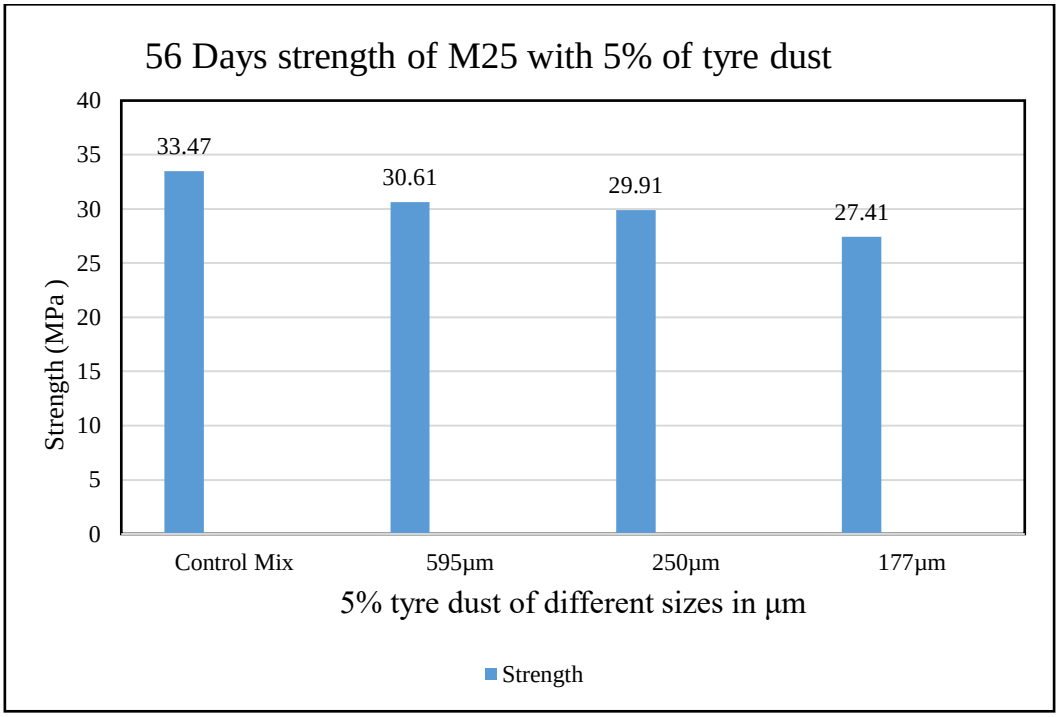

Figure 2: 56 Days strength of M25 with 5% tyre dust of different sizes

Table 6: Strength of M25 mixes with 10% tyre dust of different sizes

SL no.	Sample	Grade of concrete	% tyre rubber dust	28 days strength(MPa)	56 days strength(MPa)
1.	Set 2-1	M25	0	26.76	33.47
2.	Set 2-2	M25	10	22.69	28.64
3.	Set 2-3	M25	10	21.89	26.41
4.	Set 2-4	M25	10	19.48	25.78

From the results of compressive strength it can be seen that the decrease in strength for M25 grade of conrete after 10% replacement of fine aggregate is 14.4%, 21.09% and 22.9% for scrap tyre rubber dust

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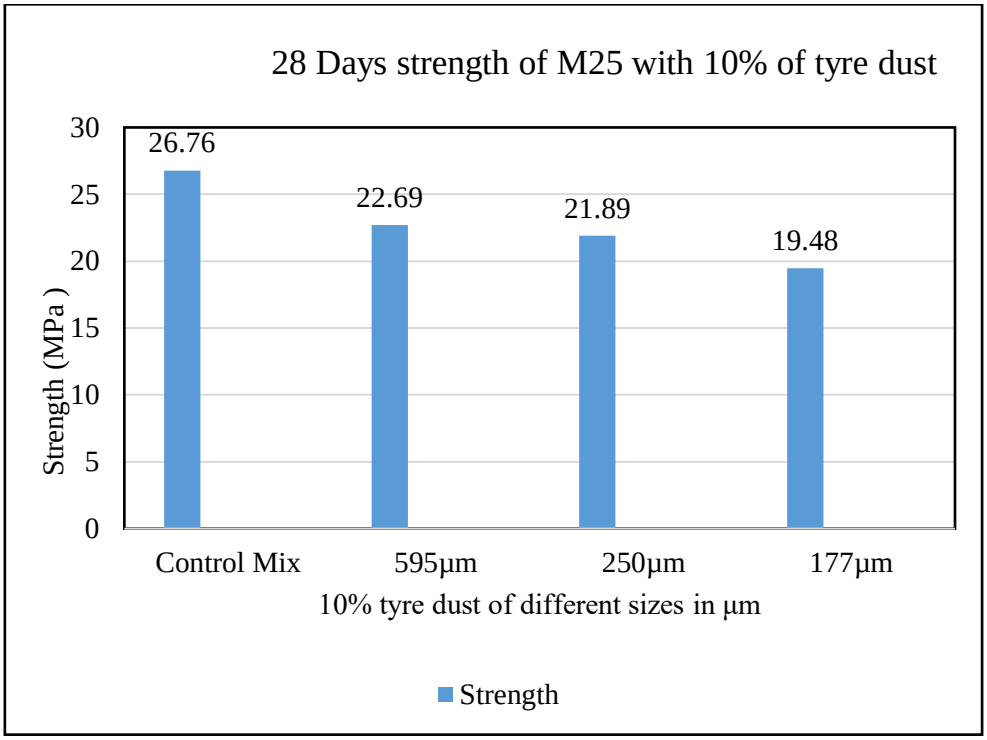

Figure 3: 28 Days strength of M25 with 10% tyre dust of different sizes

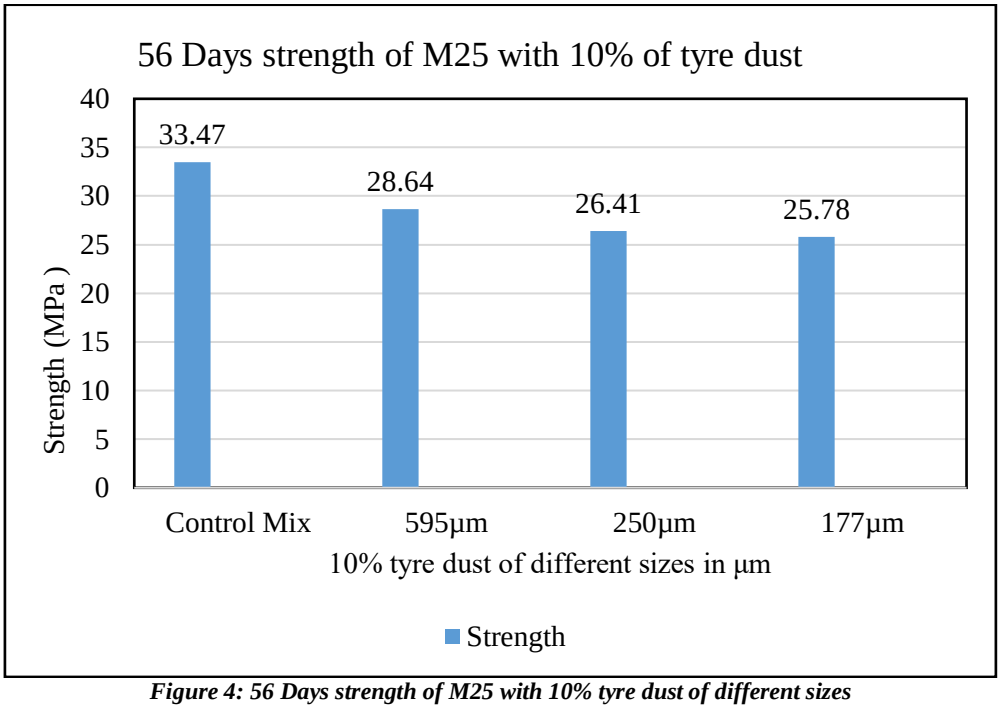

Figure 4: 56 Days strength of M25 with 10% tyre dust of different sizes

Table 7: Strength of M25 mixes with 15% tyre dust of different sizes

SL no.	Sample	Grade of concrete	% tyre rubber dust	28 days strength(MPa)	56 days strength(MPa)
1.	Set 3-1	M25	0	26.76	33.43
2.	Set 3-2	M25	15	19.54	25.48
3.	Set 3-3	M25	15	16.25	23.57
4.	Set 3-4	M25	15	14.87	21.56

From the results of compressive strength it can be observed that the decrease in strength for M25 grade of conrete after 15% replacement of fine aggregate is 23.7%, 29.40% and 34.41% for scrap tyre rubber.

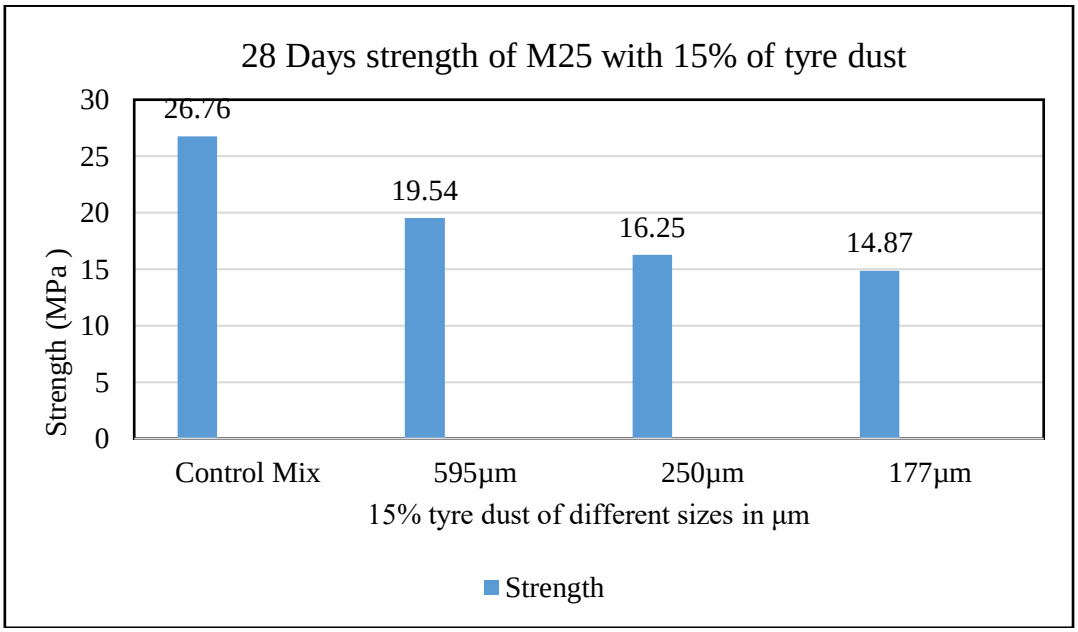

Figure 5: 28 Days strength of M25 with 15% tyre dust of different sizes

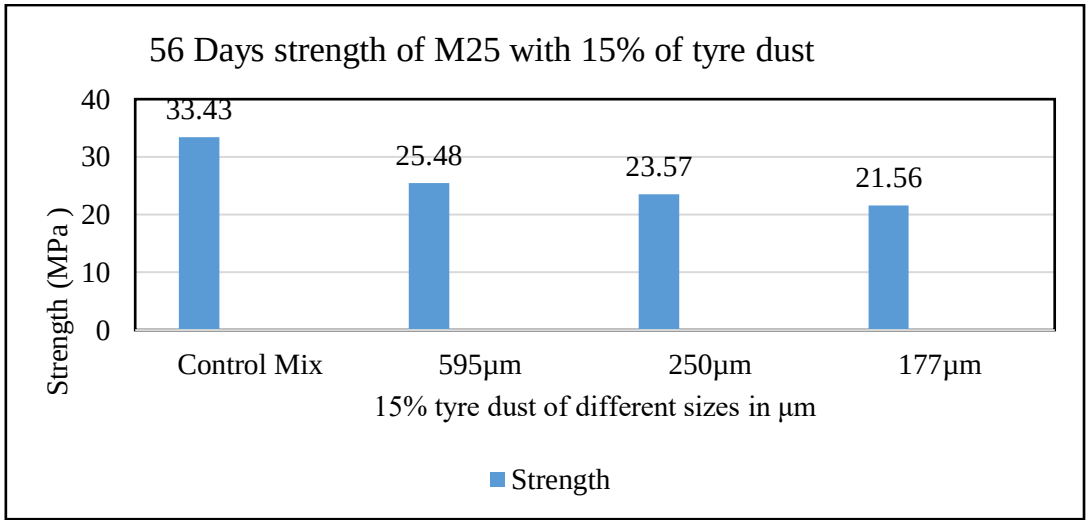

Figure 6: 56 Days strength of M25 with 15% tyre dust of different sizes

Conclusion

From the results obtained from present study it can be further concluded that:

- The test result shows the increase in rubber dust content decrease the compressive strength of concrete significantly. The compressive strength decrease 25.38%, 37.37 % and 79.95% at 28 days respectively and 22.10, 29.82 and 55.05% decrease respectively after 56 days for177 μm.
- The reason for the decrease in the compressive strength can be due to poor bonding of scrap tyre rubber particles with the other particles which makes rubber particels behave as voids resulting in the decrease in compressive strength.
- The compressive strength of concrete also decreases with the decrease in the particles size of rubber aggregate so it is intended to use the rubber aggregate of comparitively larger particle size to replace the fine aggregate.

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