Experimental Investigation On PolyetheleTerepthalate (Pet) Bottle Fibre Concrete

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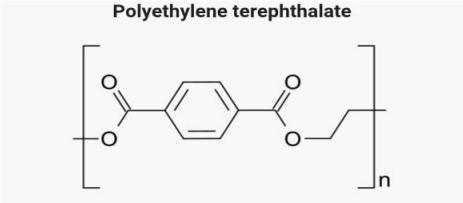
Abstract:This **project presents the work on Polyethelene terephthalate (PET) as an additional constructional material. Recently, PET fibre were proposed to be used as either replacement for fine aggregate or coarse aggregate and Recent studies show that they can be accepted as successful building materials. Since Polyethylene terephthalate (PET) bottles has the properties of a fibre, the waste polyethylene terephthalate (PET) bottle can be converted into fibre and added in concrete as an additional ingredient. PET fibre in concrete can offer high tensile strength. Concrete is Good in compression, durability, fire resistance but weak in tension. By this process the tensile strength of concrete can be increased along with a solution for the disposal of PET bottles. The percentage of fibres added with concrete is 0.25% and 0.5% to the total volume of concrete. The concrete cubes, cylinders are tested at the age of 7, 14, and 28 days of curing. Finally, the strength performance of PET fibre reinforced concrete is compared with the performance of conventional concrete.**

Keywords:PET fibre, additional ingredient,M25 mix, disposal of pet bottles.

I INTRODUCTION

The quantity of plastics of all types consumed annually all over the world has increased substantially. The manufacturing processes, municipal solid wastes (MSW) and service industries generate a large amount of waste plastic materials. With a continuous growth for over 50 years , the global production of plastics rose from 204 million tons in 2002 to 299 million tons in 2013 (Plastics the Facts -2014) and is ever increasing. The worldwide production of PET exceeds 6.7 million tons/year and shows a dramatic increase in the Asian region due to recent increasing demands in China and India (M. L. Anoop Kumar et. al. 2014). In India approximately 40 million tons of solid waste is produced every year. This is increasing at a rate of 1.5 to 2% annually. Plastics comprise 12.3% of total waste produced most of which is from discarded PET water bottles (Ms. K. Ramadevi et. al. 2012). PET bottles are extensively used as containers for beverage, water, household cleaners and oil and are thrown away after single usage. Disposed PET bottles are treated by landfill and burning, which creates serious environmental problems and hence creates waste disposal and management issues.



It is clear that the plastics are harming our natural environment and health all by themselves. It is our use of them that has catastrophic consequences. A material that lasts hundreds of years in the environment should never be used for applications that last seconds, minutes, hours, or even days. Plastic pollution is alarmingly increasing and the major reasons for that are improper disposal, irresponsible design and unsustainable throwaway habits. Hence the need arises to route the waste plastic bottles to their optimum usage.

Communities around the world rely on concrete as a safe strong and simple building material. Concrete is used on a large scale worldwide due to its many advantageous properties like good compressive strength, structural stability, durability, impermeability, specific gravity and fire resistance. Although already pilloried through its use in countless architectural eyesores, from tower blocks to car parks, concrete's defects are also now coming under scrutiny. The material used so widely has its own flaws like lower tensile strength, heavy weight, brittleness, lower crack resistance and lower impact resistance.

II MATERIALS

CEMENT: ***Ordinary*** Portland cement conforming to IS 269-1976 and IS 4031-1968 was adopted in this work. The cement used is 53 grade.

COARSE AGGREGATE*:* ***The*** aggregate used in this project mainly of basalt rock which comes under normal weight category. The aggregate are locally available. The nominal size of coarse aggregate used is 20mm. The coarse aggregate was also tested for various properties like specific gravity, fineness modulus, crushing strength, water absorption to check their suitability for the experiment.

FINE AGGREGATE*:* ***Natural*** sand which is easily available and low in prise was used in the work. It has cubical or rounded shape with smooth surface texture. Being cubical, rounded and smooth texture it gives good workability. Particles of this sand have smooth texture. Sieve analysis was done to find out fineness modulus and specific gravity for sand as per IS .383-90

PET BOTTLE FIBRE :PET bottle fibre is prepared from the collected waste PET bottles using aspect ratio.

Fig:PET bottle fibre

Symbol

III CASTING AND TESTING

Totally 33 cubes, 27 cylinders were casted for M25 mix design. PET bottle fibre was used as the

additional ingredient of concrete in different percentage of 0%, 0.25% and 0.5%. For each percentage of addition of PET bottle fibre 11cubes 9 cylinders were casted. Compression testing machine is used for testing the Compressive strength of cubes and split tensile strength of cylinder.

DETAILS OF TEST SPECIMEN

Details of moulds

Sl.no	SPECIMEN NAME	SIZE OF SPECIMEN
1	CUBE	150X150X150mm
2	CYLINDER	Dia-150mm and Height-300mm

PREPARATION OF SPECIMEN

BATCHING*: The* quantity of ingredients was arrived by conducting proper weight batching and stored separately for mixing.

MIXING: Proper mixing of concrete was carried out manually in a good way

Fig Concrete mixing

PLACING : Mixed concrete is placed in the mould in such a way that there is no chance of segregation. Proper compaction was done by using tamping rod.

FINISHING AND CURING :After placing the concrete, the surface of the specimen was finished properly in a smooth manner. After 24 hours the moulds are removed and the specimen was subjected to curing.

IV EXPERIMENTAL RESULT

COMPRESSIVE STRENGTH

Cubical specimens of size 150mm were casted for conducting compressive strength test for each mix. The compressive stress test was carried out as per IS: 516-1979. This test was carried at the end of 28 days of curing. The compressive strength of any mix was taken as the average of strength of two cubes.

Procedure

Remove the specimen from water after specified curing time and wipe out excess water from the surface. Note the weight and dimension of the specimen. Clean the bearing surface of the testing machine. Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast. Align the specimen centrally on the base plate of the machine. Rotate the moveable portion gently by hand so that

it touches the top surface of the specimen.Apply the load gradually without shock and continuously at the rate of 140kg/cm²/min till the specimen fails. Record the maximum load and note any unusual features in the type of failure.

Compressive strength = $\frac{\text{Load in N}}{\text{Area in Sq.mm}}$

Table: Compressive strength (N/mm²)

Cubes	DAYS	I	II	III	Aver age
PET 0	7 days	17.3	17.5	17.8	17.53
	14days	20.3	20	20.1	20.13
	28days	31.7	31.5	31.9	31.7
PET0.25	7 days	17.3	17.4	17.1	17.26
	14days	19.75	19.6	19.4	19.58
	28days	31.1	30.9	30.6	30.86
PET 0.5	7 days	16.8	16.9	16.5	16.73
	14days	18.75	18.6	18.9	18.75
	28days	30.2	30.5	29.9	30.2

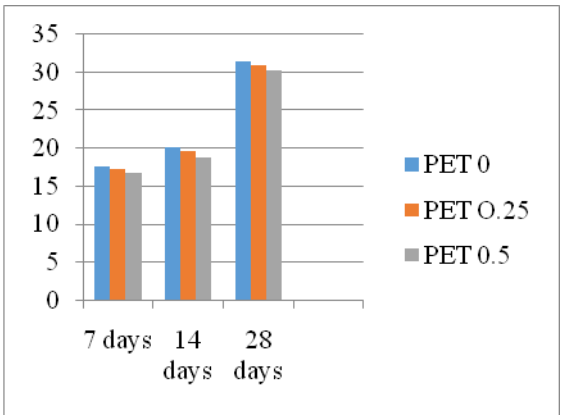


Fig result variation of compressive strength

SPLIT TENSILE STRENGTH

The split tensile strength is the indirect measurement of the tensile strength by placing a cylindrical specimen horizontally between the loading surfaces. This method consists of applying a diametric compressive force along the length of a cylindrical specimen. This loading includes tensile stress on the plane containing the applied load. Tensile failure occurs rather than compressive failure. Plywood strips are used so that the load is applied uniformly along the length of the cylinder and the load is applied until failure of the cylinder, along the vertical diameter. The maximum load is divided by appropriate geometrical factors to obtain the splitting tensile strength of concrete.

Procedure:

Take the wet specimen from water after 7 days of curing. Wipe out water from the surface of specimen. Draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place. Note the weight and dimension of the specimen. Set the compression testing machine for the required range. Keep a plywood strip on the lower plate and place the specimen. Align the specimen so that the lines marked on the ends are vertical and centred over the bottom plate. Place the other plywood strip above the specimen. Bring down the upper plate to touch the plywood strip. Apply the load continuously without shock at a rate of approximately 14-21kg/cm²/min (Which corresponds to a total load of 9900kg/min to 14850kg/min.

Split tensile strength (T) = $\frac{2P}{\pi LD}$

Where, P = Load in N ,L =Height of cylinder in mm, D = Diameter of cylinder in mm

Table: Split tensile strength (N/mm²)

Cylinders	DAYS	I	II	III	Average
PET 0	7 days	1.98	1.95	1.93	1.95
	14days	2.38	2.33	2.3	2.33
	28days	2.99	2.89	2.94	2.94
PET 0.25	7 days	2.10	2.12	2.13	2.11
	14days	2.42	2.48	2.5	2.46
	28days	3.18	3.11	3.16	3.15
PET 0.5	7 days	2.31	2.21	2.4	2.3
	14days	2.7	2.68	2.67	2.68
	28days	3.43	3.2	3.39	3.34

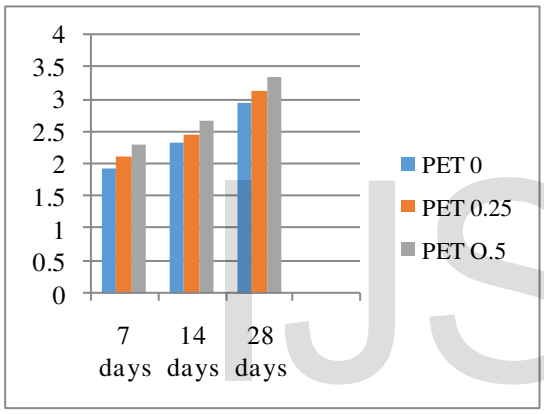


Fig Split tensile strength result variation

V CONCLUSION

The addition of PET bottle fibre as an ingredient in concrete has shown, on the basis of different tests on its mechanical properties, that there is a significant improvement in the modified concrete. The use of PET fibre as additional ingredient of concrete has increase the split tensile strength of concrete but reduction in compressive strength slightly with increase in fibre quantity. But there is no big difference in the Flexural strength.

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