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Performance of Concrete by Using Waste PET and Aggregate as Partial Replacement of Sand and Coarse by M30, M25, M20 Concrete.

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A B S T R A C T

Plastic disposal is now a significant problem for the sustainability of the environment. Concrete construction industry is one of the major sector utilizing natural resources to produce concrete for building constructions Methods/Statistical Analysis: The goal of this paper to decide ideal quality and impact of utilization of reused PET as fractional substitution of fine & coarse aggregate in common Portland bond. This research work presents an investigation of compressive strength, of concrete by adding crushed pet bottles as partial replacement of aggregate in various percentages. Ordinary Portland cement in Concrete and an attempt has been made to investigate the strength parameters of concrete (Compressive Strength). For control concrete, IS method of mix design is adopted and considering this a basis, mix design for replacement method has been made. Five different replacement levels namely 0%,2.5%, 5%,7.5%,10%,12.5% 15%, and 17.5 are chosen for the study concern to replacement method. Large range of curing periods starting from 3days, 7days and 28days are considered in the present study. Cubes (150×150×150mm) with varying ratios of PET will be casted. Total no of cubes casted would be 42. The result showed that the concrete specimen containing PET at 5 % by weight showed higher compressive strength than other specimens. The flexural strength of concrete specimens containing PET aggregate was below that of the control concrete.

Keywords— PET bottles, fine & Coarse aggregate replacement, Split tensile, Compressive strength, Flexural strength

1. INTRODUCTION

Concrete is a popularly exercised substance in the world. further than 10 billion tonnes of Concrete are devoured annually. hinge on wide operation, and it's settled at the alternate situation after water. usual Concrete, a dynamic substance, is a mix of cement, beach, total, and water. Aggregate content is the procurator, which are direct and far- reaching goods on the property of Concrete. Unlike water and cement, which don't blend any personal symptomatic except the volume in which it's exercised, the aggregate element is infinitely variable in tours of shape and grading. Top- quality total, both coarse and fine for Concrete, is of veritably extreme significance. summations consume 60 to 80 of the grand base measure of Concrete and affect the fresh and toughened patches of Concrete. Out of the grand composition of Concrete, the fine total consumes around 18 to 30 of the measure. Concrete is one of the most extensively exercised construction productions in the world. It's admixture of cement, fine total, course total and water. Concrete construction doesn't bear largely professed labour. The continuity of concrete depends upon proportioning, mingling and compacting of the constituents. numerous experimenters have tried for the application of plastic waste and many have alluded its application in concrete in numerous forms. The application of waste in the construction assiduity has two striking tips, one, environmental jolt is managed by discarding of the waste and second, the profitable jolt and this waste has the bite of being accessible voluminous volume. Concrete being the extensively exercised construction substance in the world estimated up to 11 billion metric tons every time. true concrete constituents are cement, beach and coarse total which are exercised widely for producing concrete.

1.1 OBJECTIVES OF THE PRESENT INVESTIGATION

In this study, the main aim is to find out the variations that will occur on rheological, mechanical, and physical properties of SCC when shredded waste PET granules (WPET) are added in a partial replacement of coarse aggregates at different substitution levels, for water/binder (w/b) of 0.48. The objectives to be investigated are:

The main objects in the present-day investigation are as following: -

- To determine the workability on fresh concrete by influence of waste PET plastic aggregates.
- To evaluate the mechanical properties of hardened concrete with effect of PET plastic aggregate.
- Compressive strength (σc)

- Flexural strength,
- Splitting tensile strength, and

1.2 LITERATURE SURVEY

Grounded on the once experimenter following are the literature check done for the present disquisition:

Choi et al. (2005) This paper investigates the face microstructure of waste polyethylene terephthalate (PET) bottles feather light aggregate (WPLA) to examine the sequel of granulated blast- furnace deposition (GBFS) on WPLA. The WPLA was made from the waste PET bottles and GBFS, and experimental experiments were conducted on compressive energy, ramifying tensile energy, modulus of bendy point, depression, and density of waste PET bottles feather light aggregate concrete (WPLAC). The 28- day compressive energy of WPLAC with the relief rate of 75 reduces about 33 assimilated to the control concrete in the water – cement rate of 45. The density of WPLAC varies from 1940 to 2260 kg/ m3 by the influence of WPLA. The structural forcefulness of WPLAC decreases as the relief rate raises. The malleability of concrete with 75 WPLA improves about 123 assimilated to that of the usual concrete in the water – cement rate of 53. The wedged GBFS is able to toughen the face of WPLA and to constrict the transition belt owing to the reaction with calcium hydroxide.

Albano et al. (2009) The thing 1 of this work was to study the mechanical be havior of concrete with recycled Polyethylene Therephtalate (PET), varying the water/ cement rate(0.50and0.60), PET content (10 and 20vol) and the flyspeck size. Also, the influence of the thermal degeneration of PET in the concrete was studied, when the mixes were exposed to non-identical temperatures (200, 400, 600 °C). effects indicate that PET- filled concrete, when measure proportion and flyspeck size of PET swelled, showed off a drop in compressive energy, ramifying tensile energy, modulus of elasticity and ultrasonic pulsation haste; still, the water absorption swelled. On the other phase, the flexural energy of concrete- PET when exposed to a heat source was strongly dependent on the temperature, water/ cement rate, as well as on the PET content and flyspeck size. also, the activation dynamism was affected by the temperature, PET spots situation on the beams and water/ cement rate.

Welle (2011) Polyethylene terephthalate (PET) has come the most favourable packaging substance world- wide for potables. The argument for this evolution is the excellent substance parcels of the PET stuff, especially its un breakability and the veritably low cargo of the bottles assimilated to glass bottles of the same stuffing volume. currently, PET bottles are exercised for soft drinks, mineral water, dynamism quenchers, ice teas as well as for more sensitive potables like beer, wine and authorities. For a long time, still, a bottle to- bottle recycling of post- consumer PET packaging paraphernalia wasn't practicable, because of the lack of knowledge about impurity of packaging polymers during first use or remembrance. In extension, the decontamination edge of recycling processes were in utmost cases unknown. During the last 20 times, PET remembrance as well as recovering processes made a huge process. moment, sophisticated decontamination processes, consequently called super- clean recycling processes, are accessible for PET, which are able to de-contaminate post- consumer adulterants to concentration situations of virgin PET paraphernalia In the 1991, the first food connection blessing of post- consumer PET in direct food connection missions has been given away for post- consumer recycled PET in the USA. Now, 20 times after the first food blessing of a PET super- clean recycling process, this composition gives an overview over the world- wide process of the bottle- to- bottle recycling of PET libation bottles, e.g. the recollection quantum of post-consumer PET bottles and the super-clean recycling technologies

Akcaozoglu et al. (2013) In this study, the influence of waste PET as feather light total (WPLA) relief with conventional total, on thermal conductivity, unit cargo and compressive strength parcels of concrete compound was delved. For this purpose, five different fusions were prepared (the control fusions and four WPLA fusions including 30, 40, 50, and 60 waste PET total by volume). Thermal conductivity (TC) portions of the samples were measured with guarded hot plate outfit tallying to TS ISO 8302 (1). The thermal conductivity measure, unit cargo and compressive energy of slices ceased as the quantum of WPLA swelled in concrete. The minimal thermal conductivity value was0.3924 W/ m K, observed at 60 WPLA relief. From this result, it was concluded that waste PET summations relief with conventional total in the admixture showed better sequestration parcels (i.e. lower thermal measure). Due to the low unit cargo and thermal conductivity valuations of WPLA mixes, there's a eventuality of using WPLA mixes in construction operations.

Ge, yue, sun (2015) This paper studied the fabrication and parcels, including strength, water immersion, resistance to sulfate attack and chloride ion penetration, and micro-structure of a new type of mortar made with recycled complexion slipup (CB) and post-consumer polyethylene terephthalate(PET). The goods of binder to CB total rate and curing condition on strength were delved. The results indicate that binder to CB total rate had a significant influence on strength. The optimum value was 12. For curing condition, instance cured at 180 °C for 2h had advanced strength. The instance with proper blend proportion and curing could reach42.5 MPa and12.6 MPa for compressive and flexural strength, independently. Also, the 4- h compressive strength was85.4 of 28- day Energy. The PET mortar had low water absorption of0.87 and high defiance to sulfate strike Scanning electron micro scope (SEM) test showed that PET mortar had invariant micro-structure with veritably low porosity. The CB total was well covered by PET. There were no micro-cracks set up in the total- paste interfacial area.

Mohammed. (2017) of concrete containing PET plastic wastes are now well understood as a result of multitudinous experimental experiments. Aspects of structural project and dissection of concrete ingredients made from concrete containing PET waste need accurate equations for mechanical groupings. In this paper, accessible data on mechanical groupings of usual energy concrete containing PET waste were collected, analyzed, and equations were developed for calculating elastic modulus, splitting and flexural tensile puissance. effects of dissection indicate that, in general, there is a good correlation between the three groupings and compressive energy of concrete containing PET plastic waste. The proffered equations were set up to be safe and accurate, and can apply for recycled concrete containing non identical manners of plastic waste other than tattered PET waste. The models proffered for mechanical groupings can be assumed in the dissection and project of those structural ingredients made from recycled concrete containing PET waste and some other plastic wastes

Filella (2020) Over the last 30 moments, bottled water has gained in popularity reaching high deals world- wide. ultimate of this water is sold in polyethylene terephthalate(PET) bottles. Around 15 moments ag one 10 the presence of antimony in water in those PET bottles expressed enterprises and inquiries on the motive have been regularly published since also. This review aims to estimate whether the use of good logical practices and the accurate project of these inquiries support the accepted data (i.e., PET is the origin of antimony presence in bottled waters, antimony concentration are usually below restrained valuations, temperature adding favours antimony filtering). The detailed dissection of published data has vindicated these data but has also revealed frequency of imperfect logical practices and a lack of well- aimed inquiries. A better understanding of the structure of PET polymer in the bottles, fused with statistically- robust antimony release trials, is demanded to process in the field.

Lazorenko et al. (2022) This work investigates the recycling potentiality of polyethylene terephthalate(PET) bottle wastes as natural sand cover in geo polymer(GP) mixtures to reduce plastic toxin and transition to a circular economy. Fresh and inured groupings of coal cover ash- predicated GP mortars with relief of quartz sand by grinded fine PET spots of0.315 –1.25 mm in size (20, 40, 60, 80 and 100) were estimated. It was set up out that an boost in plastic aggregate content leads to a drop in compressive energy and flexural energy of geo polymer mortars. In turn, the splitting tensile energy swelled hardly when up to 40 of the sand measure was displaced by plastic aggregate. At this relief situation, the fresh geo polymer mixes had malleability close to that of usual mortar. The flake- suchlike PET spots contributed to the reduction of cracking of the slices and farther ductile failure modes. also, GP mortars containing recycled PET bottle wastes at the full relief situation of natural aggregate showed off vantages in feather light (up to 15), water absorption up to 26) and thermal insulation groupings (up to 59), allowing product of sustainable construction paraphernalia with environmental and profitable advantages.

Sarde et al. (2022) In this study to prepare a novel polymer mortar (PM) composite comprising unsaturated polyester resin (UPR) derived from polyethylene terephthalate (PET), as a replacement for cement; calcined kaolin clay as a filler; and silica sand as an aggregate. present study, the effects compressive, tensile, and flexure strengths of the UPR2 PM formulation increased by 19.48, 25, and 28.21 %, respectively, compared to UPR1 PM. In addition, UPR2 PM with 20 % kaolin clay and sand (II) exhibited a decrease in water absorption, mass loss, and loss in compressive strength by 28.20, 15.90, and 7.31 %, respectively, compared to PM containing 18 % kaolin filler and sand (I). Moreover, the experimental trial results indicate that sand grading significantly influenced the properties of the UPR PM composite. The UPR resin prepared from waste PET and modified utilizing MMA can be successfully utilizing as a binder in PM composites to making mortar for interior decoration, repairing, grouting, and lightweight precast products in construction applications.

Saha et. al. (2023) Plastic waste operation 56 is one of the major global expostulations at present-day. 30 Recycling single exercised plastic waste as partial relief of natural aggregates in concrete may reduce cases descrying mismanagement of plastic waste and unsustainable utilization of natural resources as aggregates. This generality has been explored in multitudinous inquiries and positive effects are attained, but 25 it has not been materialized at a voluminous scale due to the query descrying profitable viability. The present-day study therefore focuses on the profitable aspects of utilizing Polyethylene predicated fine aggregates and Polyethylene Terephthalate predicated coarse aggregates as partial relief (10, 20, 30 and 40) of natural fine and coarse aggregates singly and simultaneously, with special emphasis given away on environmental and gregarious cost. A substance flux illustration utilizing STAN is first developed to calculate plastic waste generation. An artificial check 14 has been conducted to estimate product cost of plastic aggregates, while gregarious cost as WTP is determined through CVM system. The result shows that the grand cost of concrete disparagements with boost of relief luck and cost reduction varies between0.65 and7.58 analogize to usual concrete depending on the luck and type of relief without compromising energy. consequently, alongside being monstrously salutary to fiefdom and society in tours of reduction of leachate and greenhouse gas-plastic toxin, demand of tip area, mosquito borne conditions, erosion, sedimentation, land loss etc. the generality of recycling plastic waste as partial relief of natural aggregates in concrete has been substantiated to be economically doable and salutary too.

Huynh et al. (2023) present study addressed the issue of recycling waste plastic bottles as recycled plastic fiber (RPF) into sustainable waste plastic fiber-reinforced concrete (WPFRC). Thus, the effects of different RPF lengths (30, 50, and 70 mm), widths (2, 4, and 6 mm), and contents (0.3, 0.45, and 0.6 vol.%) on the performance of WPFRC were systematically examination through the laboratory test series of workability, fresh unit weight, compressive and flexural strengths, drying shrinkage, water absorption, and ultrasonic pulse velocity. Test results show that the addition of RPF had a negligible effect on the fresh properties of the WPFRC mixtures, while significantly enhancing the load-bearing capacity and reducing drying shrinkage in the WPFRC samples, particularly at early periods. Additionally, all WPFRC samples displayed low water absorption rates and high ultrasonic pulse velocities, indicating good quality and durability. Overall, the study found that an RPF content of 0.45% by volume, an RPF length of 70 mm, and an RPF width of 2 mm yielded the best performance for WPFRC. As a test result, incorporating RPF into concrete fosters the development of strong, durable, and sustainable materials for green construction.

Patel et al. (2023) Environmental conditions have deteriorated in recent decade study with increasing human intervention. Plastic is the most commonly utilizing manufacturing material due to its low manufacturing cost, availability, durability, and long life. It also has one of the minimum decline rates for plastics. Due to this property, removing plastics from the environment can be a very difficult challenges. Environmental protection is calling on communities to utilizing plastic waste. Such reuse occurs in the construction of buildings. This paper presents strong performance test result for concrete modified with in addition to waste plastic fibers. Waste bottles made up of polypropylene terephthalate (PET) were utilizing in the research work. Flexural and compressive strength were obtained to identify the viability of PET fibers as concrete components. Aggregate of 14 batches of concrete cube were cast in classes M40 and M25. Waste PET fibers were added to the concrete in alternating proportions starting at 0–1.5% and in incremental intervals of

0.25 volume mixture. A critical goal is to determine the quantity of PET incorporated into concrete. Consistent with the test results, the strength behavior of M40 and M25 concrete mixtures is somewhat similar.

1.3 Material used & Methodology

1.3.1 MATERIAL USED

1.3.1.1 CEMENT OPC 53 GRADE

Ordinary Portland Cement (OPC) Conforming to IS 12269:1983 (53 Grade) was used for the experimental work. The properties of material used for making concrete mix is determined in laboratory as per relevant codes of practice. Different materials used in tests were OPC, coarse aggregates, fine aggregates, rice and waste PET, Physical and chemical properties.

1.3.1.2 FINE AGGREGATE

In this experiment, two different sizes of fine aggregates 3, and 5 mm in diameter, and coarse aggregate with maximum size of 10 mm in diameter were adopted. In order to discover the graduation of coarse and fine aggregates, IS 383:1970 sieve analysis was done to every size ,according to IS 1607 (1977) standard.

1.3.1.3 COARSE AGGREGATE

The sand used for the work was locally procured and conformed to Indian Standard Specifications (IS: 383-1970). The fine aggregated belonged to grading zone III. Aggregates constitute the bulk of a concrete mixture and give dimensional stability to concrete. The aggregates provide about 75% of the body of the concrete and hence its influence is extremely important Locally available coarse aggregate having the maximum size of 20 mm was used in this work. The aggregates were tested as per IS: 383-1970.

1.3.1.4 WASTE PET AGGREGATE

PET is commonly used for carbonated beverage, water bottles and many food products. PET provides very good alcohol and essential oil barrier properties, generally good chemical resistance and a high degree of impact resistance and tensile strength.

1. To study the properties of PET.
2. To guide a relative study of plastic aggregate & natural aggregate.
3. To study the sequel of replacing natural aggregate with plastic aggregate on
4. workability, compressive strength & flexural strength of concrete.

1.3.1.5 WATER MIXING

Water: In this experiment, we used normal tap water which is free from organic subsistence and impurities whose pH value is 6.86.

1.4 MIX DESIGN PROPORTIONING

M30 grade of mix design has been prepared as per IS 10262:2009 guidelines Method,replaced with cement in all the mixes and Rivers sand Coarse aggregate was replaced by PET bottle waste (0, 2.5, 5, 7.5, 10, 12.5, 15, and 17.5 %) by its weight. For this Experiment we have use water-cement ratio as 0.48. The purpose of opting able constituents of concrete arbitrating their relative quantities with ideal of producing concrete of needed energy, continuity and plasticity and provident practicable is nominated as Concrete Mix Design. As per Indian Standard Concrete Mix proportioning Guidelines IS:10262 (2009) concrete mix designs has been done.

Table 1.4: the mixture proportions used in laboratory for Experimentation are shown in table

Mix	**%**	**W/c ratio**	**Water (Kg/m^3)**	**Cement (Kg/m^3)**	**Fine aggregates (Kg/m^3)**	**Coarse aggregates (Kg/m^3)**	**Pet bottles Plastic (Kg/m^3)**
Control	0	0.48	192	400	726.64	1136.55	-
Plastic	2.5	0.48	192	400	726.64	1108.14	28.41
	5	0.48	192	400	726.64	1079.73	56.82
	7.5	0.48	192	400	726.64	1051.31	85.24
	10	0.48	192	400	726.64	1022.9	113.65
	12.5	0.48	192	400	726.64	994.49	142.06
	15	0.48	192	400	726.64	966.07	170.48
	17.5	0.48	192	400	726.64	937.66	198.89

1.5 EXPERIMENTAL PROGRAM

Eight different substitution percentages of Fine & coarse aggregates 0, 2.5, 5, 7.5, 10, 12.5, 15, and 17.5 % with PA were done to investigate the influences of PA on self-compacting concrete properties. To achieve this aim, Eight batches were organized for the desired experiments. In the current thesis, a comparison among every replacement percentage will be done according to the control samples.

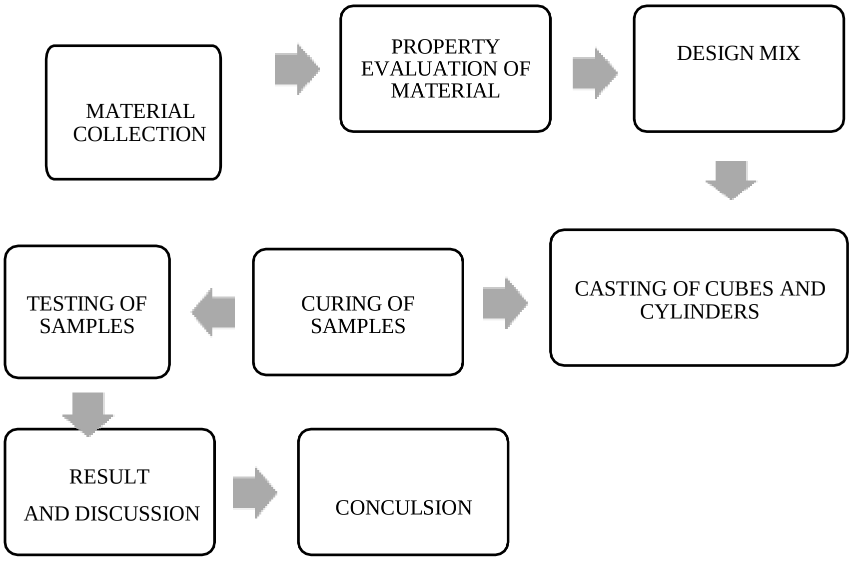


Fig. 1.5 Layout of work done

1.6 RESULTS AND DISCUSSIONS

In this chapter, the experimental outcomes and results of Eight different concrete mixtures are included and discussed. Results and discussions are displayed for workability test of fresh SCC, σ_c test, σ_s test, flexural strength test, ultrasonic pulse velocity test, and fire resistance test.

1.6.1 PROPERTIES OF FRESH W- PET-SC- CONCRETE

The slump cone tests results of the different substitution levels of W-PET by Fine & coarse aggregates 0, 2.5, 5, 7.5, 10, 12.5, 15, and 17.5 % are shown in Table 1.6.1.2 Graph 1.6.1.2 respectively. The results show that as PET content in the mix increased, the workability of W-PET-SC Concrete has a tendency to decrease.

1.6.1.1 WORKABILIT:

The workability of concrete is an important property to determine before placing Concrete. Concrete with a high compaction factor is said to be more workable.

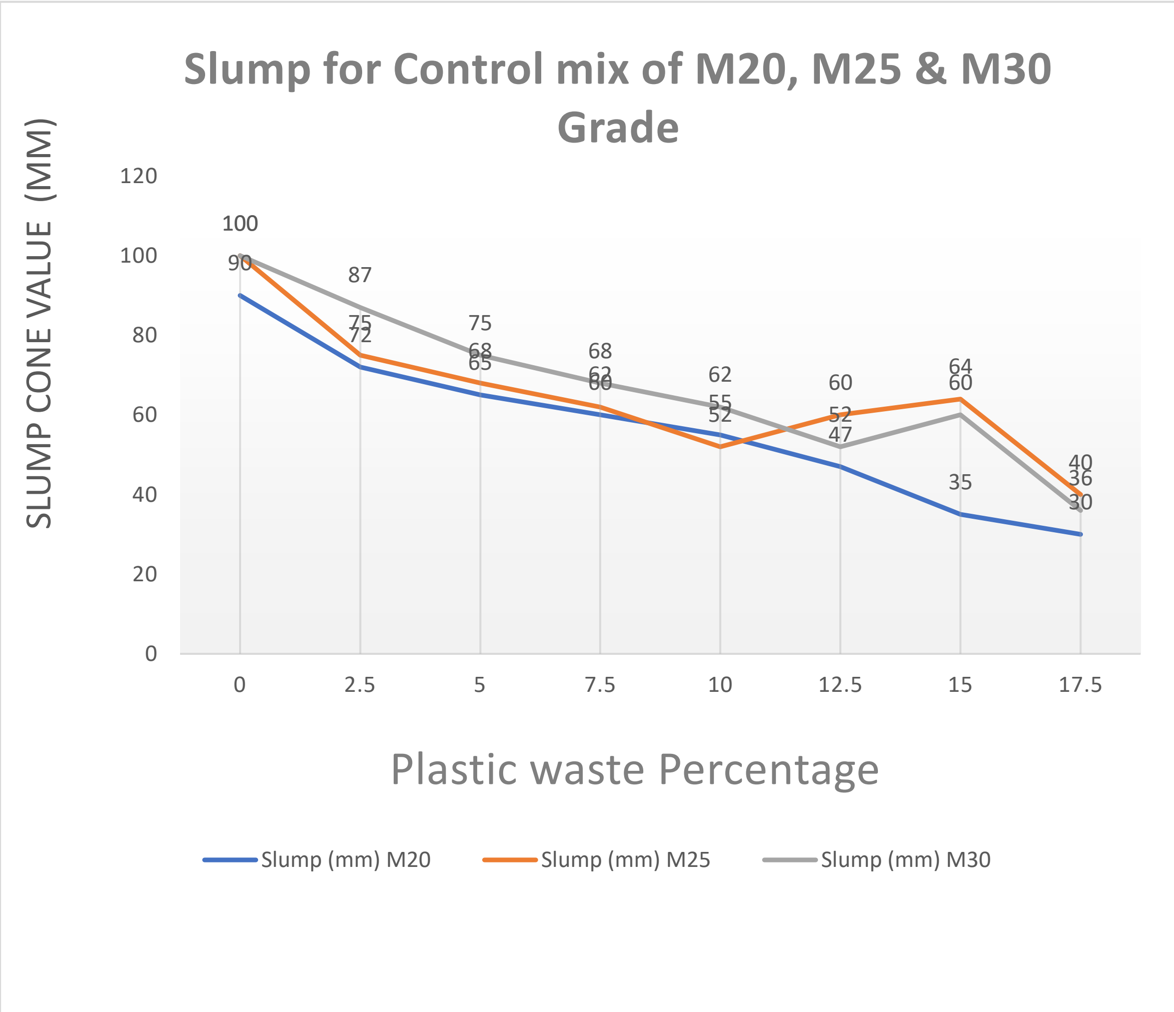
1.6.1.2 SLUM CONE TEST:

These experimentations scale the thickness of fresh concrete and also check the workability of fresh concrete. The slump test value has been conducted according to IS1199- 1959 and attained 87 mm which indicates degree of plasticity is medium.

Table No. 1.6.1.2 Slump for Control mix of M20, M25 & M30 Grade

S. No.	Plastic waste %	Slump (mm)	Slump (mm)	Slump (mm)
		M20	M25	M30
1	0	90	100	100
2	2.5	72	75	87
3	5	65	68	75
4	7.5	60	62	68
5	10	55	52	62
6	12.5	47	60	52
7	15	35	64	60
8	17.5	30	40	36

Graph. 1.6.1.2 Slump for Control mix of M25 & M30 Grade]



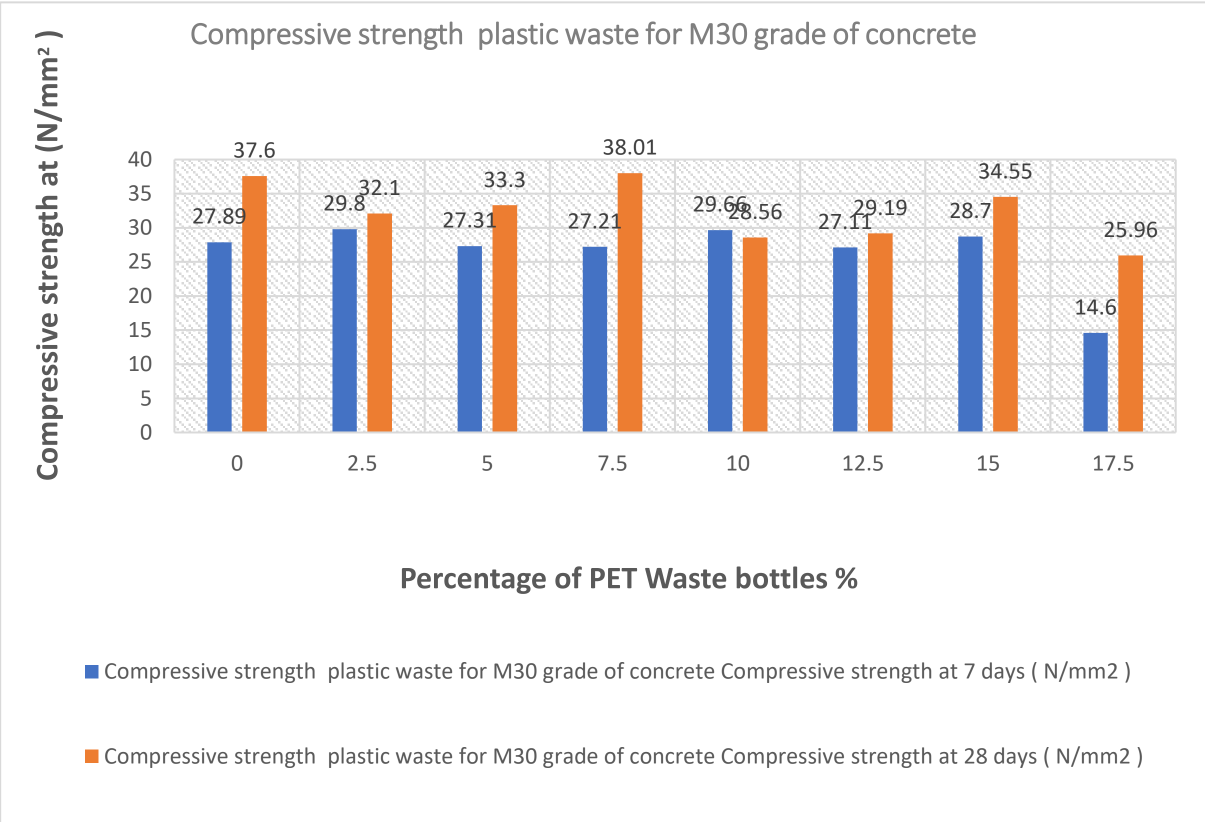
1.6.2 HARDENED CONCRETE TESTS

1.6.2.1 EFFECT OF AGE ON COMPRESSIVE STRENGTH

The 28days strength obtained for M30 Grade Control concrete is 34.55 N/mm^2.The strength results reported in table are presented in the form of graphical variations, where the compressive strength is plotted against the % of Aggregate replacement.Table 1.6.2.1 Compressive Strength of Control concrete in N/mm^2

Grade of concrete	7Days	28Days
M30	28.7	34.55

The strength attained at different ages namely, 7 and 28 for Control concrete are also represented in table 1.6.2.1



Graph. 1.6.2.1 Compressive Strength of Control concrete in N/mm^2

From the Graph, it is clear that as the age advances, the strength of Control concrete increases. The rate of increase of strength is higher at curing period up to 28 days However the strength gain continues at a slower rate after 28 days. Graph 1.6.2.1

Table 1.6.2.1: Compressive Strength of PET Concrete Strength of Control concrete in N/mm^2

	Compressive strength plastic waste for M30 grade of concrete		
S.NO.	Percentage of PET Waste bottles %	Compressive strength at 7 days (N/mm^2)	Compressive strength at 28 days (N/mm^2)
1	0	27.89	37.6
2	2.5	29.8	32.1
3	5	27.31	33.3
4	7.5	27.21	38.01
5	10	29.66	28.56
6	12.5	27.11	29.19
7	15	28.7	34.55
8	17.5	14.6	25.96

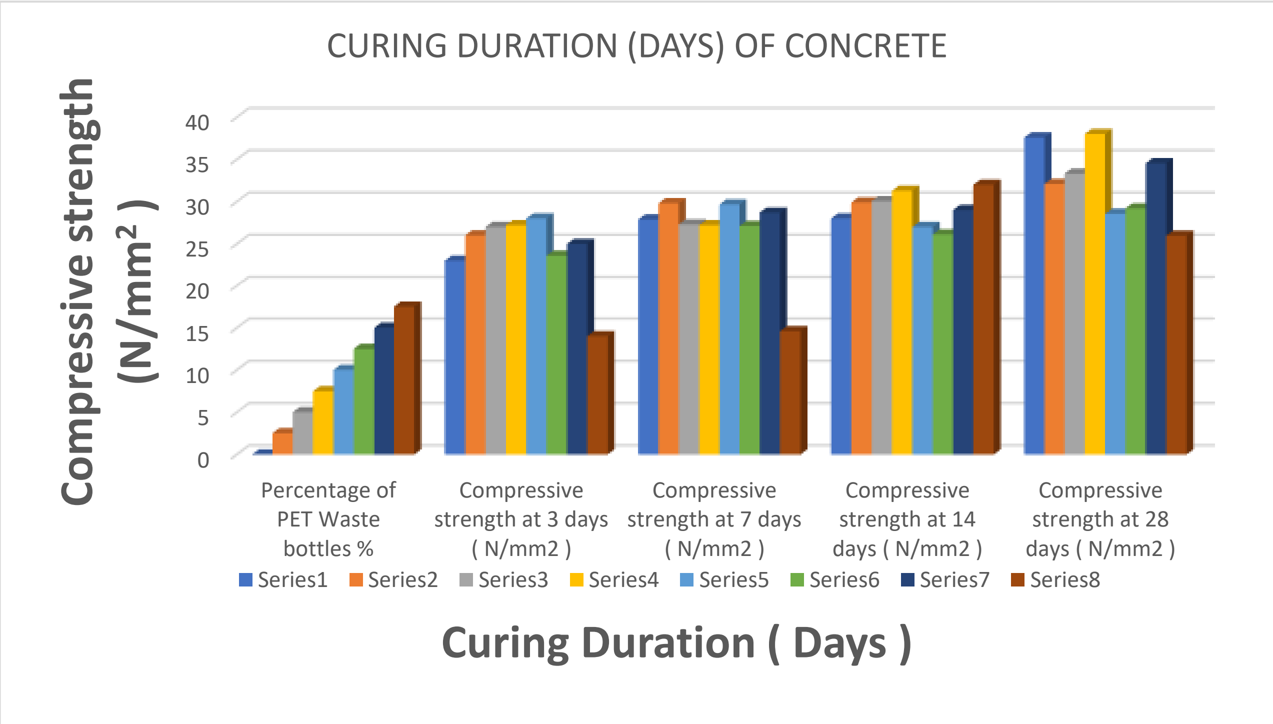
As per trial program and results shown in table no. 1.6.2.1 and graph no. 1.6.2.1and we can replace aggregates by PET up to 0, 2.5, 5, 7.5, 10, 12.5, 15, and 17.5 % Because the compressive strength of M30 Grade of concrete replacement of aggregate is comparatively equal to control mix design. If aggregate is replaced by PET more than 15% the loss in compressive strength is comparatively. It is only 15 % acceptable mix proportion PET Waste.

1.6.3 CURING DURATION DAYS OF CONCRETE

Table 1.6.3: CURING DAYS Compressive Strength of PET Concrete Strength of Control concrete in N/mm^2

	Compressive strength plastic waste for M30 grade of concrete				
S.NO.	Percentage of PET Waste bottles %	Compressive strength at 3 days (N/mm^2)	Compressive strength at 7 days (N/mm^2)	Compressive strength at 14 days (N/mm^2)	Compressive strength at 28 days (N/mm^2)
1	0	23	27.89	28	37.6
2	2.5	26	29.8	29.9	32.1
3	5	27	27.31	30.05	33.3
4	7.5	27.21	27.21	31.3	38.01
5	10	28	29.66	27	28.56
6	12.5	23.6	27.11	26.11	29.19
7	15	25	28.7	29	34.55
8	17.5	14	14.6	32	25.96

Graph. 1.6.3 CURING DURAQTION OF DAYS

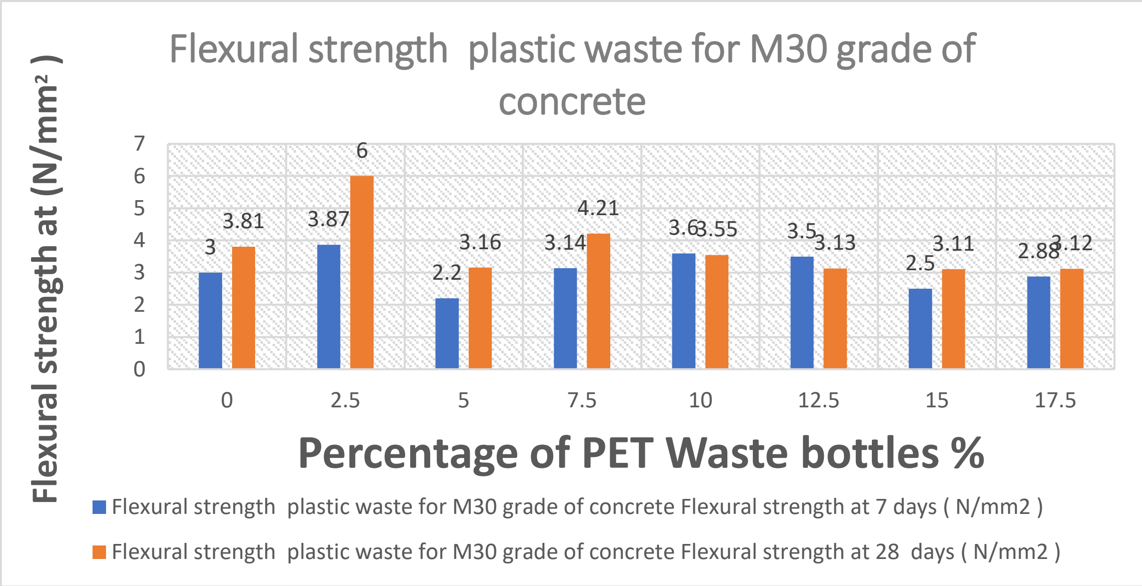


1.6.4 EFFECT OF AGE ON FLEXURAL STRENGTH

The 28days strength obtained for M30 Grade Control concrete is 3.12 N/mm^2.The strength results reported in table are presented in the form of graphical variations, where the Flexural strength is plotted against the % of Aggregate replacement.

Table 1.6.4 Flexural Strength concrete in N/mm^2

Grade of concrete	7Days	28Days
M30	3.55	3.13



Graph 1.6.4 Flexural Strength concrete in N/mm^2

The strength achieved at different ages namely, 7 and 28 for Control concrete are also represented graphically in figure 1.10

From the figure, it is clear that as the age advances, the strength of Control concrete increases. The rate of increase of strength is higher at curing period up to 28 days. However the strength gain continues at a slower rate after 28 days.

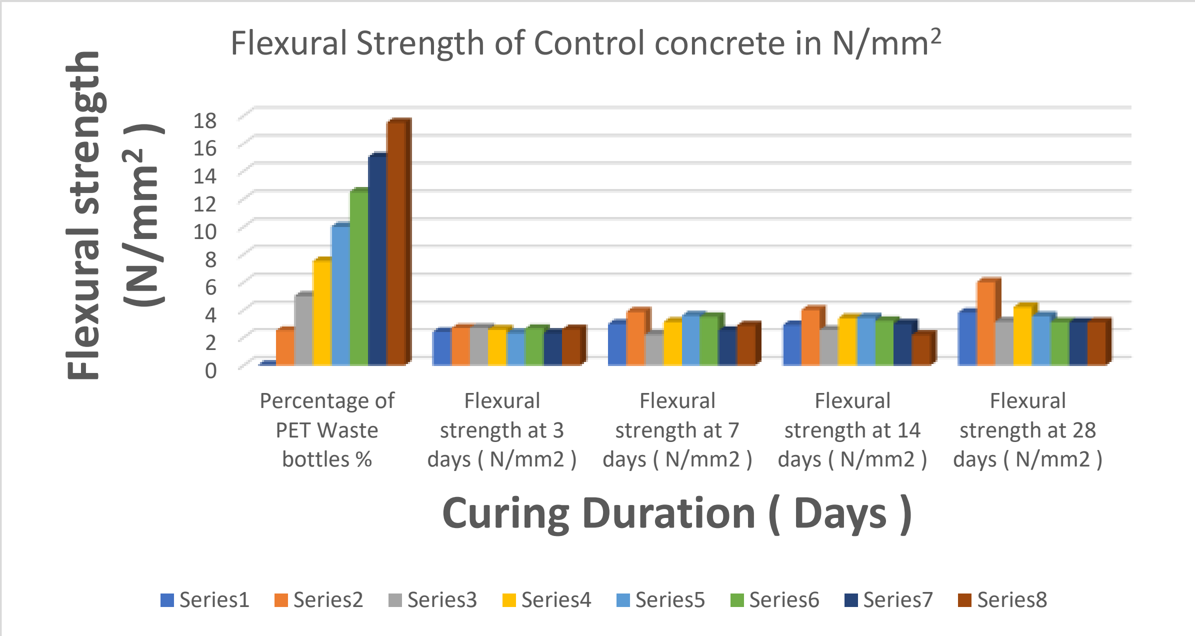
Table 1.6.4 Flexural Strength concrete in N/mm^2

	Flexural strength plastic waste for M30 grade of concrete		
S.NO.	Percentage of PET Waste bottles %	Flexural strength at 7 days (N/mm^2)	Flexural strength at 28 days (N/mm^2)
1	0	3	3.81
2	2.5	3.87	6
3	5	2.2	3.16
4	7.5	3.14	4.21
5	10	3.6	3.55
6	12.5	3.5	3.13
7	15	2.5	3.11
8	17.5	2.88	3.12

As per experimental program and results shown in table no. 1.6.4 and graph no. 1.6.4 and we can replace aggregates by PET up to 0, 2.5, 5, 7.5, 10, 12.5, 15, and 17.5 % Because the Flexural strength of M30 Grade of concrete replacement of aggregate is comparatively equal to control mix design. If aggregate is replaced by PET more than 12.5% the loss in Flexural strength is comparatively. It is only 12.5 % acceptable mix proportion PET Waste.

1.6.5 CURING DURATION (DAYS)

	Flexural strength plastic waste for M30 grade of concrete				
S.NO.	Percentage of PET Waste bottles %	Flexural strength at 3 days (N/mm^2)	Flexural strength at 7 days (N/mm^2)	Flexural strength at 14 days (N/mm^2)	Flexural strength at 28 days (N/mm^2)
1	0	2.4	3	2.91	3.81
2	2.5	2.68	3.87	4	6
3	5	2.7	2.2	2.56	3.16
4	7.5	2.58	3.14	3.41	4.21
5	10	2.31	3.6	3.45	3.55
6	12.5	2.65	3.5	3.21	3.13
7	15	2.3	2.5	3.01	3.11
8	17.5	2.6	2.88	2.18	3.12



Graph 1.6.5 (B) curing days Flexural Strength of curing days concrete in N/mm^2

1.6.7 EFFECT OF AGE ON SPLIT TENSILE STRENGTH

The 28days strength obtained for M30 Grade Control concrete is 5 N/mm^2.The strength results reported in table are presented in the form of graphical variations, where the Split tensile strength is plotted against the % of Aggregate replacement.

Table 1.6.7 Split Tensile Strength of Control concrete in N/mm^2

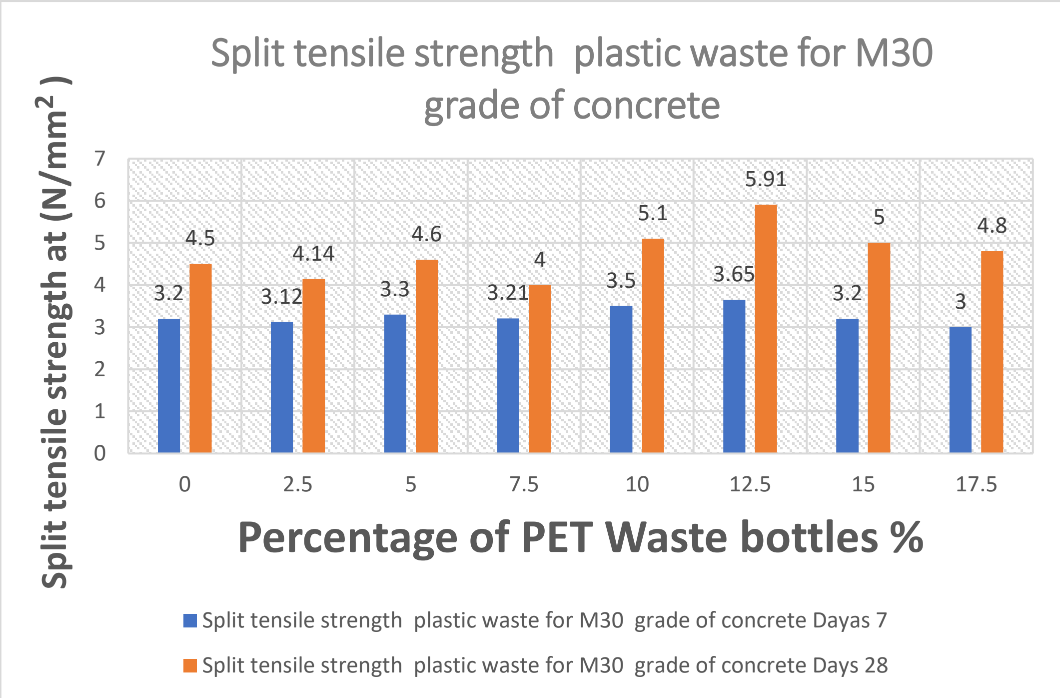
Grade of concrete	7Days	28Days
M30	3.2	5

The strength achieved at different ages namely, 7 and 28 for Control concrete are also represented graphically in figure1.6.7

Table 1.6.7 (A) Split Tensile Strength of Control concrete in N/mm^2

	Split tensile strength plastic waste for M30 grade of concrete		
S.NO.	Percentage of PET Waste bottles %	Dayas7	Days 28
1	0	3.2	4.5
2	2.5	3.12	4.14
3	5	3.3	4.6
4	7.5	3.21	4
5	10	3.5	5.1
6	12.5	3.65	5.91
7	15	3.2	5
8	17.5	3	4.8

From the figure, it is clear that as the age advances, the strength of Control concrete increases. The rate of increase of strength is higher at curing period up to 28 days. However the strength gain continues at a slower rate after 28 days.



Graph 1.6.7 Split Tensile (B) Strength of Control concrete in N/mm^2

As per trial program and results shown in table no. 1.6.7 and graph no. 1.6.7 (A)and we can replace aggregates by PET up to 0, 2.5, 5, 7.5, 10, 12.5, 15, and 17.5 % Because the Split tensile strength of M30 Grade of concrete replacement of aggregate is comparatively equal to control mix design. If aggregate is replaced by PET more than 12.5% the loss in Split tensile strength is comparatively. It is only 15 % acceptable mix proportion PET Waste.

1.7 RESULT AND CONCLUSION

- From the experimental investigation this present investigation work can be concluded as follows: -
- The behavior of fresh and hardened properties of concrete almost depend upon shape and the size of the Waste-PET bottles aggregate.
- Waste-PET bottles fine & coarse aggregate non-uniform, angular & sharp edges reduce the slump value of concrete. Smooth-surface & spherical textured increase the concrete slump value.
- The workability of Waste-PET bottles mixed concrete is 72 mm for fresh concrete with 2.5% Waste-PET bottles addition and the mix with the highest workability is Mix 2.
- Waste-PET bottles material improves the compressive strength, split tensile strength and flexural strength of concrete.
- The addition of Waste-PET bottles increases the strength of concrete for all curing ages up to a certain point. After that there is an abrupt reduction in the strength of the Waste-PET bottles mixed concrete. Because at higher dosage, concrete loses its ability to make a proper bond.

1.7.1 RECOMMENDATIONS FOR FUTURE STUDIES

1. Research the combined effect of waste PET particles as a partial replacement with sand and the glass powder as a partial replacement with cement on the physical, mechanical and rheological properties of concrete.
2. The influence of using waste PET particles on the mechanical behaviour of fiber reinforced concrete
3. Investigating the combined effects of PET particles as a coarse aggregate replacement, and PET fibers as a concrete additive.

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