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STRENGTH AND BEHAVIOR OF CONCRETE CONTAINS WASTE PLASTIC

Sagar[1], Shivani Choudhary[2], Mr.Samik Arya[3]
[1,2]Department of Civil Engineering, GGSIPU University, Delhi, India
[3]Guide By Civil Engineering Department,M.V.S.I.T, SONIPAT

Abstract: This paper presents a way of strengthen concrete by the addition of percentages recycled waste plastic (polyethylene). virtually 126 samples of concrete ar ready, the concrete Strength (compressive, ripping tensile and flexural strength) ar investigated on a amount of seven to twenty-eight days victimisation I Chronicles, third-dimensional and five-hitter from fine mixture recycled waste plastic (polyethylene). it's found that once waste plastic bottles redoubled from zero to five of the sand within the combine, the compressive, tensile and flexural strength of concrete minimized by the ratios of twelve.81, 10.71, and increase by four.1% severally at seven days age and conjointly these concrete strength decrease by the ratios seven.93, 28.6, and 23.6% at twenty eight days age
Keywords: Recycled plastic waste; Polyethylene; Concrete; Environment; Strengthen concrete

I. INTRODUCTION

The rapid urbanization and industrialization all over the world has resulted in large deposition of waste polymer materials. The world's annual consumption of plastic materials has increased from around 5 million tons in the 1950s to nearly 100 million tons in 2001 [1]. Plastic waste materials consist of surplus, obsolete, broken, old plastic furniture, different household plastic materials, equipment, anti-static packaging materials and devices made of plastic. These polymer wastes are almost non-degradable in the natural environment even after a long period of exposure.

Inclusion of polymer waste in concrete can be a proper utilization of this valuable property. Thus, utilization of waste polymer material in making concrete/mortar can be good solution to this environmental hazard. Very few information is available regarding recycling of polyurethane formaldehyde (PUF) -based polymer wastes and its use as construction materials. In the Dhaka city corporation area, about 3,315 tons of solid waste had been generated per day during 2005, of which 4.15% was composed of plastic materials [2]. In view of this, a unique, novel experimental work has been conducted. The safe use of plastic waste (plastic bags or plastic containers such as water bottle) is very important because plastics are normally stable and not biodegradable. In Iraq approximately 11.3 million tons of solid waste is produced annually. The aim of this research is to investigate the effect of two types of waste plastic on strength of concrete.

Details of Specimens

The experimental program consists of casting and testing of 42 (100 × 100 mm × 100 mm) cubs for determining compressive strength (fcu), 42 cylinders (100 mm × 200 mm) for determining indirect tensile strength (fct) and 42 prisms (100 mm × 100 mm × 500 mm) for determining flexural strength or modulus of rupture (fr) of concrete.

The specimens classify into seven teams, every cluster contains half-dozen cubs, half-dozen cylinders and half-dozen prisms. the primary cluster is planned to check the compressive, indirect tensile and flexural strength. cluster 2 is employed to check constant parameters as cluster one, however with 1 Chronicles recycled waste plastic bottle as partial replacement, in concrete combine rather than natural combination. teams 3 and 4, in distinction, ar accustomed study constant parameters, however with three-d and five-hitter recycled waste plastic bottle as partial replacement, in concrete combine rather than natural combination severally. teams 5, six and 7 ar accustomed study constant parameter however with 1 Chronicles, three-d and five-hitter non-recycled plastic baggage as partial replacement, in concrete combine rather than natural combination severally.

Material Used

Concrete is used as the main material. The concrete mixed design was chosen from a previous study. The concrete mix proportion was 1:1.67:2.5 (cement: sand: gravel) and water cement ratio was 0.46. The materials used are listed in Table1:

Basic materials	Specifications
Cement	Ordinary Portland cement
Sand	The fine aggregate was sand having a specific gravity 2.7.
Gravel	Maximum size of 12.5 mm, specific gravity of 2.72 was used as coarse aggregate.
Waste Plastics	Recycled waste plastic (polyethylene) with a percentage 1%, 3% and 5% from the sand was used. Waste plastic bags with a percentage 1%, 3% and 5% from the sand also used after washing and grinding with specific gravity equal to 1.04.
Water	Fresh water was used for mixing process and

	curing.

Materials used.

The component of concrete for production 1 m3 concrete in kg was; cement 400, sand 688, gravel 1000 and water 184.
Experimental Work: The Applied Processes

Mixing
First gravel ANd sand square measure supplemental to an electrical mixer for one minute. The cement is then supplemental into the mixer, followed by gradual addition of water, combination is sustained till a consistent mix is made.
Tests for recent concrete: Slump take a look at
This take a look at is employed to work out the consistency of concrete. The consistency, or stiffness, indicates what quantity water has been employed in the combination. The stiffness of the concrete combine ought to be matched to the necessities for the finished product quality. The slump take a look at resulted values square measure at intervals the vary of seven to nine millimetre.
Casting
Molds square measure clean and oiled before casting, then they're placed on the extent space. The molds square measure stuffed with the concrete combine. Concrete surface square measure leveled by trowel, then marked. when casting, molds square measure placed on the extent ground reassuring no vibration or compaction, the molds square measure unbroken within the laboratory for twenty-four hours.

Curing
After on a daily basis of casting method, the molds square measure removed, and concrete specimens square measure place into the set tank for periods of seven and twenty eight days.

Tests for Harden of Concrete
The fifth and final method is to check the concrete hardness when strengthen, which is finished when drying the samples for half-hour. Rebeiz et al. [3] investigated on the structural behaviors of chemical compound concrete beam exploitation recycled plastic. Al- Manaseer et al. [4] studied the result of plastic aggregates on the majority density and compressive strength of concrete. Soroushian et al. [5] conjointly reported the result of plastic aggregates on compressive strength, moreover, Elzafraney et al. [6] thought-about the energy-efficiency of buildings exploitation recycled plastic aggregates in concrete. Kumar et al. [7] characterised waste plastics and optimized modifier content (waste plastic). Batayneh et al. [8] suggested recycled waste plastic materials changed concrete in sure engineering science applications, Kumar et al. reported the result of waste plastics on mechanical strength. Siddique et al. [10] investigated on the result of recycled plastic on the properties of recent and hardened concrete. supported the literature, 3 main tests square measure distributed, and these square measure listed below:

Compressive strength take a look at
It is the foremost common of all tests on hardened concrete; additionally, compressive strength is that the most vital parameter in structural style. 3 commonplace cubes of a hundred mm3 square measure shaped for every combine. The compressive strength take a look at is distributed per the Bachelor of Science nut 12390-3 (2002) at ages of seven and twenty eight days.

Indirect tensile test
An indirect take a look at for durability of concrete, established originally in Brazil, has recently inherit rather general use and standardized (ASTM C496- 62T). The specimen is that the standard a hundred millimetre × two hundred millimetre, cylinder. The cylinder is loaded in compression on 2 axial lines that ar diametrically opposite through bearing strips of laminate.
The laminate cushion distributes the compressive load over atiny low dimension that is ample to avoid undue concentration of stress, and it compensates for surface irregularities. The compressive force produces a thwartwise tensile stress that is much constant on the vertical diameter.

Flexural strength test
The prismatic beam five hundred × one hundred × one hundred mm3 specimens ar utilized in this check to computing modulus of rupture of concrete. One central purpose load is employed. Firstly, place every support, then a central purpose load is marked, a similar rod is additionally used at mid-span for focused load.

Experimental Results
Compressive strength
Table 2 indicates the test results of compressive strength of hardened concrete; equation 1 is used to calculate the compressive stress in MPa.

$$f_{cu} = P/A \qquad (1)$$

Percentages of added plastic waste	**f_{cu} (MPa) at 7 days**		**f_{cu} (MPa) at 28 days**	
	with waste plastic bottles	**with waste plastic bags**	**with waste plastic bottles**	**with waste plastic bags**
0%	35.02	35.02	46.5	46.5
1%	37.65	29.6	44.5	45.80
3%	28.40	24.80	43.7	39.2
5%	30.56	27.03	42.92	38.96

Table 2: Results from the compressive test.

It is obvious from Table 2 that the compressive strength of concrete decreases with increasing the percentages of waste plastic bottles. The compressive strength of concrete also decreases with increasing the percentages of waste plastic bags.

Indirect tensile strength

Table 3 indicates the test results of indirect tensile strength of hardened concrete; equation 2 is used to calculate the indirect tensile stress in MPa.

$$f_{ct} = 2P/\pi DL \qquad (2)$$

It is clear from Table 3 that when the percentage of added waste plastic bottle increases the strength on the contrary decreases. Similarly for concrete strengthen with waste plastic bags.

Percentages of added plastic waste	f_{ct} (MPa) at 7 days		f_{ct} (MPa) at 28 days	
	with waste plastic bottles	with waste plastic bags	with waste plastic bottles	with waste plastic bags
0%	2.87	2.87	4.06	4.06
1%	2.532	2.73	3.192	3.15
3%	2.47	2.42	2.91	3.2
5%	2.56	2.03	2.87	2.91

Table 3: Results of indirect tensile test.

Flexural strength (modulus of rupture)

Table 4 indicates the test results of flexural strength (modulus of rupture);

Percentages of added plastic waste	f_r (MPa) at 7 days		f_r (MPa) at 28 days	
	with waste plastic bottles	with waste plastic bags	with waste plastic bottles	with waste plastic bags
0%	3.62	3.64	3.7	3.7
1%	3.2	3.62	3.64	3.2
3%	2.70	2.291	3.91	2.80
5%	3.77	3.33	2.91	2.63

Modulus of rupture is calculated using equation 3:

$$f_r = MC/I$$

Table 4: Results of flexural strength test.

It indicates that the increasing ratios of waste plastic bottle lead to a decrease in the modulus of rupture when using both, the waste bottles and plastic bags. the indirect tensile and modulus of rupture for concrete with waste plastic bottle percentage for ages of 7 and 28 days.

Correspondingly, the indirect tensile strength of plastic bags based-concrete decreased by the ratio of 29.54% at 7 days age and by the ratio 27.4% at 28 days age.

II. CONCLUSION

In general, the compressive strength, indirect enduringness and modules of rupture area unit found to be belittled with increasing the odds of waste plastic bottle and waste plastic baggage. what is more, once percentages of waste plastic bottles area unit enlarged from zero to five of the sand within the combine, the compressive, tensile and flexural strength of concrete area unit found to be belittled by the ratios of twelve.81, 10.71, and area unit enlarged by four.1% severally at seven days age, additionally these concrete strength decrease by ratios seven.93, 28.6, and 23.6% at twenty eight days age. On an analogous manner, it's noticed that once percentages of additional waste plastic baggage area unit enlarged from zero to five of the sand within the combine, the compressive, tensile and flexural strength of concrete area unit belittled by ratios of twenty seven.5, 29.54, and 7.98% severally at seven days age, additionally these concrete strength decrease by ratios of sixteen.41, 27.4, and 30.52% at twenty eight days age. It will be additionally explicit that the result of waste plastic bottles on the decreasing strengths is a smaller amount than the waste of plastic baggage. To add, the usage of waste plastic in concrete results in a amendment within the modes of failure from brittle (rapid) failure to additional ductile failure.

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