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An Experimental Study on Partial Replacement of Coarse Aggregate with Plastic Scrap and Sand with Foundry Sand in Concrete

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ABSTRACT
Concrete is the most widely used construction material in the world it is a mixture of cement, sand, coarse aggregate and water. Storage and safe disposal of industrial byproduct such as Waste foundry sand is major disposable item of metal casting industries and plastic bottle is a huge problem everywhere, reuse of these waste eliminates/reduce the problem. Plastic bottles are a major issue of solid waste disposal. Several things which were invented for our convenient life are responsible for polluting environment due to improper waste management technique. One of them is plastic which has to be disposed or recycled properly to maintain the beauty of our nature. Polyethylene Terephthalate (PET, PETE or polyester) are routinely used for carbonated beverage and water bottles. This is an environmental issue as waste plastic bottles are difficult to biodegrade and involve processes either to recycle or reuse. In the Modern world, the construction industry is searching for cost-effective materials for enhancing the strength of concrete structures. In this experiment fine aggregate is replaced 0%, 10%, 20% and 30% of its weight by foundry sand and course aggregate is replaced 0% & 5% of its weight by Plastic bottles in all concrete mix and there effects are studied.

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INTRODUCTION

Foundry waste sand: Foundry sand is clean, uniformly sized, high-quality silica sand and it is used to form molds for ferrous (iron and steel) and nonferrous (copper, aluminum, brass) metal castings. Specific Gravity of foundry sand is 2.55 and bulk density is 1650 kg/m^3.

Foundry sand is clean, uniformly sized, high quality silica sand, used in foundry casting processes. The sand is bonded to form molds or patterns used for ferrous (iron and steel) and non-ferrous (copper, aluminum, brass) metal castings. Shake-out sand from completed metal casting are often reclaimed back into the foundry sand process.

Plastic bottle Scrap: Plastic bottle were collected from plastic waste in Libya such as plastic waste of packed water and cold drinks water bottle were flake into 5mm and length 18 mm. Table 1 shows the plastic waste properties in this is study.

Literature Survey

General

In this section an elaborative talk is made with respect to works done as such far around there as writing audit. Natural course aggregate & fine aggregate is getting depleted due to large-scale construction. So it is important to find out an alternative of natural aggregate, which can be used as partial replacement of natural course aggregate & fine aggregate. There are many types of waste material/byproducts that are explored for attainable use in concrete as a partial replacement of course aggregate & fine aggregate mixture. Such sorts of materials are coal bottom ash recycled fine mixture, sewerage sludge ash, stone dust and glass cullet, and waste foundry sand, waste plastic scrap, fiber waste etc.

1. **Younus Maqbool 2019** Concrete with 1%, 2%, 2.5%, 3% and 5% PET bottle fibers for fine aggregate were produced and compared against control mix with no replacement. Cube specimens, cylinder specimens and prism specimens were cast, cured and tested for 7 day and 28 days strength. Tests such as Compression test, splitting tensile test and flexural strength tests were done and the results were compared with control specimens and results were compared. The observed results revealed an increase in compression and tensile strength hence with the increasing demand for fine aggregate, PET bottle fiber replacements can be adopted. This study was carried to investigate the

properties of concrete with plastic pet (bottle) fibres as partial replacement of fine aggregates.

2. **Rudiele Schankoski 2019** The use of waste materials in the building industry is a major challenge for eco-efficient construction. Brazil generates more than 3 million tons of waste foundry sand (WFS) annually, making it one of the largest industrial wastes produced in the country. This work proposes the use of WFS in two novel ways: in conventional concrete by WFS calcination, and in dry-mix concrete for the production of concrete blocks. For the conventional mixture study, mortars with 0, 50 and 100% replacement of natural sand by WFS and calcined WFS (CFS) were produced. The fresh state properties, volumetric variation, cement hydration and 28-days.
3. **L.R. Prudêncio Jr 2019** This work investigated the use of diabase (D) and gneiss (G) quarry powders as alternatives to limestone filler (L) for self-compacting concrete (SCC) production. For this, SCCs with the different quarry powders, each one in three different particle size distributions, were produced. The shape and texture of the particles were evaluated through SEM image analysis. The fresh state properties of the SCCs were evaluated by the workability tests slump flow, V-Funnel, J-ring and VSI, and by rheometry.
4. **Divya.M.R (et al.), (2018),** were concluded that Among the various mixes it was observed at the age of 28 days the maximum strength attained at 15% of foundry sand with 10% of cow dung ash. Use of cow dung ash in higher proportion reduces the strength and hence, a constant value of 10% is maintained throughout the project. This concrete preparation is eco-friendly and cost effective. The degree of workability of concrete was normal with the addition of Cow Dung Ash and Foundry sand for M20 grade concrete. The main advantage being reduction of environmentally hazardous material and increasing the strength of concrete to a considerable percentage.
5. **Raissa Ferron 2017** The influence of the mineralogy and particle size distribution was evaluated by rheological methods on cement pastes containing the materials under investigation. In addition, in-situ particle size analysis of the fresh pastes was conducted to observe how these different by-product dusts affect agglomeration kinetics. Pastes containing quarry powders showed lower yield stress and lower viscosity than pastes containing only cement.
6. **Arivalagan.S' 2017** Tests were conducted to determine the properties of plastic aggregate such as density and specific gravity. As 100% replacement of natural fine aggregate with plastic fine aggregate is not feasible, partial replacement at various percentage were examined. The percentage substitution that gave higher compressive strength was used for determining the other properties such as modulus of elasticity, split tensile strength and flexural strength. Higher compressive strength was found with 10% natural fine aggregate replaced concrete.

Problem identification

- The construction industry is the area where the safe use of foundry waste sand with plastic bottles scrap is possible.
- When it is introduced in concrete as a replacement material, it reduces space problem and also reduces the cost of concrete.
- There is no investigation performed on foundry waste sand with plastic bottles scrap to use in construction industries.

Objectives

The objectives of the research are outlined below:

- To study suitability of waste plastic bottle scrap & foundry sand for its compressive, tensile and flexural strength in concrete mix made as partial replacement of natural sand.

Workability Properties

Fresh mix characteristics are more emphasized in fibre concrete compared to the plain concrete, generally increasing weight fraction of fibres results in further reduction of fresh concrete workability. In this experiment fine aggregate is replaced 0%, 10%,20% and 30% of its weight by foundry sand and course aggregate is replaced 0% & 5% of its weight by Plastic bottles in all concrete mix and there effects are studied.

Slump Test

Table 1.1 Slump Test Results

S. NO.	% of waste foundry sand	% of waste Plastic bottle scrap	Slump for M25
1	0%	0%	68
2	10%	5%	65
3	20%	5%	57
4	30%	5%	51

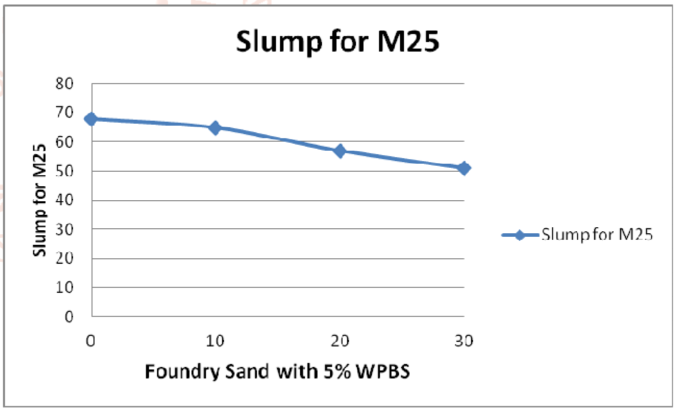

Figure 1.1 Line chart slump value of M25 Grade concrete with 5% plastic bottle scrap

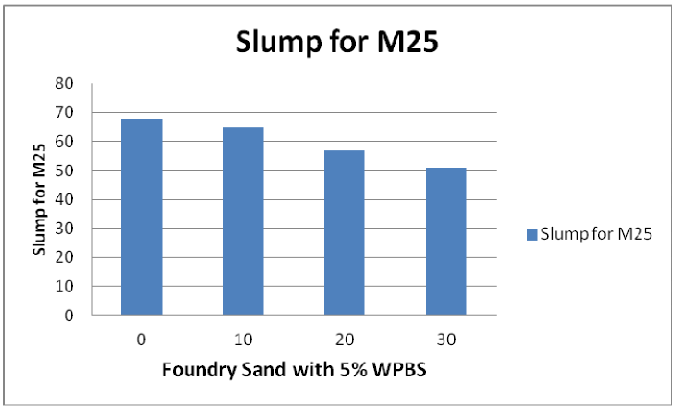

Figure 1.1 Bar chart slump value of M25 Grade concrete with 5% plastic bottle scrap

Table 1.2 – Compressive Strength of M25 Grade concrete in N/mm²

S. No.	Different % of waste used in concrete		Compressive Strength of M-25grade concrete in N/mm2		
	% of waste foundry sand	% of waste Plastic bottle scrap	7days	14days	28days
1	0%	0%	18.92	22.25	28.19
2	10%	5%	19.62	25.35	29.43
3	20%	5%	20.42	25.92	29.88
4	30%	5%	18.88	24.49	27.35

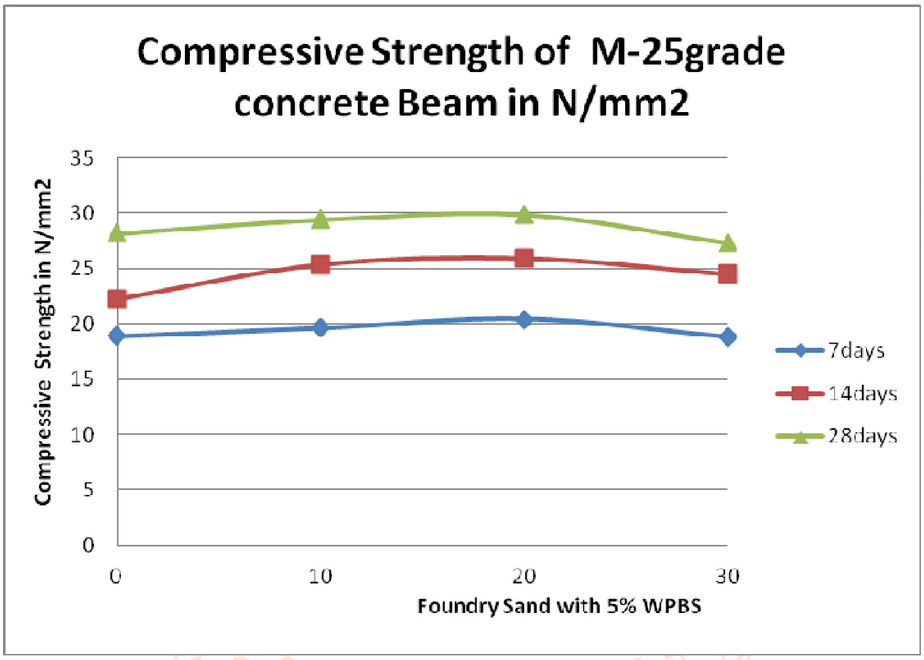

Figure 1.2 – Line graph Compressive Strength of M25 Grade concrete with 5% plastic bottle scrap

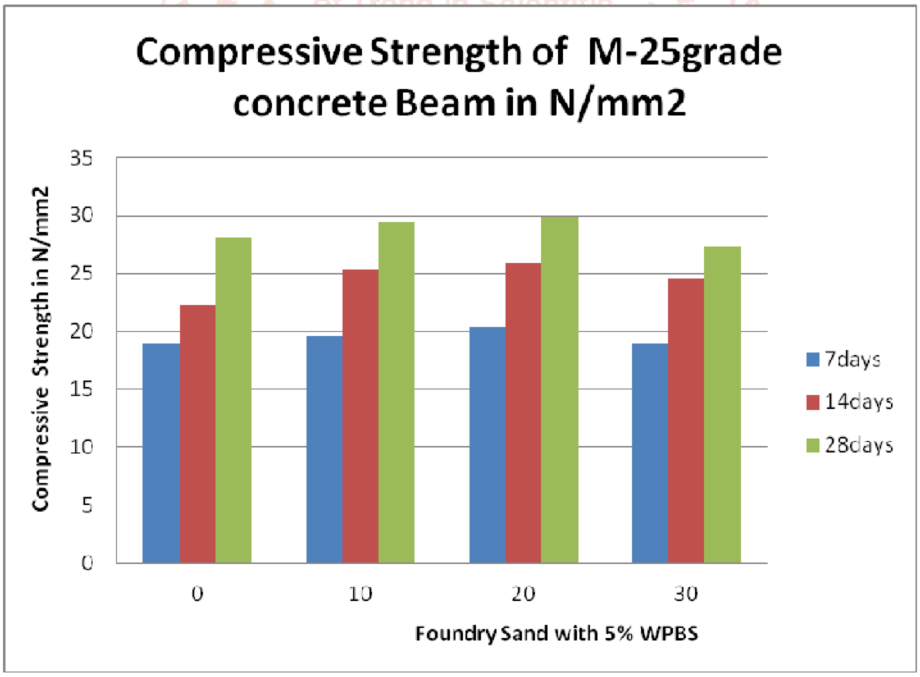

Figure 1.2 –Bar graph Compressive Strength of M25 Grade concrete with 5% plastic bottle scrap

Split Tensile Strength

Table 1.3 – 28 days Split tensile strength of Cylinder in N/mm²

S. No.	Different % of waste used in concrete		Split Tensile Strength for M25 Grade of Concrete in N/mm2		
	% of waste foundry sand	% of waste Plastic bottle scrap	7days	14days	28days
1	0%	0%	2.31	2.68	3.39
2	10%	5%	2.46	2.75	3.47
3	20%	5%	2.49	2.89	3.56
4	30%	5%	2.23	2.72	3.22

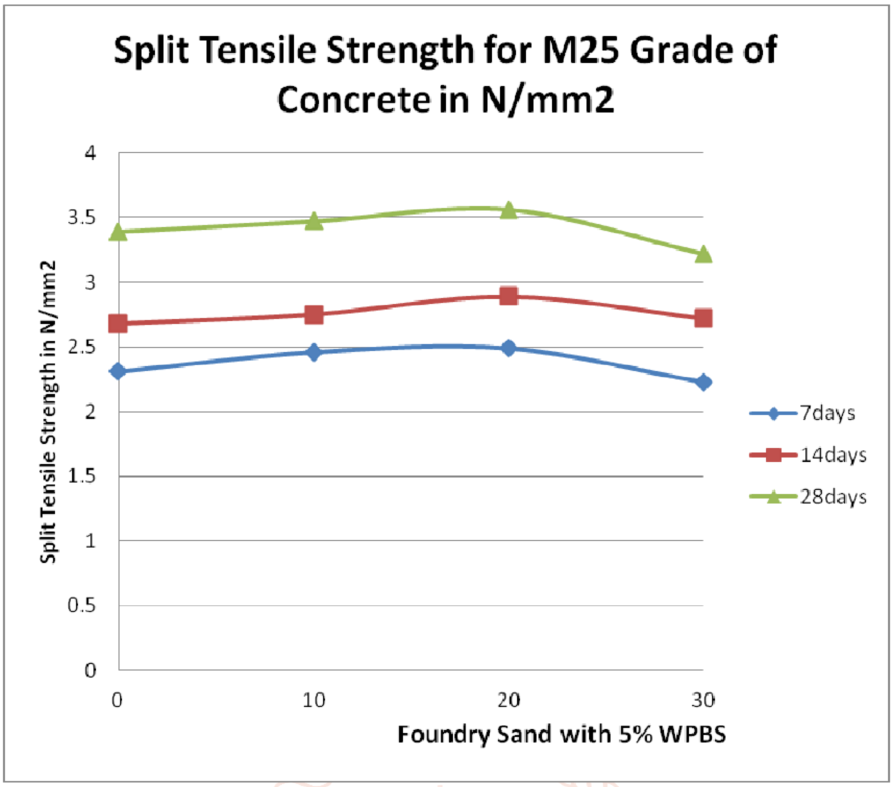

Figure 1.3 – Line graph Split tensile strength of Cylinder of M25 Grade concrete with 5% plastic bottle scrap

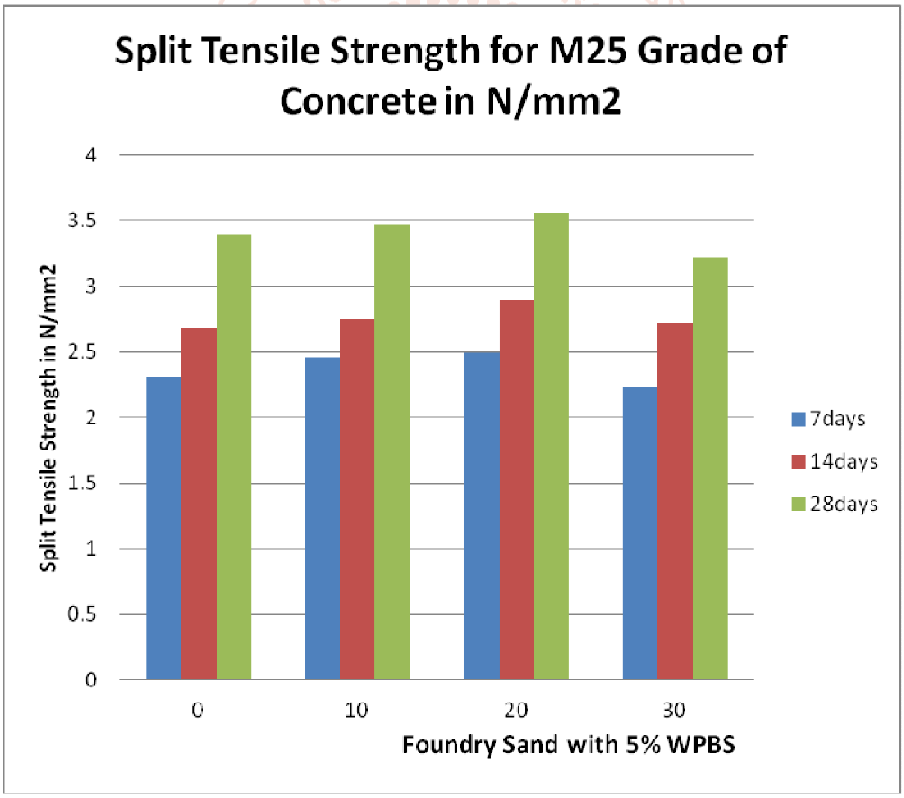

Figure 1.3 – Bar graph Split tensile strength of Cylinder of M25 Grade concrete with 5% plastic bottle scrap

Flexural strength of Concrete:

Table 1.4 – Flexural Strength of concrete Beam in N/mm²

S. No.	Different % of waste used in concrete		Flexural Strength of M-25grade concrete Beam in N/mm2		
	% of waste foundry sand	% of waste Plastic bottle scrap	7days	14days	28days
1	0%	0%	2.22	2.78	3.73
2	10%	5%	2.56	3.26	4.02
3	20%	5%	2.63	3.42	4.28
4	30%	5%	2.42	3.05	3.67

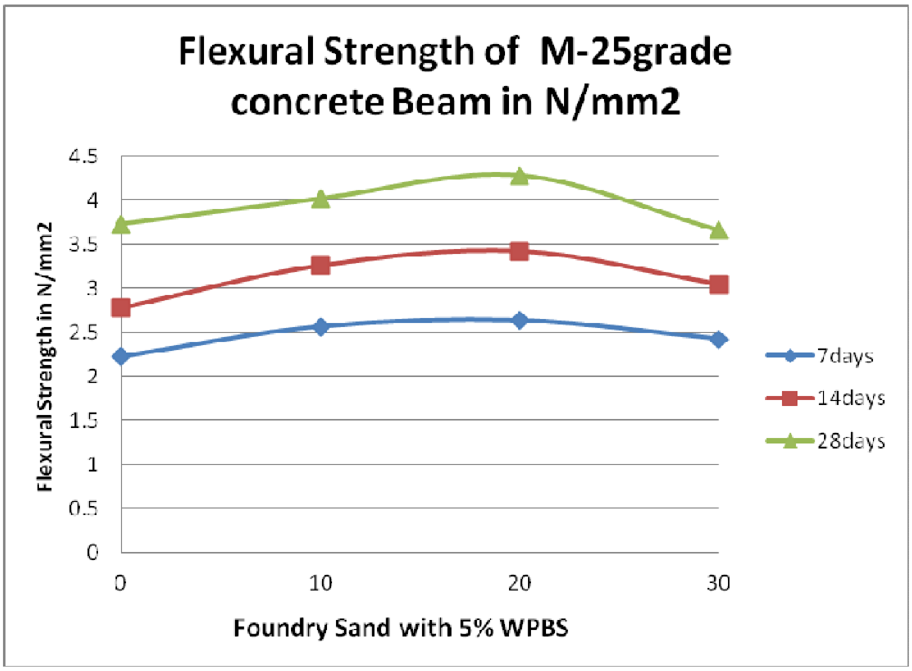

Figure 1.4 – Line graph Flexural Strength of concrete Beam for M25 Grade concrete with 5% plastic bottle scrap

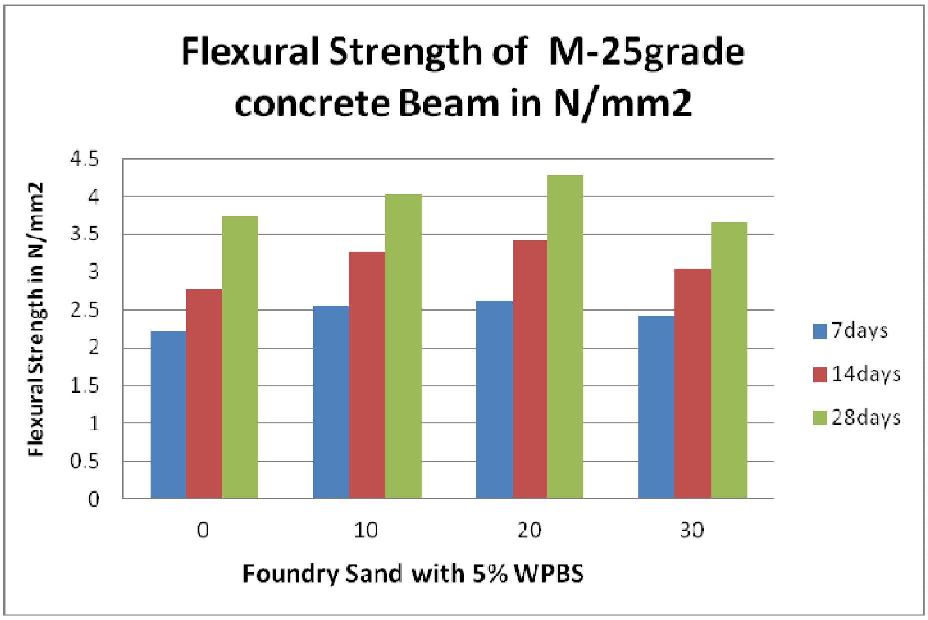

Figure 1.4 – Bar graph of Flexural Strength for concrete Beam for M25 Grade concrete with 5% plastic bottle scrap

Conclusion

- The values that are obtained at 7 days, 14 days and 28 days of curing for 0% to 30% of WFS replaced by fine aggregate & 0% to 5% of waste plastic bottle scrap as partial replacement of course aggregate.
- Compared to plane concrete to conventional concrete with Waste plastic bottle scrap & foundry sand expansion brought about better reinforcing (compressive, malleable and flexural) properties of concrete.

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