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AN INVESTIGATION ON USE OF SHREDDED BOTTLE CAPS IN CONCRETE AS A FIBERS IN CONCRETE

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ABSTRACT

This study intended to recycle PET (Polyethylene Terephthalate) bottle caps in concrete to solve the environmental issue associate to plastic waste. Therefore, shredded PET bottle caps used as fibers in concrete. This study makes an effort to put the idea of sustainability into practice by minimizing the environmental pollution caused by plastic trash, particularly Polyethylene Terephthalate (PET), which is used to make soft drink bottle caps. The bottle caps were gathered and shredded into fibers with a particular size and shape of an aspect ratio (L/D) of 0.75 and 0.5. Different percentages of PET (i.e. 0.5, 1.0, 1.5, and 2%) have been added to normal concrete. It was investigated how PET fibers affected the workability, density, compressive, and split tensile strengths of concrete. It was observed that the workability of concrete decreases as the percentage of pet fibers increases, the workability decreases by using both aspect ratios, but it was observed that the workability more decreases by using aspect ratio 0.75 in the comparison of aspect ratio 0.5. The 150mm cubes were cured for 7 and 28 days, the compressive strength was examined after completion of curing period. The results indicated that the compressive strength of cubes cured in water, it was observed that the compressive strength of concrete decreases with increases the percentage of pet fibers in concrete but it was also observed that the compressive strength more decreases with aspect ratio 0.5 in comparison of aspect ratio 0.75.

Keywords: Concrete, Shredded PET Bottle Caps, Workability, Density, Compressive Strength.

I. INTRODUCTION

In the construction industry concrete is the most widely used material globally and concrete is the second most available substance on earth after water. Concrete is a completely hardy and flexible malleable material of construction. It includes cement and aggregates blended with water. The brittleness of concrete is known to increase when subjected to greater loads and this is a major disadvantage as it makes prediction of failure more difficult, especially in structures subject to explosions or applied loads. However, the use of PET (Polyethylene terephthalate) wastes in concrete could be viable solution to develop lightweight concrete. Reducing the weight of concrete is one of the goals of structures designed to resistant earthquakes (Ahmed, 2015).

The recycling of waste materials in concrete are the essential to achieve and treat the industrial and municipal generated solid wastes. Plastic is one of the most significant materials of the 20th century. The amount of plastic consumed each year remains to grow and is developing a serious environmental problem. To cope with the disposal of large amounts of recycled plastic, the use of plastic in the concrete industry is seen as a feasible application, so the use of waste materials in concrete can greatly affect the amount of waste (Ishaiba, 2015).

Now-a-days plastic has an important use in routine life because it is used in many products because it is strong, lightweight, easy to shape and simple to manufacture. However, PET (Polyethylene terephthalate) plastic is one of the types of plastic waste. PET is mainly used for packaging drinking bottles, foods, oil, cleaners etc. PET bottles are thrown away in large quantity after first use. The recycling of PET plastic bottles is still remaining behind its production. PET bottle waste is difficult to decompose, which causes various problems. These wastes are difficult to treat due to their large quantity, their inefficiency to recycle and their effects on health. Using plastic waste in construction material is an environment friendly method of disposing such waste (D Alighiri, 2019).

Plastic plays an important role in our daily life mostly used in industrial, agricultural, food, medical and pharmaceutical applications. The demand of plastic is growing rapidly because of their cheap cost and ease of manufacturing. Plastic is lightweight, water repellent, strong, durable and economical. However, plastic waste accounts for approximately 13% of total solid waste. About 300 million tons of plastic are generated worldwide

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yearly, of which only around 25% is recycled and the rest is sent to landfill (Kamaruddin MA, 2017). Furthermore, an amount of 107 tons of PET is annually used to produce 27250 bottles all over the world. About 30% of the PET is used for manufacturing of bottles from its total production (Saiter J. M., 2011).Industrial mass production of PET bottles at larger scale has created environmental challenge, as these bottles are only used once and left as plastic waste, which by nature is slowly biodegradable. Recycling, is best way to utilize and minimize the huge amount of waste (Abbas, 2008).

II. MATERIALS AND METHODOLOGY

The major binding element in the concrete was Ordinary Portland Cement (OPC). It is a binding material that firmly holds and adheres the remaining ingredients together in a homogenous shape. The Lucky cement's OPC brand was obtained from the local market Khairpur mir's was used in the experimental work at laboratory. The fine aggregate employed in this investigation was available in the laboratory as Bolari sand. The Coarse aggregate was obtained from rohri power station located in the area. The PET Bottle caps was obtained from scavenger (Trash Collector) and then cut it into two aspect ratios 0.75 and 0.5 and then added each aspect ratios with reference to total volume of concrete, different percentages 0.5%, 1%, 1.5%, 2% was added in the concrete. The mix ratio for the preparation of the M30 grade concrete 1:1.5:3 (cement to fine & coarse aggregate) with w/c ratio (water to cement ratio) 0.50 was selected. Total 50 cubes were casted through mould of each aspect ratio the size of cubes were 150x150x150 mm. The shredded PET bottle caps fibers was added as 0%, 0.5%, 1%, 1.5%, and 2% with respect to total volume of concrete. After 24 hours the concrete cubes were de-moulded and kept in plain water tanks for 7 and 28 days curing. However five specimens of each mix were tested after 7 and 28 days curing. The workability of fresh mixed concrete determined through slump cone test method and compressive strength of hardened concrete tested.

III. RESULTS AND DISCUSSION

3.1 Workability

The workability of fresh mix concrete was determined through slump cone test method and the results are shown in the fig.1.The workability of concrete decreases as the percentage of pet fibers increases (Laith Sh. Rasheed, August 2021).The workability decreases by using both aspect ratios, but it was observed that the workability more decreases by using aspect ratio 0.75 in the comparison of aspect ratio 0.5.

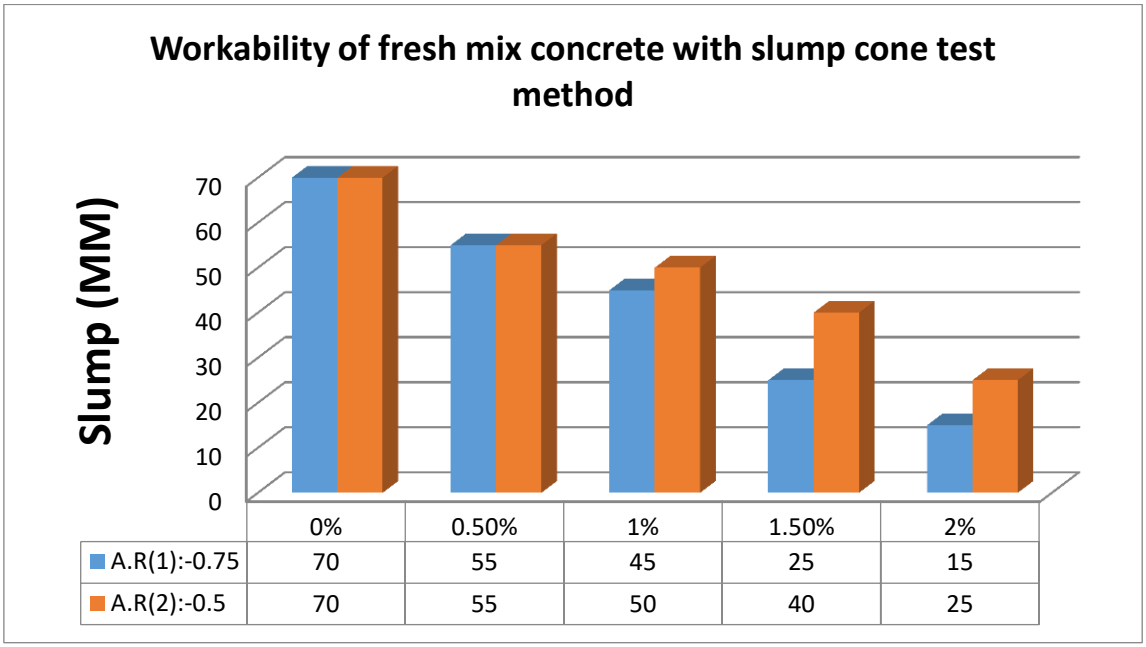

Fig.1

3.3. Compressive Strength

This test was performed using a compression testing machine a total of 90 cubes were tested as shown in fig.2and fig. 2. In this test five cubes were tested at different proportions of shredded pet bottle caps added as

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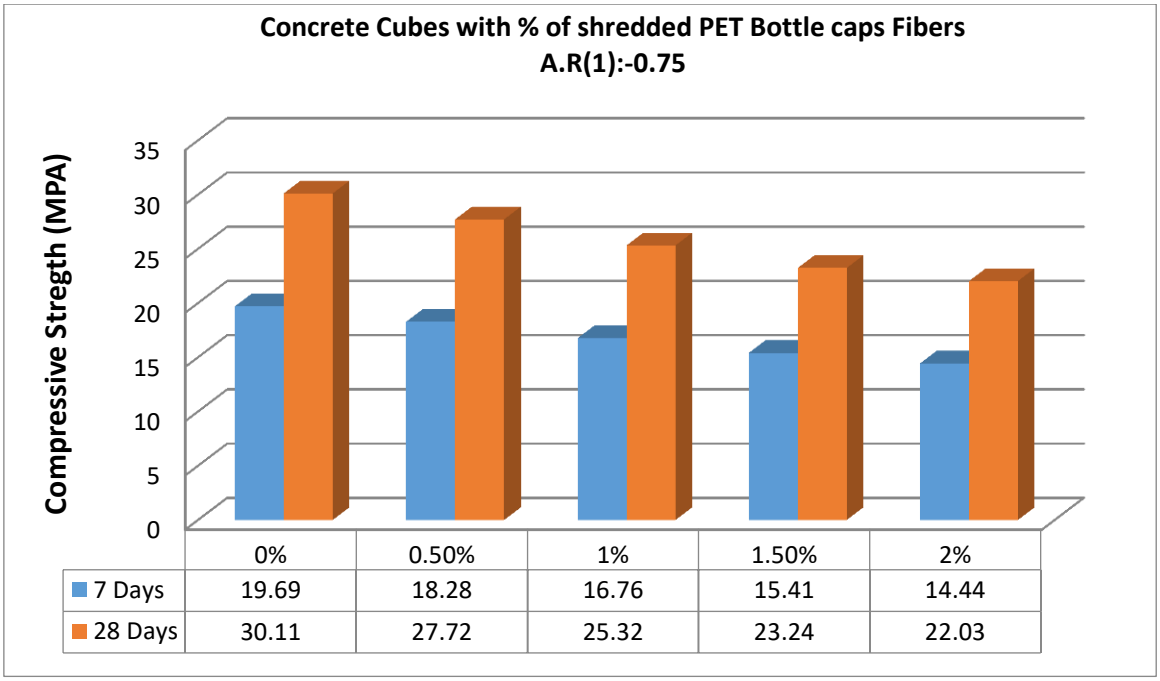
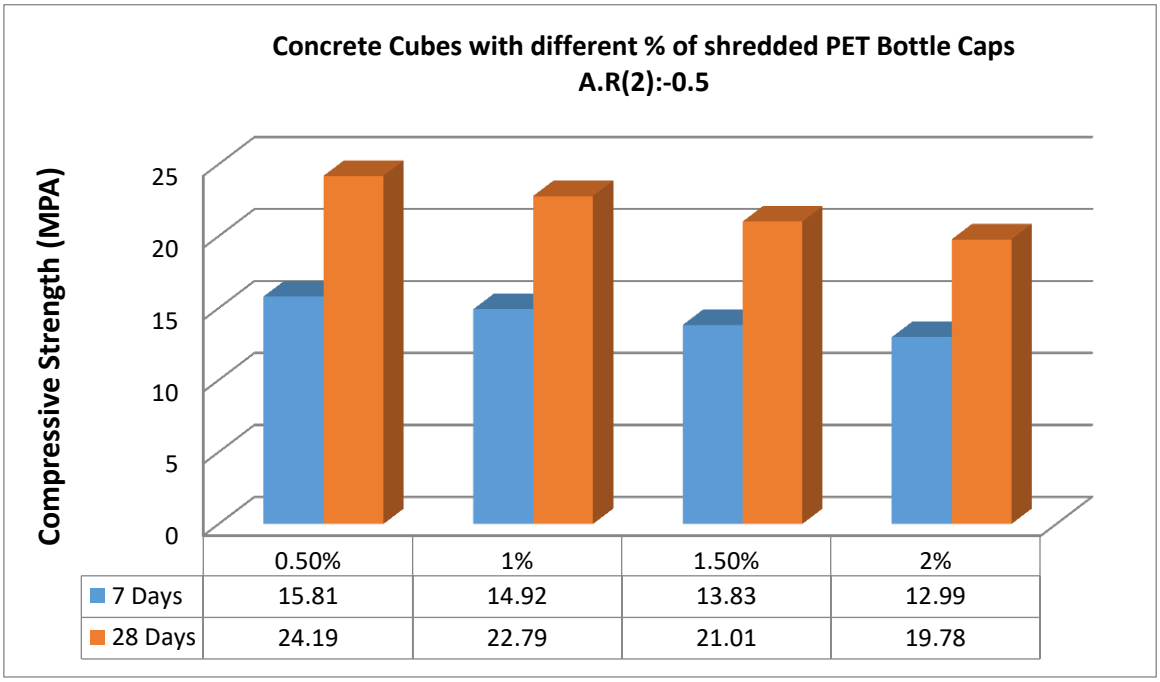
fibers in concrete of each aspect ratio at 7 and 28 days curing in plain water. From the experimental results it was observed that the compressive strength of concrete decreases with increases the percentage of pet fibers in concrete but it was also observed that the compressive strength more decreases with aspect ratio 0.5 in comparison of aspect ratio 0.75 (Ms. Samruddhi C. Sagane, May 2015).



	0%	0.50%	1%	1.50%	2%
7 Days	19.69	18.28	16.76	15.41	14.44
28 Days	30.11	27.72	25.32	23.24	22.03

Fig.2



	0.50%	1%	1.50%	2%
7 Days	15.81	14.92	13.83	12.99
28 Days	24.19	22.79	21.01	19.78

Fig.3

IV. CONCLUSION

Following conclusions were made.

The workability decreases from 21% to 79% by adding 0.5% to 2% shredded PET bottle caps of two aspect ratios 0.75 and 0.5. Besides that, the experimental results, 0.5% is deemed the ideal dose of shredded PET bottle caps in concrete mix, which produces the lowest compressive strength drop of roughly 8% with 0.75 aspect ratio and 20% with 0.5 aspect ratio when compared to the control mix at the age of 28 days.

This study suggested that future studies may add 0.25 percent of a different aspect ratio for compressive strength and 2.5 percent or more for split tensile strength tests, consider extending the curing period beyond 28 days, and take different w/c ratios into account.

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