Waste Plastic as Partial Replacement for Aggregate

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Abstract: Plastic waste management has become a burden and a threat for countries and major cities as well as a danger to environmental safety. The current report covers the ability of the concrete sector to use and recycle plastic wastes. The demand for concrete and raw materials for construction engineering has become very high in recent years because of urban development and the expansion of cities. Therefore, the use of this waste in civil and structural engineering is considered a successful way to get rid of plastic wastes properly to protect the environment. This research investigates the effectiveness of using plastic drinking water bottles (currently the highest plastic waste on the Iraqi market) as a partial substitution of the gravel in concrete. Plastic waste was added in different weight ratios of 20%, 25%, 40% as a partial substitute for the gravel and a cement mixture. A benchmark of 0% plastic wastes was prepared as a reference concrete for comparison purposes. The use of major plastic wastes as fine aggregates in concrete as an effective way to deal with the scarcity of sand and disposal of plastic waste. Aggregates in concrete account for the largest volume of solid material extracted around the globe at a rate far greater than their regeneration. The removal of aggregates has a major impact on rivers, deltas and marine ecosystems which results in deterioration of land through coastal or river erosion, Depletion of the water table and decrease in sediment supply. Plastic waste such as polyvinyl chloride (PVC), Polypropylene (PP), Polyethylene to substitute the sand in concrete to tackle the ill-effects of sand extraction and the problems related to disposal of plastic waste. The results show the possibility of using plastic waste, such as construction material. Research results show that this is useful to add plastic wastes for obtaining lightweight concrete.

Keywords: Experimental Study, Plastic Waste, Coarse Aggregate, Structural Concrete

Introduction

The development in large cities and an increase in the vast population witnessed by all countries creates more problems in environmental pollution. Since the plastic industry has proliferated and its product is very robust, most of which can only be decomposed after a very long time. The disposal of these waste materials after the first use is the biggest threat to the environment. The increasing demand for construction materials has become significant, and many studies have suggested emerging plastic waste in the concrete mixture. Many types of research have been conducted on the concept of long-term sustainability and how to protect the environment against the dangers of pollution resulting from industrial and plastic waste in particular . The tested the strength of reinforced concrete polymers and non-reinforced concrete by recycling polyethylene terephthalate (PET) waste. The results obtained that the use of these waste materials can be produced precast concrete of good quality. studied the impact of replacing aggregates by PET plastic bottles waste in concrete properties. The results of this research showed that these wastes reduced the weight by 2 to 6% and the compressive strength by 33% as compared to the standard concrete mixture. The effect of the partial replacement of the sand by plastic waste at ratios of 20%, 25% ,40% in a standard concrete mixture.The compressive strength of the concrete was studied at different percentages of recycled plastic waste (0 to 50%) by coarse and fine aggregates. The results of the study showed a gradual decrease in pressure strength with an increase in plastic waste In the current research, the effect of utilizing plastic waste from water bottles as a partial substitute for coarse aggregate on the density and compressive strength. This approach assists in protecting the environment and disposing of

these wastes by using them in the structural engineering sector.

Natural coarse aggregate was utilized as an angular crushed aggregate from local sources. Locally available gravels were sieved and passed through 20 mm. Any material passing sieve 4.75 mm was ignored in order to confirm the standard sieves being used for coarse aggregate. These particles were then washed and cleaned by water several times and left to dry.The goal of the current study is to find a proper way to dispose of plastic materials. Gravel in the concrete mixture was substituted by waste plastic waste residue and the changes in compressive strength and density were measured.

Objectives & Problem Statement of Proposed Work

Problem statements:

- Waste reduction: By incorporating plastic waste into concrete, it can be diverted from landfills and the environment, reducing the amount of waste that is generated.
- Carbon footprint reduction: The production of cement, which is a key component of concrete, is a significant source of carbon emissions. Using plastic as a partial substitute for cement can reduce the amount of cement needed in concrete, thereby lowering its carbon footprint.
- Improved durability: The addition of plastic fibers to concrete can improve its durability and resistance to cracking. This can lead to longer-lasting structures and reduced maintenance costs.
- cost reduction: The use of plastic as a partial substitute for cement can potentially reduce the cost of concrete production, as plastic waste is often cheaper than cement.
- Improved insulation: Adding plastic insulation to concrete can increase its insulating properties, leading to energy savings in buildings.

Objectives:

1) If we can use plastic as a partial substitute for aggregates in concrete, the environmental pollution caused by the discarded plastic can be prevented to a great extent .

2). Lot of the natural fine aggregates can be saved due to the substitution with the waste plastic in concrete.

3)This could be an effective method to dispose thediscarded plastic.

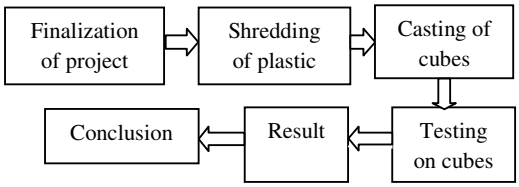
4)The cost of construction project can be reduced by reducing the use of the costlier natural fine aggregates.

5)A light weight concrete that can be used for some specific works can be developed.IT HAS Excellent thermal and electrical insulation properties

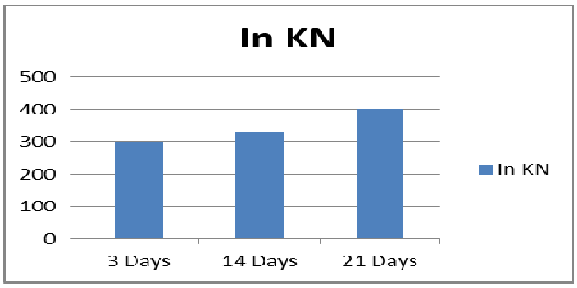
Property ofPolyethylene terephthalate (PET) plastic:

1) Strength: PET plastic is strong and durable, which makes it suitable for use in applications that require a high degree of strength and rigidity.
2) Transparency: PET plastic is transparent, which makes it an ideal choice for applications where visibility is important, such as food packaging.
3) High melting point: PET plastic has a high melting point, which makes it suitable for use in applications that require heat resistance.
4) Low water absorption: PET plastic has a low water absorption rate, which means

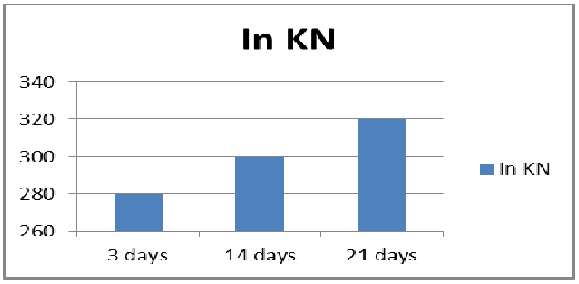
that it is resistant to water damage and is ideal for use in applications that require water resistance.



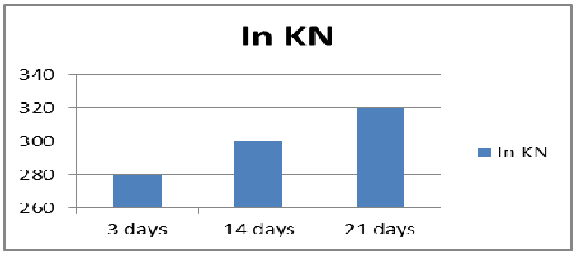
Results:



Proportion of M15



Proportion of M20



Proportions of M35

Conclusion: The main conclusion that can be drawn from this review is that the compressive strength of all concrete involving plastic as partial substitution most likely to be significantly lower than the ordinary or controlled concrete. It is much clearer when the percentage of plastic content as partial substitution increases the lower the strength of the concrete gets. Same conclusion can be made for the slump test result where higher percentage of plastic lower the slump test which was caused by the irregular shape, angularity as well as the surface smoothness of the plastic used as the substitution. As for the bulk density for the ordinary and plastic concrete it was shown that the plastic concrete will definitely weight lesser compared to the ordinary concrete since it is made out of plastic. This shows that plastic

will be a good platform in producing light weight concrete if proper research were to conducted which in other hand will produce good compressive strength in the meantime. In addition to that, from the review above it can be concluded that plastic as fine aggregate substitution in concrete manage to produce a much more better result compared to the substitution for coarse aggregate since most of the research conducted with fine aggregate give positive feedback rather than mostly negative result from coarse aggregate as substitution. Therefore, it is much more recommendable to use plastic as partial replacement for fine aggregate instead of coarse aggregate

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