Behavior of Concrete which is Partially Replaced with Waste Plastic

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Abstract—One of the environmental issues in most regions of Iran is the large number of bottles made from poly-ethylene terephthalate (PET) deposited in domestic wastes and landfills. Due to the high volume of these bottles, more than 1 million m3 landfill spaces are needed for disposal every year. The purpose of this experimental study was to investigate the possibility of using PET waste in asphalt concrete mixes as aggregate replacement (Plastiphalt) to reduce the environmental effects of PET disposal. Concrete is the most widely used man made construction material in the world and its second only to water as the most utilized substance in the planet. Seeking aggregates for concrete and to dispose of the waste from various commodities is the present concern. Today sustainability has got top priority in construction industry. In the present study the recycled plastics were used to prepare the coarse aggregates thereby providing a sustainable option to deal with the plastic waste There are many recycling plants across the world, but as plastics are recycled they lose their strength with the number of recycling. So these plastics will end up as earth _ll. In this circumstance instead of recycling it repeatedly, if it is utilized to prepare aggregates for concrete, it will be a boon to the construction industry. Most of the failures in concrete structures occur due to the failure of concrete by crushing of aggregates. Plastic aggregate which have low crushing values will not be crushed as easily as the stone aggregates. These aggregates are also lighter in weight compared to stone aggregates. Since a complete substitution for Conventional Aggregate was not found feasible, a partial substitution with various percentage of plastic aggregate was done. Both volumetric and grade substitution was employed in this investigation.

Keywords: Plastic Aggregate, Plastic Waste's. About four key words or phrases in alphabetical order, separated by commas.

I. INTRODUCTION

Disposal of plastic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. In recent time use of such, Industrial wastes from polypropylene (PP) and polyethylene terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. If plastic wastes can be mixed with the concrete mass in some quantity or in some form, without affecting the fundamental and other properties or slight negotiation in strength the strength of concrete. Due to which we can consume large quantities of plastic waste by mixing it in the concrete mass as additive.

The changed lifestyle and endlessly increasing population has resulted in a sign cant rise in the quantity of post-consumer plastic waste. The world's annual consumption of plastic materials has increased from around 5 million tons in the 1950′s to nearly 100 million tons in recent times, resulting in a significant increase in the amount of plastic waste generation. Out of this waste, a significant part is recycled but the majority of post-consumer plastic wastes, like shampoo sachets, carry-bags, nitro packs, milk and water pouches etc. though recyclable, remains comparatively untouched as they are difficult to separate from household garbage. In most of the cases, such post-consumer waste either litters all around or is disposed of by landfilling.The disposal of post-consumer plastic waste in this manner poses significant environmental hazards as it results in reduction in soil fertility, reduction in water percolation, emission of toxic gases, health hazard to animals and birds consuming the wastes, poor drainage due to landfilling, pollution of ground water due to leaching of chemicals from these waste products etc. Disposal of waste plastic consumer bags from the domestic has become a major problem to the agencies in the town and cities. The waste plastic bags available in the domestic waste mainly consist of low density polyethylene (LDPE). Plastic bags dumped in the dustbins _nd their way into the drainage system and clog them. Often, these are burnt along the roadside, which produces fumes causing air pollution. Industrial wastes from polypropylene (PP) and polyethylene terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. Five replacement levels. 10%, 20%, 30%, 40% & 50% by volume of aggregates were used for the preparation of the concretes. The results of this research suggest that PP and PET can be used as concrete aggregates for certain structural applications. The thermal behavior of concretes containing 20% by volume PET as aggregate replacement was also studied. The results suggest that temperatures up to 120*o*C produce little damage to concrete that contains PET aggregates but as was expected, concrete exposed to 250*o*C was seriously damaged.

A. Figure No.1 Preparation of Plastic aggregate

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Plastic Aggregate

Why the Plastics

Polymers have a number of vital properties, which exploited alone or together, make a significant and expanding contribution to constructional needs.

_ Durable and corrosion resistant.

_ Good Insulation for cold, heat and sound saving energy and reducing noise
pollution.

_ It is economical and has a longer life.

_ Maintenance free (such as painting is minimized).

_ Hygienic and clean.

_ Easy to processing / installation.

_ Light weight.

Plastic Mix design

Proportion as per mix design							
Material proportion in weigh batching							
Material	**Proportion**	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**
Cement	1	14	14	14	14	14	14
Sand	1.5	21.87	21.87	21.87	21.87	21.87	21.87
CA			36.9	32.8	28.7	24.6	21.87
PA			4.1	5.2	12.3	16.4	20.5
TA	3	41	41	41	41	41	41

Result & Discussion

Physical Properties	**CA**	**PA**
Specific Gravity	2.85	2.433
Bulk Density	1600kg/cm2	1700kg/cm2
Fineness Modulus	4.65	2.2
Water Absorption	0.49%	0.22%
Free Moisture	NIL	2

Workability of concrete by compaction & Slump Cone Test

Replacement of PA in %	**Partially Compacted in kg**	**Fully Compacted in kg**	**Compaction Factor in %**
0%	18.8	19.20	97.92%
10%	19.36	18.82	95.56%
20%	17.94	18.42	94.36%
30%	16.78	17.86	98.89%
40%	15.36	17.12	92.17%
50%	15.12	16.59	91.14%

Density of Concrete

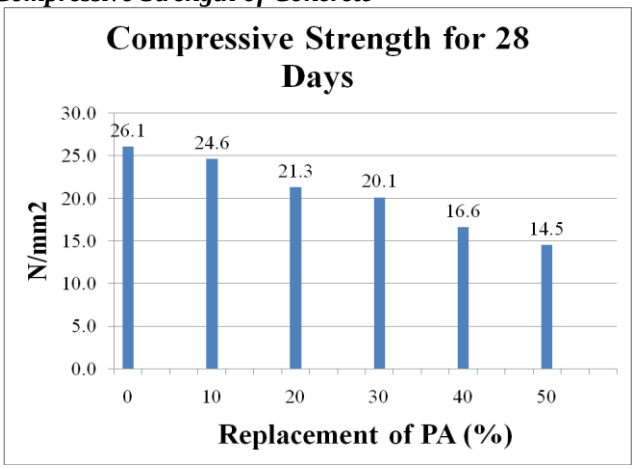
Replacement of PA	Density of Concrete in kg/m^3
0%	2612.3
10%	2514.74
20%	2398.06
30%	2326.10
40%	2270.10
50%	2168.79

Discussion

Replacement of conventional aggregate by plastic aggregate decreases density of concrete.

- Up to 10% replacement of conventional aggregate by plastic aggregate decreases density by 3.73 % .
- Up to 20% replacement of conventional aggregate by plastic aggregate decreases density by 8.20% .
- Up to 30% replacement of conventional aggregate by plastic aggregate decreases density by 10.95%.
- Up to 40% replacement of conventional aggregate by plastic aggregate decreases density by 13.088%.
- Up to 50% replacement of conventional aggregate by plastic aggregate decreases density by 16.99%.

Compressive Strength of Concrete



Discussion

1 Compressive strength decrease in concrete is 1.8 *N/mm2 at 10% replacement of* plastic aggregate made from waste plastic(i.e. decrease in 5.75%)

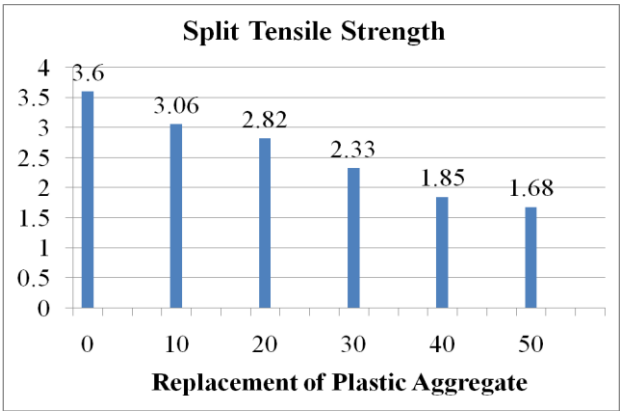
2 Compressive strength decrease in concrete is 4.8*N/mm2 at 20% replacement of* plastic aggregate made from waste plastic (i.e. decrease in 18.39%)

3 Compressive strength decrease in concrete is 6.0 *N/mm2 at 20% replacement of* plastic aggregate made from waste plas40%tic (i.e. decrease in 22.88%)

4 Com50%pressive strength decrease in concrete is 9.5*N/mm2 at 20% replacement of* plastic aggregate made from waste plastic (i.e. decrease in 36.39%)

5 Compressive strength decrease in concrete is 11.60 *N/mm2 at 20% replacement of* plastic aggregate made from waste plastic (i.e. decrease in 44.44.%)

Split Tensile Strength of Concrete



Discussion

1 Split tensile strength decrease in concrete is 0.54 N/mm2 at 10% replacement of plastic aggregate made from waste plastic(i.e. decrease in 15%)

2 Split tensile strength decrease in concrete is 0.78 N/mm2 at 20% replacement of plastic aggregate made from waste plastic(i.e. decrease in 21.66 %)

3 Split tensile strength decrease in concrete is 1.27 N/mm2 at 30% replacement of plastic aggregate made from waste plastic(i.e. decrease in 35.27 %)

4 Split tensile strength decrease in concrete is 1.75 N/mm2 at 40% replacement of plastic aggregate made from waste plastic(i.e. decrease in 48.61 %)

5 Split tensile strength decrease in concrete is 1.92 N/mm2 at 50% replacement of plastic aggregate made from waste plastic(i.e. decrease in 53.33 %)

II. CONCLUSION

1.The modified concrete mix, with addition of plastic aggregate replacing conventional aggregate up to certain 20% gives strength with in permissible limit.

2. Modified concrete casted using plastic aggregate as a partial replacement to coarse aggregate shows 10 % it could be satisfy as per IS codes.

3. Density of concrete is reducing after 20% replacement of coarse aggregates in a concrete.

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