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EXPERIMENTAL STUDY ON RECYCLED LDPE WASTE INCEMENT MORTAR

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Abstract—Extensive research work has been done to improve the decreasing sustainability of environmental condition through plastic wastes. Improper land disposal of plastic wastes results in the depletion of fertility of soil as well as resulting adverse effect over environment and living being. This paper emphasizes on effect on properties of recycled plastic waste in cement mortar as a replacement of fine aggregate in varying percentage. The study reveals decreasing environmental problems and the feasibility of recycled waste inclusion as partial aggregate replacement in normal cement mortar. It involves three replacement levels of wastes into cement mortar for each mix design. In the design mix of plastic wastes cement mortar, percentage of fly ash and w/c ratio is kept constant (32 % and 0.5) and recycled Low-Density Polymer Ethylene (LDPE) is varied from 0 to 30 % by weight of natural sand. The test results indicate that the mechanical properties of Recycled LDPE modified mortar are improved, whereas the water absorption is increased upto as compared to that of plain mortar.

Keywords—Recycled LDPE, Eco-friendly, Water absorption, Economic.

I. INTRODUCTION

Cement mortar has great significance in structural material.Mortar is a homogeneous mixture, produced by intimately mixing cementitious materials, water and inert materials, such as sand to the required consistency for use in building together with masonry units. Due to growing environment concern and the need to conserve energy, various research efforts have been directed toward the utilization of waste materials in cement mortar. With ever-increasing environmental problems because of plastic waste, comes a great need to use this non-biodegradable waste in an appropriate manner to reduce health and environmental problems.The use of recycledLow-Density Polymer Ethylene (LDPE) made cement mortar economical and without affecting normal strength. Efforts has been made to perform recycling of waste plastic such as Low-Density Polymer Ethylene (LDPE), LDPE is a thermoplastic made from the monomer ethylene. However, due to its ubiquitous nature, and resistance to biodegradability, the disposal strategies are critical and need attention.

II. IMPORTANCE AND SCOPE OF PROJECT

Due to increase in population and public demand led to enhancement in industrialization and urbanization, the amount and type of waste materials have increased accordingly. Many of the non-biodegradable waste materials will remain in the environment for hundreds, perhaps thousands of years. Improper disposal of non-biodegradable waste materials produces hazardous gases whichaffects the eco-system adversely and causing fatal problems to health. The problem of waste accumulation exists worldwide, specifically in the urban areas. Most of these materials are left as stockpiles, landfill material or illegally dumped in selected areas. Hence inorder to reducethis problem, the waste product is utilized as construction material. This paper involves replacement of fine aggregate(sand) used in cement mortar by recycled LDPE wastes by various percentages. Utilization of such recycled plastic waste materials made the partial solution to environmental and ecological problems. Use of these materials not only helps in getting them utilized in cement mortar, concrete and other construction materials, it helps in reducing the cost of cement and fine aggregates (sand), but also has numerous indirect benefits such as reduction in masonry and finishing cost, saving in energy, to reduce the fatal effect on the loss of fertility of soiland protecting the environment from possible threat due to pollution.

III. OBJECTIVE

Following objectives are driven: -

- Proper mix proportioning of recycled LDPE waste and fine aggregate is utilizedfor modified cement mortar.
- To investigate variation in compressive strength of cement mortar with sand and recycled LDPE waste.
- To determine optimum content of recycled LDPE waste as a replacement of fine aggregate.
- To study the density as well as water absorption of modified mortar formed by utilization of different mix proportion of sand and recycled LDPE.

IV. LITERATURE REVIEW

Oliveira used fibers made from recycled PET bottles in reinforced mortar. He added different volumes of fiber with the variable quantity of 0.0%, 0.5%, 1.0%, and 1.5% to the dry mortars. The results showed that using PET fibers makes a significant improvement on compressive strength of mortars, in addition to a noticeable effect on the flexural strength along with increase in their toughness.

Yousef Ghernouti et al. The study presents the partial replacement of fine aggregate in concrete by using plastic fine aggregate obtained from the crushing of waste plastic bags. Plastic bags waste was heated followed by cooling of liquid waste which was then cooled and crushed to obtained plastic sand having finesse modulus of 4.7. Fine aggregate in the mix proportion of cement mortar was replaced with plastic bag waste sand at 10%, 20%, 30% and 40% whereas other materials remain same for all four mixes.

V. MATERIALS REQUIRED

1. Cement

The cement used in experiment should be fresh, of uniform consistency and free of lumps and foreign matter. Cement used in the experiment was Portland Pozzolona Cement(PPC) consists of 32% Fly-ash conforming to IS 1489-1991 (Part I). The cement was tested and the physical properties of the cement were computed, the results obtained were within limit as specified in Indian Standards and are as follows: Normal Consistency -33%, Initial Setting Time - 30min And Final Setting Time - 600 min, Specific Gravity =3.15, Density Of Cement - 3.10 gm/cc, Fineness - 300 m^2/kg, Dry shrinkage – 0.15%, soundness – 10 mm. The minimum compressive strength of PPC after 28 days, as prescribed by BIS is 33 MPa or 330 kg / Cm2. However, the ultimate, long-term strength of PPC is better compared to OPC 53. Since the pozzolanic material reacts with calcium hydroxide liberated by the hydrating Portland cement and forms cementitious compounds, PPC makes the concrete more impermeable and denser as compared to OPC and it is this property coupled with its cost effectiveness that has helped in its emerging more popular in the construction industry.

2. Fine aggregate

Normal weight fine aggregate (sand) is the most common aggregate used in cement mortar. It should be clean, hard, strong, free of organic impurities and deleterious substances and relatively free of silt and clay. It should be inert with respect to other materials used and of suitable type with respect to strength, density, shrinkage and durability of the mortar made with it. Grading of the sand is to be such that a mortar of specified proportions is produced with a uniform distribution of the aggregate, which will have a high density and good workability and which will work into position without segregation and without use of high water content. The sand was sieved using 4.75mm and the fraction passing 4.75mm was used for all experiments The sand belongs to zone -II as per IS: 383-1970. The physical properties of fine aggregate were computed according to IS 383-1970 and results obtained are as follows: Fineness Modulus-2.83, Silt Content - 0.5%, Specific Gravity - 2.65.

3. Water

Water is an important component of cement mortar. Water cement ratio plays crucial role in mixing of matrix, when cement comes in contact with water, an exothermic reaction occurs and setting of cement starts. Water used in the mixing is to be fresh and free from any organic and harmful solution which will lead to deterioration in the properties of the mortar. Salt water is not acceptable but chlorinated drinking water can be used. Potable water is fit for use as mixing water as well as for curing.

4. LowDensity Polymer Ethylene(LDPE)

LDPE are thermoplastics made from the monomer ethylene, LDPE is high molecular weight polyolefin material, it is an acronym for Low Density Polyethylene and is a thermoplastic derived from petroleum.Like all polyolefins, LDPE is nontoxic, non-contaminating and exhibits a high degree of break resistance. It is lighter than water, easily withstands environmental exposure. As a result, LDPE is naturally very flexible without the addition of plasticizers and melts at a relatively low temperature (85-115°C). This thermoplastic is available in the range of flexibilities depending on the production process. High density materials are the most rigid, the polymers can be formed by wide varieties of thermoplastic processing methods and is particularly useful where moisture resistance and low cost are required.

Properties of LDPE: -

Following are some of general properties of LDPEWaste: -

TABLE I

PROPERTIES OF LDPE

Properties	Values
Melting Point	85- 115° C
Density	0.920 - 0.940 g/cm^3
Water absorption	High

VI. APPLICATIONS OF RECYCLED LDPE IN CEMENT MORTAR

- Punning
- Cement roofing sheets
- Cement mortar plaster
- Boundary walls/fencing
- Flooring over foundation.

VII. MIX PROPORTION

We have casted cubes of size 70.6×70.6×70.6 mm.Following material proportion with constantw/c ratio 0.5 have beenused. Nominal mix of 1:3 cement mortar with variant recycled LDPE is used.

Design mix proportion for modified Mortar Samples (1:3)

TABLE II

MIX PROPORTIONING

Mix type	Cement (gm)	Sand (gm)	LDPE (gm)	Water
$M_{(0)}$	250	750	00	0.5
$M_{(10)}$	250	675	75	0.5
$M_{(20)}$	250	600	150	0.5
$M_{(30)}$	250	525	225	0.5

VIII. EXPERIMENTAL INVESTIGATION

1. COMPRESSIVE STRENGTH TEST

In order to study the effect of recycled LDPE waste as partial fine aggregate replacement on the strength of cement mortar (1:3), cubes of size 70.6 mm × 70.6 mm × 70.6 mm were cast for different percentage of recycled LDPE waste and for zero percentLDPE waste, mix have been casted in the laboratory. For making the mortar cubes, IS 2250-1995 is used.

An effort has been made here to compare the strength of cubes made up with different percentage of recycled LDPE waste to the respective strength of conventional cement mortar at the end of 7,14, and 28 days of curing and to have an idea about the optimum percentage of recycled LDPE waste which does not affect the strength of recycled mortar considerably. Water cement ratio adopted was 0.50.

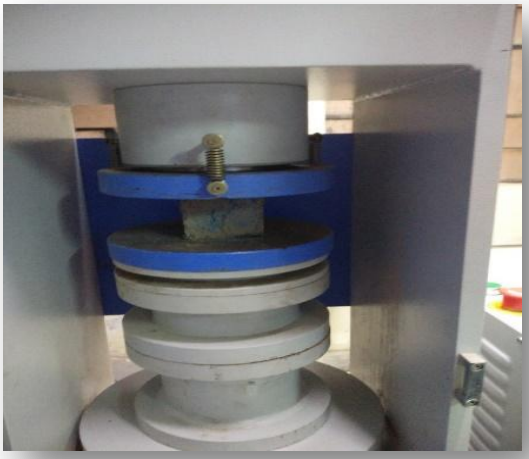
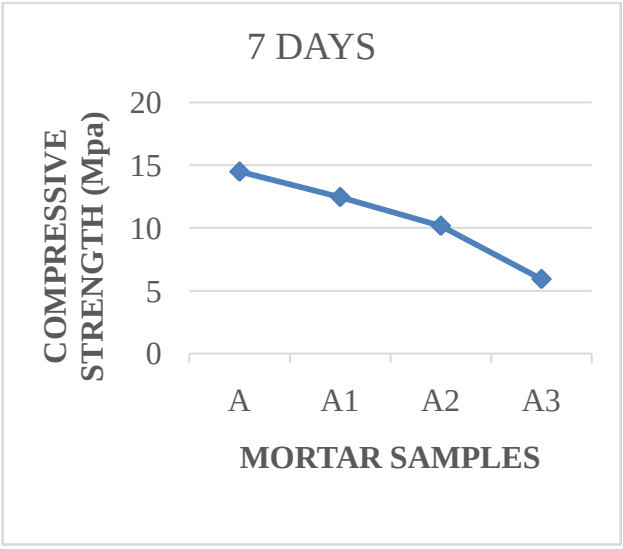


TABLE I
COMPRESSIVE STRENGTH OF MORTAR WITH CONSTANT W/C RATIO7 DAYS

MIX TYPE	W/C Ratio	LDPE (%)	Compressive Strength(Mpa)
A	0.50	0	14.15
A1	0.50	5	12.47
A2	0.50	10	10.18
A3	0.50	15	5.94



TABLEII
COMPRESSIVE STRENGTH OF MORTAR WITH CONSTANT W/C RATIO14 DAYS

MIX TYPE	W/C Ratio	LDPE (%)	Compressive Strength(Mpa)
A	0.50	0	17.38
A1	0.50	5	15.40
A2	0.50	10	12.45
A3	0.50	15	7.58

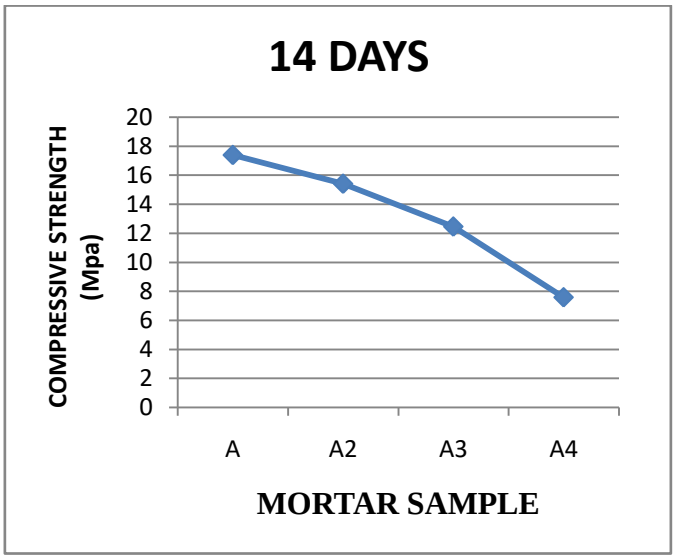
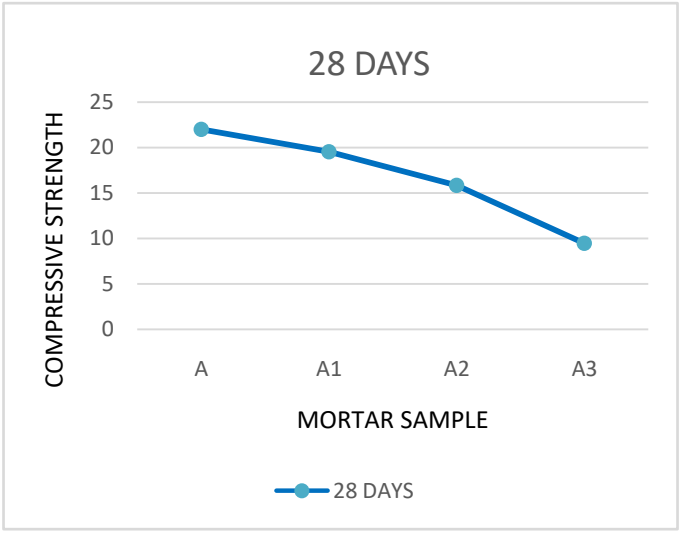


TABLE III
COMPRESSIVE STRENGTH OF MORTAR WITH CONSTANT W/C RATIO28 DAYS

MIX TYPE	W/C Ratio	LDPE (%)	Compressive Strength(Mpa)
A	0.50	0	22
A1	0.50	5	19.53
A2	0.50	10	15.84
A3	0.50	15	9.48



2. WATER ABSORPTION TEST

Water absorption is the measurement of the water proofness of the mortar mix. All the mixes were subjected to water absorption test at the end of curing period of 28 days after demoulding. The 70.6 mm x 70.6 mm x 70.6 mm size cube after casting were immersed in water for 28 days curing. These specimens were then oven dried for 24 hours at the temperature 85° C until the mass became constant and again weighed. This weight was noted as the dry weight (W1). After that the specimen was kept at 85° C for 24 hours. Then this weight was noted as the wet weight (W2).Now using formula, water absorption of various mortar samples is calculated.

Water absorption = [(W2– W1) / W1] x 100

Where,

W1 = Oven dry weight of cubes in grams

W2 = After 24 hours wet weight of cubes in grams

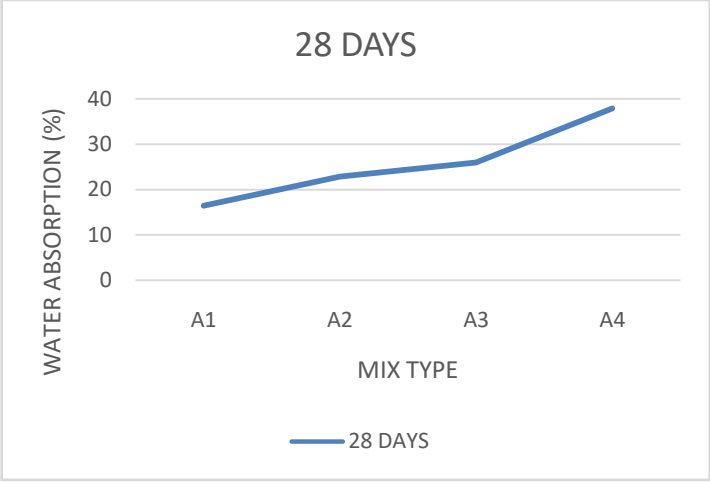
It results in low infiltration of moisture to bricks and absorbs moisture to great extent than normal cement mortar through wall plaster which acts as damp-proof material.

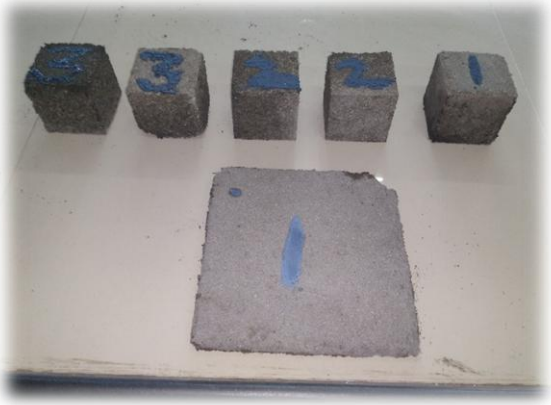
The results so obtained are listed in table below

TABLE II

WATER ABSORPTION OF MORTAR 28 DAYS

S.NO	Mix designation	Mix Type (%)	Water Absorption (%)
1	A1	Mix $_{(0)}$	16.45
2	A2	Mix $_{(5)}$	22.83
3	A3	Mix $_{(10)}$	25.95
4	A4	Mix $_{(15)}$	37.88





IX. CONCLUSION

- It has several indirect benefits such as cost effective, reduction in masonry and finishing cost, saving in energy.
- It was observed that compressive strength upto 5% LDPE replaced cement mortar, has slightly changed from normal mortar.
- The test results indicate that not more than 15 % of Recycled LDPE waste are replaced.
- Use of recycled LDPE plays significant role to resist the loss of fertility of soil and reducing environmental threats.
- It was found that the water absorption is increased to that of plain mortar without affecting its mechanical property.
- It results in low infiltration of moisture to bricks, which acts as damp proof material.

X. REFERENCE

[1] LA. Pereira de Oliveira, JP. Castro-Gomes, "*Physical and mechanical behavior of recycled PET fiber reinforced mortar*," Construction Build Mater, pp. 1712–7, April 2011.

[2] GirumBahri,*Sustainable Management of Plastic Bag Waste: The Case of Nairobi, Kenya, Lund, Sweden.*, September 2005.

[3] Plastic Europe, (2009*) The Compelling Facts about Plastics 2009 An analysis of European plastics production, demand and recovery for 2008*, Plastic Europe, www.plasticseurope.org–998.

[4] S. L Wong, N.Ngadi, and T.A.T. Abdullah. Solubilization of Low Density Polyethylene (LDPE) for Pyrolysis. in 4th International Graduate Conference on Engineering Science & Humanity 2013. 2013. UniversityTechnology Malaysia, Johor Bahru, Johor,Malaysia.

[5] Bhatti. J, *Low-density Polymer Ethylene*, Thermofisher scientific.

[6] I.S. 456-2000, *Indian Standard Plain and Reinforced Concrete* – Code of Practice

[7]Youcef Ghernouti, Bahia Rabehi, Brahmi Safi and Rabah Chaid, "*Use of Recycled Plastic Bag Waste in The Concrete*" Journal of International Scientific Publications: Materials, Methods and Technologies Volume 8, ISSN 1314-7269

[8] Nema. S, Soley .P, Bhawar . ANim .*A, Effect of mill scale and fly ash waste on the performance of cement mortars*, International Journal of Research in Engineering and Technology, 2014.

[9] Oswaan.V ,*Overview of materials for Low Density Polyethylene (LDPE)*, Film Grade, MatWeb, Material Property Data, 2006.