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Utilisation of Waste Plastics as a Replacement of Coarse Aggregate in Paver Blocks

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Abstract : The rapid industrialization and urbanization in the country leads lot of infrastructure development. This process leads to several problems like shortage of construction materials, increased productivity of wastes and other products. This paper deals with the reuse of waste plastics as partial replacement of coarse aggregate in M20 concrete. Usually M20 concrete is used for most constructional works. Waste Plastics were incrementally added in 0%, 2%, 4%, 6%, 8% and 10% to replace the same amount of Aggregate. Tests were conducted on coarse aggregates, fine aggregates, cement and waste plastics to determine their physical properties. Paver Blocks of I section of casted and tested for 7, 14 and 28 days strength. The result shows that the compressive strength of M20 concrete with waste plastics is 4% for Paver Blocks.

1.0 Introdution

As the world population grows, wastes of various types are being generated[5]. The creation of non–decaying and low biodegradable waste materials, combined with a growing consumer population has resulted in waste disposal crisis. One solution to this crisis is recycling wastes into useful products. Many Government agencies, private organizations and individuals have completed or in the process of completing a wide variety of studies and research projects concerning the feasibility, environmental suitability and performance of using waste plastics in construction field which needs better and cost effective construction material and reuse of waste plastics and save our world from environmental Pollution[4,6]. With the increase in development, there is an increase in cost of construction and the maintenance of pavements. So, the Engineers and Designers have been looking for new concept of using waste plastics in cement concrete Paver Blocks. This pavement are less susceptible to rutting, minimum fatigue or thermal cracking, low stripping due to moisture and offers great durability, little or no impact on processing and also produces eco friendly construction and costs less.

The wastes plastic in household is large and increases with time[7]. In each country the waste composition is different, since it is affected by socioeconomic characteristics, consumption patterns and waste management programs, but generally the level of plastics in waste composition is high. The largest component of the plastic waste is polyethylene, followed by polypropylene, polyethylene Terepthalate and polystyrene[3]. The large volume of materials required for construction is potentially a major area for the reuse of waste materials. Recycling in concrete has advantages since it is widely used and has a long service life, which means that the waste is being removed from the waste stream for a long period. Because the amount of mineral aggregates required in concrete is large, the environmental benefits are not only related to the safe disposal of bulk waste, but also to the reduction of environmental impacts arising from the extraction of aggregates.

1.1 Background

Paving blocks have made a fast inroad into the construction industry, and have almost become the de-facto choice[2]. Most construction firms nowadays prefer paving blocks over slabs, asphalt, stone or clay. Mass production of paving blocks has reduced their price, and made it easily affordable. With the advent of paving block machines, it has become even simpler to complete their laying.

Fig 1 Types of paver blocks

1.2 Types of Paving Blocks

There are two basic types of paving blocks – concrete and clay.

1.2.1 Concrete Paving Blocks:

Concrete blocks are mass manufactured to standard sizes. This makes them interchangeable. Typical concrete paving blocks have one smooth face and one rough, although some paving blocks so come with reversible surfaces (can be used both sides). The performance characteristics of concrete paving blocks make it suitable for the heaviest duty applications, able to support substantial loads and resist shearing and braking forces[6].

These blocks come in different colours. The colours typically come from metallic oxides. However, these colours tend to fade over a period of time, so it is helpful to exercise caution while selecting them!

Concrete paving blocks are the most preferred choice for laying of pavements, driveways, etc.

1.2.2 Clay Paving Blocks

Clay paving blocks (also called as bricks or cobbles) are generally available as typical, rectangular bricks, although custom shapes can be made for specific projects. Unlike the concrete paving blocks, both the surfaces of most clay blocks are fully useable or interchangeable.

Clay bricks do not use any dyes to impart colour; they come in natural colour. Consequently, the colour of these blocks does not usually fade with time. Clay paving blocks are more difficult to cut than their concrete counterpart.

The paving blocks are most suitable for walls or pillars.

Advantages of paving blocks:

- can be used immediately after laying
- comfortable to walk on
- excellent interlocking characteristics
- very durable
- great aesthetics

Paver Patterns Pages:

- Brick Pavers
- Cambridge Pavers
- Cobblestone
- Concrete Pavers
- Flagstone Pavers
- Rubber Pavers
- Stone Pavers
- Travertine Pavers

Paver Shapes Pages:

- Bluestone Pavers
- Brick Pavers
- Cambridge Pavers
- Concrete Pavers
- Flagstone Pavers
- Granite Pavers
- Slate Pavers

1.3 Definition of Plastic

A material which contains one or more number of polymers having large molecular weight." Solid in its finished state same state will manufacturing or processing into finished articles is known as Plastic. Looking to the global issue environmental pollution by post-consumer plastic waste, research efforts have been focused on consuming this waste on massive scale in efficient and environmental friendly manner[5,7]. Researchers planned to use plastic waste in form concrete ingredient as the concrete is second most sought material by human beings after water. The use of post-consumer plastic waste in concrete will not only be its safe disposal method but may also improve the concrete properties like tensile strength, chemical resistance, drying shrinkage and creep on short and long term basis. Why The Plastics:- Polymers have a number of vital properties, which exploited alone or together, make a significant and expanding contribution to constructional needs

2.0 Literature Review

2.1 M. C. Nataraja1 and Lelin Das2

Interlocking Concrete Block Pavement (ICBP) technology has been introduced in India in construction, a decade ago, for specific requirement namely footpaths and parking areas etc. Now ICBP is being adopted extensively in different uses where the conventional construction of pavement using hot bituminous mix or cement concrete technology is not feasible or desirable. In this investigation, various properties such as compressive strength, split tensile strength, bending strength and water absorption of paver blocks consisting of crushed granite, unconventional materials such as kadapa and broken paver for various percentage replacements of coarse aggregate are studied as per IS 15658:2006. Key words: IS 15658:2006, ICBP, kadapa, broken paver aggregate.

2.2 Dixit N. Patel* Jayeshkumar R. Pitroda**

Foundries for the metal-casting industry generate by- products such as used foundry sand. Applications of foundry sand, which is technically, sound, environmentally safe for sustainable development. In this study, partially replacement of Cement (PPC 53 grade cement) in paver block by used foundry sand for determining the change in the compressive strength of paver blocks and cost of paver block. Partial replacement of cement (PPC 53 grade cement) in bottom layer in different percentage as like 10%, 20%, 30%, 40% and 50%. The compressive strength, flexural strength has been determined at the end of 7, 14 and 28 days and water 5 absorption test has been determined at 28 days. The paper also shows the cost comparison per block for the paver block mix proportion. KEYWORDS: Various Test, Portland Pozzolana Cement (PPC) Used Foundry Sand, Paver Block, Cost

2.3 R. C. Yeole1 ,Dr. M. B.Varma2

Concrete paving blocks are ideal materials on the footpaths and roads for easy laying, better look and finish. In this paper, a parametric experimental study for producing paving blocks using waste steel aggregates (the form of rounded bearings of size 6.35 mm) is presented. Waste steel bearings are added in concrete of paver blocks in various percentages. Rubber pads are also used below the paver blocks. Impact strength of paver blocks with various percentages of waste steel aggregates and using rubber pads is investigated. Test results show that combination of using rubber pads and adding various percentages of waste steel aggregates in paver blocks gives upto 50% more impact strength than ordinary paver blocks. Index Terms - waste steel aggregates, compressive strength, flexural strength, Concrete interlocking paving blocks, Impact test. I. INTR

3.0methodology

- To find properties of Coarse, Fine Aggregates and Cement
- To find out physical properties of Waste Plastics
- To conduct mixed design as per IS: SP 23 – 1982 (1)
- To cast Paver Block with Waste Plastics
- To study the Compressive strength in 0%, 2%, 4%, 6%, 8% and10%of waste plastics added samples as a replacement of coarse aggregate.

3.1 M20 Grade Concrete Mix

Mix Design

Stipulations For Proportioning

Grade of designation	-	M20
Type of cement	-	OPC 53 grade
Chemical admixture	-	Nil
Max. nominal size of aggregate	-	10 mm
Max. cement content	-	540 kg/m^3
Min cement content	-	250 kg/m^3
Workability	-	100 mm
Exposure condition	-	Severe (for reinforced concrete)
Degree of supervision	-	Good
Type of aggregate	-	Crushed angular

Design Data

Specific gravity of cement	-	3.15
Specific gravity of sand	-	2.64
Specific gravity of aggregate	-	2.7
Specific gravity of super plasticizer	-	-

Water absorption

Coarse aggregate	-	0.5%
Fine aggregate	-	1.0%

Result

Cement	=	383.00 Kg/m³
Sand	=	546.00 Kg/m³
Coarse aggregate	=	1188.00 Kg/m³
Water	=	191.61 Kg/m³
W/C Adopt	=	0.50

3.2 Mix Ratio

Mix Ratio for M_{20}

W/C ratio	Cementitious	Fine aggregate	Coarse aggregate
191.61	383.00	546.00	1188.00
0.5	1.000	1.425	3.10

3.3 Materials

3.3.1 Aggregates (Coarse and Fine Aggregates)

Coarse Aggregate:-

coarse aggregate shall comply with the requirement of IS 383 as for as possible crushed Aggregate shall be used for ensuring adequate durability. The aggregate used for production of block shall beSound and free from soft and honeycombed particle the nominal maxi size of coarse aggregate used in Production of paver block shall be 10 mm.

Fine aggregate:-

Fine aggregate shall conform to requirement of IS 383 For river sand

3.3.2 Cement

Ordinary Portland cement of 53 – grade was used as it satisfied the requirements of IS: 269 – 1969 and results have been tabulated

3.3.3 Water

Water for the concrete should be clean and free from oils,acids,alkalis,vegetables or other organic impurities.Ingeneral,water that is fit to drink is suitable for the concrete.Excess of acidity or alkalinity can be avoided. Soft water may produce a weaker concrete than hard water. Water containing decayed vegetable matter should be particularly avoided as they may interface with setting of cement.Water in concrete has two fold purposeto hydrate the cement and to lubricate the mix so as to aid compaction.The salt present in water corrodes the reinforcement.so water should be pure for good concrete.

3.3.4 Plastics

Plastic Aggregate in concrete is acceptable there are for the making of concrete used coarse aggregate having size 10mm, These plastics consist mainly of High Density Polyethylene (HDPE).

Fig:2 Waste Plastics

3.4 Casting

Usually M20 concrete is used for most constructional works, hence in this project M20 concrete is taken and waste plastics is used as Replacement of aggregate. Aggregates such as 0%, 2%, 4%, 6%, 8% and 10% was added in percentage, in order to replace the same amount of Aggregate. Tests were conducted on coarse aggregates, fine aggregates, cement and waste plastics to determine their physical properties. Paver blocks of I section (Paver Block) were casted and tested for 7, 14 and 28 days strength.

Fig 3.casting of specimen

3.5 Manufactured sand

Manufactured Sand is a sand produced from crushing of granite stones in required grading to be used for construction purposes as a replacement for river sand.

Fig 4.M sand

4.0 Results and Discussions

Experimental investigation is carried out on the concrete test specimens to ascertain the strength related properties namely compressive strength. This chapter presents the test results of the experimental investigation carried out on the test specimens to study the optimum percentage replacement of coarse aggregate with waste plastics.

4.1 Test Result

Testing for Compressive Strength

Testing of casted specimens are tested for 7, 14 and 28 days compressive strength by using hydraulic compressive testing machine strength. After conducting Compressive strength testing the test Results are tabulated.

Table 1 Compressive Strength Test Report M 20 Grade Paver Block

S.NO	Water plastic in %	7 days compressive strength in N/mm^2	14 days compressive strength in N/mm^2	28 days compressive strength in N/mm^2
1	0 %	9.5	16.5	26.9
2	2 %	9.3	16.2	26.4
3	4 %	9	16	26.1
4	6 %	7	13.5	20
5	8 %	5.5	12.7	17
6	10 %	4	9	14

4.2 Results and Discussion

In the present investigation it is found that optimum up to 4% by replacing of waste plastics there is a slight deviation of compressive strength. From the test results it was observed that the compressive strength value of the concrete mix decreased with the addition of waste plastics more than 4% of waste plastics. So we can add waste plastics in paver blocks so this will helps to reuse of plastics in paver blocks.

5.0 Conclusion

Looking into the above aspects, the analysis concluded that the waste plastics can be used in the cement concrete mix. This modified cement concrete mix is applicable in the construction of rigid pavements. The compressive strengths of modified cement concrete are as equal as plain cement concrete. The optimum

modifier content of waste plastics is found to be 4% for paver blocks. The cost of construction will reduce and also helps to avoid the general disposal technique of waste plastics namely land filling and incineration which have certain burden on ecology.

6.0 References

1. Bhogayata A, Arora NK. Green concrete from the post-consumer plastic wastes: Indian scenario. ICTSET proceedings. 2011 Apr; 437–40.
2. Marzouk OY, Dheilly RM, Queneudec M. Valorisation of Post-consumer waste plastic in cementitious concrete composites. PubMed. U. S. National Library of Medicine. National Institute of Health. 2006 May; 27(12):310–6.
3. Naik TT, Singh SS, Huber CO. Brodersen B.S. use of post-consumer plastics in cement based composites. Cement and Concrete Research. 1996 Oct; 26(10):1489–92.
4. Prvinkumar K, Kaushik SK. Some trends in the use of concrete: Indian Scenario. The Indian concrete Journal. 2003 Dec; 1503–8.
5. Ismail ZZ,Al-HashmiEA.Use of waste plastic in concrete mixture as aggregate replacement. Waste Management. 2008 Nov; 28(11):2041–7.
6. Madam Mohan Reddy, K, Ajitha .B, and Bhavani .R, "Melt-DensifiedPost Consumer Recycled Plastic Bags Used as Light Weight Aggregate in Concrete"," International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 2, Issue4, July-August 2012, pp.1097-1101.
7. V. Kasselouri - Rigopoulou, S. Gavela, S. Kolias "Use Of Polymeric Wastes in The Concrete Production" Polymers in concrete: a vision for the 21st century, Cement & Concrete Composites 21: (1999) 449-452.

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