International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Behaviour of Paver Block by Addition of Waste Rubber

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Abstract

Concrete is one of the widely used construction material in the construction industry. The durability and aesthetics aspects of concrete made it to use in making paver blocks which are used in outdoor versatility application as street road, sidewalks, and other Construction places. Paver block has low cost maintenance and easily replace with a newer one at the time of breakage. The quality of concrete used to make paver block may be the major issue, so that the durability of paver block depends on quality of concrete. Rubber is used in different fields throughout the world. But the utilization or disposal of waste rubber after its regular. Thus an attempt is made by inclusion waste rubber into the concrete and to measure how rubber affects the properties of paver block. This research study presents the information about the development of the rubber mould paver block with inclusionwaste rubber.

Keywords: Rubber Mould Paver Block, Compressive strength.

I. INTRODUCTION

Concrete, artificial engineering material made from a mixture of Portland cement, water, fine and coarse aggregates and a small amount of air. It is the most widely used construction material in the world. Concrete is the only major building material that can be delivered to the job site in a plastic state,

This unique quality makes concrete desirable as a building material becauseit can be molded to virtually any form or a shape. Concrete provide wide latitude in surface textures and colors and can be used to construct a wide variety of structures such as highways and streets, bridges, dams, large buildings, airport runways, irrigation structure, break waters, piers and docks, sidewalks, soils and farm building homes and even barges and ship. Other desirable qualities of concrete as a building material are its strength, economy and durability. Dependingon the mixture of materials used, concrete will support, in compression, 700 or more kg/sq cm, (10,000 or more 1b/sq cm). The tensile strength of concrete is much lower when compared to compressive strength of concrete, but by using properly designed steel reinforcing, the structural members can be made that are asstrong as in compression. The durability of concrete is evidenced by the fact that concrete columns built by the Egyptians more than 3600 years ago are still standing.

HISTORY OF PAVER BLOCK

Concrete paver blocks were first introduced in Holland in the fifties as replacement of paver bricks which had become scarce due to the post war building construction boom. These blocks were rectangular in shape and more or less the same size as the bricks.

Block paving also known as **brick paving** is a commonly used decorative method of creating a pavement or hard standing. The main benefit of bricks over other materials is that individual bricks can later be lifted up and replaced. This allows for remedial workto be carried out under the surface of the paving without leaving a lasting mark once the paving bricks have been replaced. Typical areas of use would be for driveways, pavement, patios**,** town centers, and pedestrian precincts and more commonly in road surfacing. Bricks are typically made of concrete or clay, though other composite materials are also used. Each has its own means of construction. The biggest differenceis the way they set hard ready for use. A clay brick has to be fired in a kiln to bake the brick hard.

A concrete brick has to be allowed to set. The concrete paving bricks are a porous form of brick formed by mixing small stone hardcore, dyes, cement and sand and other materials in various amounts. Many block paving manufacturing methods are now allowing the use of recycled materials in the construction of the paving bricks such as crushed glass and crushed old building rubble.

There are many different laying patterns that can be achieved using block paving. The most common of these is the herringbone pattern. This pattern is the strongest of the block paving bonds as it offers the most interlock, therefore making it a good choice for driveways and road surfacing. A herringbone pattern can be created by setting the blocks at either 45 degrees or 90 degrees to the perpendicular. Other popular types of pattern include stretcher bond and basket weave; with the latter being better suited to pavedareas that will only receive light foot traffic, due to its weaker bond.

II. LITERATURE REVIEW

Maulik Sharma et al (2007) [1]: The quality of concrete used to make paver block may be the major issue, so that the durability of paver block depends measuredly on quality of concrete, thus an attempt is made by inclusion bacteria into the concrete and to measure how bacteria affect the properties of paver block. This research study presents the information about the development of the rubber mould paver block with inclusion bacteria.

P. Kirubagharan et al (2010) [2]: Waste tyres in India are categorized as solid waste or hazardous waste. It is estimated that about 60% of waste tyres aredisposed through unknown routes in the urban as well as rural areas.By considering the advantages of rubber pads, in this project the rubber powder is used as a cement replacing material in Concrete paver blocks in order to increase the strength of paver and to reduce the emitted carbon dioxide percentage while casting cement concretepaver. The optimum percentage of the rubber pad is finalized from the results of the experimental work and preferred for the pavement works. By replacing 20% of rubber powder for cement is used to obtain the compressive strength of 51Mpa andimpact strength of 15 blows. Therefore by replacing the cement by rubber pavers.

BHAVINK.KASHIYANI,JAYESHKUMAR PITRODA&
BHAVNABEN K. SHAH (2013) (poly propylene fiber)[3]:
In the only top layer polypropylene fibre is to be added to the 0.1%, 0.2%,0.3%, 0.4% and 0.5%by weight of the concrete paver block. After about 24 h the specimens were placedat safe place and water curing was continued till the respective specimens were tested after 7, 14 and 28 days for compressive strength and water absorption tests.

G.Navya, J.Venkateswara Rao (2014)(polyster fiber)[4]: Paver block concrete contains cement, fine

aggregate, and quarry dust in the bottom layer of paver block and in the top layer of paver block only a mixture of cement, semi grit, dolomite powder and pigment is used. In the top layer 20 mm polyester fiber is to be added to the concrete in proportions of 0.1%, 0.2%, 0.3%, 0.4% and 0.5% by weight of the concrete. The respective specimens were tested after 7 and 28 days for compressive strength, flexural strength and water absorption tests.

R. Bharathi Murugan and C. Natarajan (2017) [5]: The utilization of waste tyre crumb rubber as the fine aggregate in precast concrete Paving block (PCPB). PCPB's are generally preferred for city roads, pedestrian crosswalk, parking lots and bus terminals. The main aim of this paper is to evaluate the mechanical properties of wet cast PCPB containing waste tyre crumb rubber. The mechanical properties were investigated using a density, compressive strength, split tensile strength and flexural strength tests at 7, 28 56 days according to the IS 15688:2006 and EN1338. The wet cast method was followed for producing PCPB samples. The fine aggregate (river sand) was replaced with waste tyre crumb in percentage of 5%, 10%, 15%, 20% and 25% by volume. All the test results were compared with the conventional PCPB (Without rubber). The test results indicate its feasibility for incorporating waste tyre crumb rubber in the production of PCPB by the wet cast method.

Dr. R.Bharathi Mrugan (2019)[6]: This paper investigates the utilization of waste tyre crumb rubber as the fine aggregate in precast concrete Paving block (PCPB). PCPB's are generally preferred for city roads, pedestrian crosswalk, parking lots and bus terminals. The main aim of this paper is to evaluate the mechanical properties of wet cast PCPB containing waste tyre crumb rubber. The mechanical properties were investigated using a density, compressive strength, split tensile strength and flexural strength tests at 7, 28,56 days according to the IS 15688:2006 and EN1338. The wet cast method was followed for producing PCPB samples. The fine aggregate (river sand) was replaced with waste tyre crumb in percentage of 5%, 10%, 15%, 20% and 25% by volume. All the test results were compared with the conventional PCPB (Without rubber). The test results indicate its feasibility for incorporating waste tyre crumb rubber in the production of PCPB by the wet cast method.

III. MATERALS

GENERAL INTRODUCTION:

This chapter provides the details of the materials used and the tests conducted on them. It also provides the procedure adopted for designing the mix. The common ingredients of concrete are cement, coarse and fine aggregates and water.

The raw materials used in this investigation were locally available and these included Ordinary Portland cement (OPC) as binder, river sand as fine aggregate. Potable tap water was used for mixing. Detailed descriptions of each material and their properties are provided in the following sections.

CEMENT:

The cement is an important constitute of concrete. The cement is a binder, a substance that sets and hardens independently, and can bind other materials together. The word "cement" traces to the Romans, who used the term opus caementicium to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder. The volcanic ash and pulverized brick additives that were added to the burnt lime to obtain a hydraulic binder were later referred to as cementum, cimentum,

cement, and cement.

AGGREGATES

Aggregates are defined as inert, granular, and inorganic materials that normally consist of stone or stone-like solids.

Aggregates can be used alone (in road bases and various types of fill) or can be used with cementing materials (such as Portland cement or asphalt cement) to form compositematerials or concrete.

The most popular use of aggregates is to form Portland cement concrete. Approximately three-fourths of the volume of Portland cement concrete is occupied by aggregate. It is inevitable that a constituent occupying such a large percentage of the mass should have an important effect on the properties of both the fresh and hardened products. As anotherimportant application, aggregates are used in asphalt cement concrete in which they occupy 90% or more of the total volume. Once again, aggregates can largely influence the composite properties due to its large volume fraction. Aggregates like sand, gravel and groundnut shell are used in this study.

In Accordance With Size-Coarse aggregate, Fine aggregate (sand)

Particle Shape and Texture

The external characterizes of mineral aggregate, in terms of physical shape, texture and surface conditions significantly influence the mobility of the fresh, concrete, and the bond of aggregate with the mortar phase To avoid lengthy description of the aggregate shape, IS 583-1970 lists four aggregate groups of in terms of particle shape where rounded particle require less water and less paste volume for a given workability. Nevertheless, crushed or un crushed rounded gravels generally tend to have a stranger aggregate mortar as bond and result in substantially the same compressive strength for a given cement content. The unit water content could be reduced by 5 to 10% and sand content by 3 to 5% by the use of rounded gravel. Use of crushed aggregate on the other hand may result in 10 to 20% highest compressive strength for water cement ratio below 0.4.

FINE AGGREGATE

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. The composition of sand is highly variable, depending on the localrock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO_2), usually in the form of quartz. The second most common type of sand is the calcium carbonate, for example aragonite, which has mostly been created, over the past half billion years, by various forms of life, like coral and shellfish. It is, for example, the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean. In terms of particle size as used by geologists, sand particles range in diameter from 0.0625 mm (or 1/16 mm) to 2 mm.

In this study River Sand was used throughout the investigation as the fine aggregate conforming to grading zone III as per IS 383:1970. The sand was air-dried and sieved to remove any foreign particles prior to mixing.

COARSE AGGREGATE

The word gravel comes from the old French word gravel. Gravel is composed of unconsolidated rock fragments that have a general particle size range and include size classes from granule to boulder-sized fragments.

Gravel is an important commercial product, with a number of applications. Many roadways are surfaced with gravel, especially in rural areas where there is little traffic. Globally, far more roads are surfaced with gravel than with concrete or tarmac; Russia alone has over 400,000 km (250,000 mi) of gravel roads. As of 2006, the United States is the world's leading producer and consumer of gravel.

In this study Crushed granite stone aggregate 3-12 mm sizes were used

WATER

Water is one of the most important elements in construction but people still ignorequality aspect of this element. The water is required for preparation of mortar, mixing of cement concrete and for curing work etc during construction work. The quality and quantity of water has much effect on the strength of mortar and cement concrete in construction work.

The water used for mixing and curing should be clean and free from injurious quantities of alkalis, acid, oils, salt, sugar, organic materials, vegetable growth and other substances that may be deleterious to bricks, stone, concrete or steel. Potable water is generally considered satisfactory for mixing. The pH value of water should be not less than 6.

PLASTICIZER:

- Plasticizers are used to harden the concrete.
- It is economical. Sg plasto 100
- Plasticizers are used to harden the concrete.

These are used in rubber mould paver block, rcc slabs, beams, columns.

WASTE RUBBER:

- Rubber size 5-6cm long, 2-3mm thick.
- This rubber is taken from damaged bike tubes and vehicle tubes.

IV. TESTS ON MATERIALS

The usual tests carried out on cement are for chemical and physical requirements. There are many ways and methods for the testing of cement. Some of them need a proper laboratory setup while other can be conducted at field itself. For the sake of convenience we will divide the methods under following two categories as (i) Tests in Field and (ii) Tests in Laboratory.

Tests in Field

Field tests are convenient way of primary inspection of cement when it is used in small scale works or when decision has to be made during purchase process. These are some ofthe steps that can ensure you good quality cement while inspection at site.

Tests in Laboratory

Field tests only indicate that cement is not bad and can be used for small scale works. Thus Laboratory

tests are necessary to confirm that cement is good in nature and can even be used for important works too. The necessary tests to be conducted on cement in laboratory are discussed in the next sections.

Initial and Final Setting Time of Cement

The objective of this test is to determine the initial and final setting times of the cement. The time interval for which the cement products remain in plastic condition is known as the setting time. Initial setting time is regarded as the time elapsed between the moments that the water is added to the cement to the time that the paste starts losing its plasticity. The final setting time is the time elapsed between the moment the water is added to the cement, and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain pressure.

The constituents and fineness of cement is maintained in such a way that the concrete remains in plastic condition for certain minimum time. This time should not be more than 10 hours which is referred to as final setting time. Initial setting time should not be less than 30 minutes. The procedure adopted for finding out initial and final setting timesof cement is as follows.

S. No	Time in Minutes	Depth of Penetration (mm)
1	5	0
2	12	2
3	24	3
4	32	4
5	45	5
6	52	6
7	65	7

TTable-4.1: Initial and final setting time

Fineness of Cement

The main objective of this test is to determine the fineness of cement using IS- sieve method. The fineness of cement has an important bearing on the rate of hydration and hence on the rate of gain of strength and also on the rate of evolution of heat Finer cement offers a greater surface area for hydration and hence the faster and greater the development of strength. Different cements are ground to different fineness. The disadvantage of fine grinding is that it is susceptible to air set and early deterioration.

Observations

Trail	Wt(w1)grm	Retained(w2)	%
1	100	2	2/100*100=2%
2	100	4	4%
3	100	2	2%

Table -4.2: Fineness of cement

Weight of cement taken = W1

Weight of residue after sieving = W2

% of fineness of the cement = (W2 /100) ×100

Avg=2+4+2/3=2.66

Specific Gravity of Cement

The main objective of this test is to determine the specific gravity of the cement used in this study. Specific gravity is defined as the ratio between weight of a given volume of material and weight of an equal volume of water at a specified temperature.

To determine the specific gravity of cement, kerosene is used which not react with cement. specific gravity is found to be 3.10

TESTS CONDUCTED ON AGGREGATES

Aggregates typically make up 70-80% of the volume of Portland cement concretes and over 90% of asphalt concretes. Thus, their properties play important roles in determining the properties of the composite materials in which they are to be used. Knowledge of relative density/specific gravity, absorption, unit weight and voids content are necessary for the proper design of both Portland cement and bituminous concretes.

To ensure aggregates continually meet the required specification, and thus to ensure the end product is suitable for its intended use, a series of laboratory tests have been devised

1. Specific gravity of fine aggregate is found to be 2.57
2. Fineness modulus of fine aggregate=2.71
3. Specific gravity of coarse aggregate is found to be 2.74
4. Fineness modulus of coarse aggregate=4.85

V. MIX DESIGN

Design for M30 grade of concrete

Wt in kg/cu.m	**cement**	**Fine aggregate**	**Coarse aggregate**	**water**
1	369.2	919.28	1020.1	147.68
2	1	2.4	2.76	0.4

VI. EXPERIMENTAL PROCEDURE

Mixing

Pan Mixers: All pan mixers work on basically the same principle: a cylindrical pan (fixed or rotating) contains the concrete to be mixed, while one or two sets of blades rotate inside the pan to mix the materials and a blade scrapes the wall of the pan. The shapes of the blades and the axes of rotation vary.

Compaction with table vibrator:

- Compaction is done with table vibrator.
- The vibrator table consist of a rigidly build steel platform mounted on flexiblesprings and driven

by an electric motor.

- The normal frequency of vibration is 4000 rpm an acceleration of 4g to 7g.
- The vibrating tables are very efficient in compacting stiff and harsh concrete mixes required for manufacture of precast element in the factors and test specimens in laboratories.

Testing of Specimens:

i. Compressive strength test:

The apparent compressive strength of individual specimen shall be calculated by dividing the maximum load (in N) by the plan area (in mm2). The corrected compressive strength shall be calculated by multiplying the apparent compressive strength by the appropriate correction factor. The strength shall I be expressed to the nearest 0.1 N/mm^2.The test results obtained are in the table below.

Sl.no	% waste rubber added	Weight in kg	Compressive strength N/mm2 (7 days)	Compressivestrength (28 days)
1	0	0	22.91	37.68
2	0.2	0.260	23.64	38.14
3	0.4	0.521	23.53	38.01
4	0.6	0.781	23.25	37.51
5	0.8	1.042	23.26	37.53
6	1	1.303	23.23	37.48

Table-6.1: Compressive strength

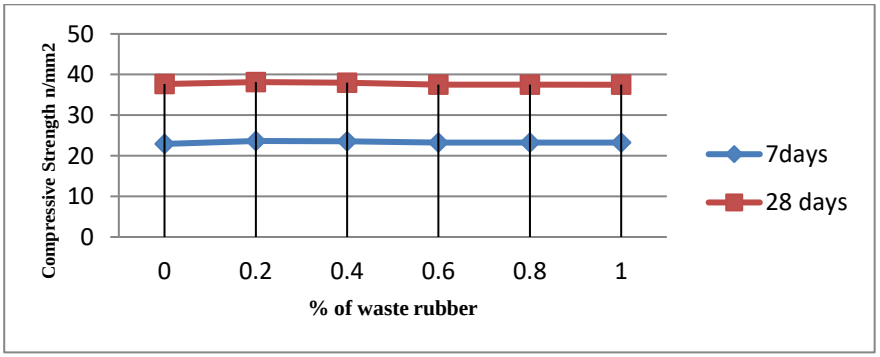

Fig- 7&28 days Compressive strength test

TENSILE SPLITTING STRENGTH

The specimen shall be placed on the testing machine with the packing pieces on the upper face and the bed face, in contact with the bearers. It shall be ensured that the packing pieces and the axes of the bearers are in line with the splitting section .of the specimen. The splitting section shall be chosen according to the following order of priority:

- The test is carried out along the longest splitting section of the specimen, parallel and symmetrical to the edges, in such a way that the distance of the splitting section to any side face is at least 0.5 times the thickness of the specimen over atleast 75 percent of splitting section area.

- If the condition in (a) cannot be met, the test is carried out along two splitting sections, chosen in such a way that the distance from one splitting section to theother splitting section or to any side face of the specimen is at least 0.5 times thethickness of the specimen over at least 75 percent of the splitting section length considered.

% of waste rubber added	7days split tensile strength	28 days split tensile strength
0%	2.34	3.67
0.2%	2.38	3.75
0.4%	2.36	3.71
0.6%	2.33	3.62
0.8%	2.33	3.61
1%	2.30	3.58

Table-6.2: Split tensile strength

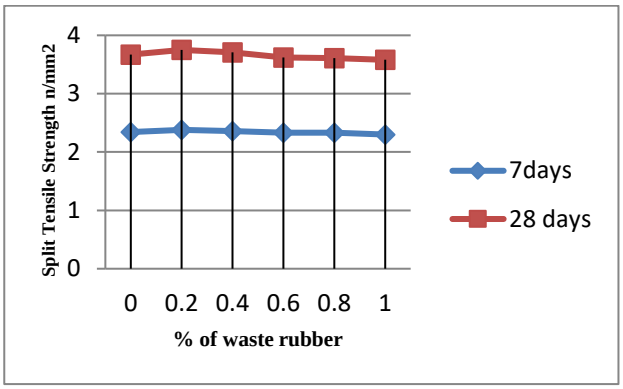

Fig- 7&28 days Split Tensile strength test

FLEXURAL STRENGTH TEST:

The test procedure shall be the same as in 8of IS516, with the followingmodifications

The load shall be applied from the top of the specimen in the form of a simple beamloading through a roller placed midway between the supporting rollers, . Loading of irregular-shaped specimens shall be placed in machine.

- The 10M shall be applied without shock and increased continuously at a uniform rate of 6kn/min.
- The load shall be increased until the specimen fails, and the maximum loadapplied shall be recorded to the nearest N.

Sl.no	% of waste rubber added	7 days flexuralstrength	28days flexuralstrength
1	0%	3.35	4.34
2	0.2%	3.42	4.41
3	0.4%	3.39	4.35
4	0.6%	3.38	4.27
5	0.8%	3.38	4.28
6	1%	3.37	4.20

Table-6.3: Flexural strength

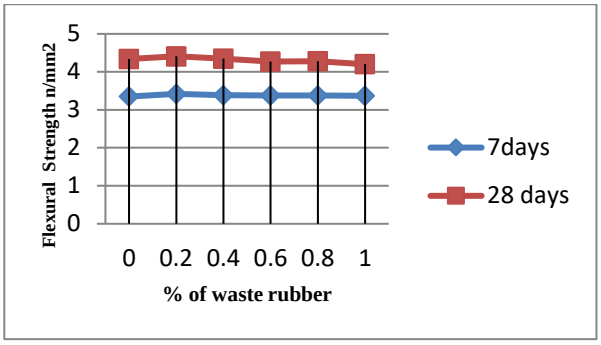

Fig- 7&28 days Flexural strength test

CONCLUSION

- Mix 1 with 0.2% WRTT fiber showed the highest value of compressive strength, split tensile and flexural strength when compared with other mixes. In general,the compressive strength split tensile and flexural strength of concrete is decreased when the amount of WRTT fiber increased.
- This reduction in the compressive split tensile and flexural strength may be related to the bond defects between rubber and the matrix.
- The compressive strength split tensile and flexural strength is found to decrease with increasing rubber content.
- The strength reduction is mainly due to the bonding between the rubber particles and cement paste.

REFERENCE

1. P. S. Song, S. Hwang &B. C. Sheu, “Strength Properties of Nylon- and Polypropylene-fiber-reinforced Concretes,” Cement and Concrete Research 35, pp 1546-1550, 2005.
2. O. A. Duzgun, R. Gul &A. C. Aydin, “Effect of Steel Fibers on the Mechanical Properties of Natural Lightweight Aggregate Concrete,” Materials Letters 59, pp 3357- 3363, 2005.
3. J. Katzer&J. Domski, “Quality and Mechanical Properties of Engineered Steel Fibres Used as Reinforcement for Concrete,” Construction and Building Materials 34, pp 243 – 248, 2012.
4. P. Shafigh, H. Mahmud & M.Z. Jumaat, “Effect of steel fiber on the mechanical properties of oil palm shell lightweight concrete,” Materials and Design 32, pp. 3926- 3932, 2011.
5. M. Baena, A. Turon, L. Torres&C. Mias, “Experimental Study and Code Predictions of Fibre Reinforced Polymer Reinforced Concrete (FRP RC) Tensile Members,” Composite Structures, Volume 93, Issue 10, pp 2511-2520, 2011.