

# An Experimental Study on Using of Commercialized Crumb Rubber in Interlocking Concrete Paver Block

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**Abstract - In this study, commercialized crumb rubber powder is used in concrete mixed material to investigate its various properties. This type of study gives advantage for substitute valuable or priceless resources to protect the environment from inappropriate waste disposal. Crumb rubber is a type of material which is made by breaking the scrap tyres into small or uniform granules pieces used widely in several sector like pavement, ground sidewalk, playgrounds, blocks, rubber tiles, supplement fuel etc. In this investigation crumb rubber was utilized to replace fine aggregate (sand) in concrete at equivalent quantity of 0% to 40% by volume to make interlocking paving blocks and their concrete properties like water absorption, abrasion, tensile and compressive strength are calculated. Conclusion of this investigation present from the result of the tests. Interlocking concrete block is very easy to use in any field also its compressive strength is very high to resist load.**

**Keyword-** crumb rubber, waste tyres, prevent environmental.

## I. INTRODUCTION

Currently, the disposal of waste materials has emerged as a major problem for any developing country. For this reason, the construction investigator is also given a lot of attention to the recycling and production industry, so this type of waste material is being used in construction material. Crumb rubber is a type of recycled rubber which is obtained from automobile industry as a scrap tyre in a large scale. Wires are separated with the help of a magnetic catch separator by using cracker mill. In Past literatures has been shown crumb rubber mix with concrete as different size or proportion and produced paver block in different ways like use of waste rubber chips for the production of concrete paver block [1], experimental study on behavior of paver block using crushed rubber

powder [2], granulated waste tyres in concrete paving block [3] In this study different properties will be checked by mixing non recyclable tyres with concrete. To maintain the quality of concrete, it is necessary to manage the properties of the ingredient materials that are being mixed and utilized. Additionally factors for quality paver block are proper mixing of ingredients, placing, sufficient vibration and proper curing. Moreover, the use of scrap tires for increasing water ground water table, quick maintenance of roadway pavement and good for environment health because crumb rubber is found to be economical.

## II. MATERIAL

The materials utilized in this study were collected from locally Jaipur city. The resource of grinded tyres crumb rubber was obtained from vishkarama industrial area.

### A. CEMENT

Fresh Ordinary Portland cement was utilized in all over the experimental study. In sieve test 100 gm cement taken and continuously passed for 15 minutes through sieve no 9 [4] Average percentage of fineness of cement is 92.17%.

- Compressive strength of cement is 45.89N/mm<sup>2</sup> (after 28 day)
- Initial setting time = 30 min
- Final setting time = 360 min
- Standard Consistency of cement= 32%

### B. FINE AGGREGATE (F.A.)

In this test use nearby available sand. In this experiment using 50: 50 proportions to mix sand with

the coarse sand in this way to achieve the well grading of sand.

- Fineness modulus of sand=3.018
- Avg. specific gravity of sand=2.59
- Moisture Content in fine sand(%)=.5%
- Grading=zone II [5]

### C. COARSE AGGREGATES (C.A.)

Nearby available coarse aggregate was utilized in this experiment. In this test hard stone utilized as limestone, granite.

- Fineness modulus of C.A.=6.0378
- Avg. specific gravity of C.A.=2.67
- Moisture Content in C.A.(%)=NIL
- Grading=zone II
- Texture=angular

### D. WATER

Water used in the experimental work is conformed to IS: 456-2000 for mixing as well as curing of Concrete specimens.

### E. CRUMB RUBBER (C.R.)

Generally using Crumb Rubber in the size range from 4.75 mm to less than 0.075 mm (75 micron).

## III. PREPARATION OF TEST SPECIMEN

### A. DIMENSION OF SPECIMEN

For M30 grade concrete minimum thickness is 50mm so we use 60 mm thickness paver block with tolerance limit  $\pm 3$ mm [6-7]. Dimension of paver block is zigzag.

TABLE I  
Dimension of specimen

Length (mm)	Width (mm)	Thickness (mm)	Plane area mm <sup>2</sup>	Aspect ration
240	125	60	30868	4

### B. CASTING OF CONTROL SPECIMEN

Generally rubber paver mould is used to cast paver block of concrete. This paver block is made in such a way that the specimen can be removed from the mould without any damage. The process we taken was by weight mix of the material hence we use design mix. after the weight mix of the ingredients is mixing in paver manufacturing. When mixed concrete placing in paver block following compaction is done. The compaction was completed manually or vibrating. A well done curing extend the strength of paver concrete. In mix proportion of concrete w/c ratio is (0.5).[8-9]

TABLE II  
Mix proportion of concrete in Kg

	Cement	F.A.	C. A.	C.R.	Admixture
5% C.R.	1	2.21	2.48	0.15	0.011
10% C.R.	1	2.10	2.48	0.23	0.011
15% C.R.	1	1.98	2.48	0.35	0.011
20% C.R.	1	1.86	2.48	0.47	0.011
25% C.R.	1	1.75	2.48	0.59	0.011
30% C.R.	1	1.63	2.48	0.70	0.011
35% C.R.	1	1.51	2.48	0.82	0.011
40% C.R.	1	1.40	2.48	0.93	0.011

## IV. TEST AND RESULT

### A. CONCRETE SLUMP TEST

The test is a type of empirical test, main ability of this test is measures the workability of a fresh concrete.

TABLE III  
Average Slump tests results for all mixes

Mix	Crumb rubber was used to replace fine aggregate (sand) in %	Slump (mm)
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1	00	67
2	5	63
3	10	59
4	15	52
5	20	48
6	25	44
7	30	40
8	35	37
9	40	33

### B. COMPRESSIVE STRENGTH

The test method performs to determination compressive strength to find out strength of experimental paver block specimen. According to IS:15658 (2006), number of Specimens taken for this test 3 to determine strength of paver block. The upper face of the paver block specimens shall be cover by 4 mm thick wooden plywood sheets of size larger than the test paver specimens. For this plywood 5mm Margin should be taken from all edges of the paver specimen. Load applies by UTM machine shall be without shock and continuously increasing load at a rate of 15 + 3 N/mm<sup>2</sup>/minutes. A correction factors apply according to table 5 IS: 15658

TABLE IV

Average compressive strength at 7 days and 28 day.

Mix	C.R. (%)	Compressive Strength (7days) (N/mm <sup>2</sup> )	Compressive Strength (28 days) (N/mm <sup>2</sup> )
1	00	28.44	40.85
2	5	29.08	41.02
3	10	26.21	38.13
4	15	25.30	36.45
5	20	22.90	32.80
6	25	21.93	29.70
7	30	20.30	29.50
8	35	18.08	26.83
9	40	18.05	25.16

TABLE V

% Average compressive strength loss or gain at 28 days test results

Mix	Percentage replacement (%)	% Average compressive strength loss or gain
1	00	0
2	5	+0.42
3	10	-6.67
4	15	-10.77
5	20	-19.70
6	25	-22.88
7	30	-27.78
8	35	-34.32
9	40	-38.40

### C. ABRASION RESISTANCE

The abrasion testing machine shall be the same -as described in IS 1237.

In this test Square-shaped specimen's use which dimension is 71.0 ± 0.5 mm shall be cut from the paver block. For testing wet paver specimens; the specimens shall be immersed in water at least 7 days. The grinding wheel shall be run at 30 rpm. The wheel shall be stopped after completing one cycle of 22 revolutions. The wheel and contact face of the paver specimen shall be cleaned of fine abrasive powder and debris. At every 4 cycle paver specimen shall be rotate 90° in the clockwise direction and approximate 20 gm of fine abrasive powder shall be use on the testing track before starting the next process of cycle.

TABLE VI  
Abrasion resistance result

C.R. (%)	initial weight in gm	Final weight in gm after 16 cycle	Weight loss in gm	Thickness loss in mm
0	572	557	15	1.57
5	569	555	14	1.48
10	565	549	16	1.70
15	559	541	18	1.93
20	549	525	18	1.96
25	541	522	19	2.10
30	540	522	18	2.00
35	530	508	22	2.49
40	526	501	25	2.85

In this performed test Wearing depth not exceed 3.5 mm for general purpose.

#### D. WATER ABSORPTION

The weighting machine used shall be very responsive to within 0.5% of the mass of the smallest paver block specimen tested.

The test paver block specimen shall be completely immersed in clean water at room temperature for 24±2 hour. The paver specimen then shall be recapturing from the water and allowed to drain off for 1 minute by placing over a 10mm or coarser wire mesh. Visible water on the paver specimens shall be removed with a dry cloth.

TABLE VII  
Water absorption test results

C.R. (%)	Saturated Weight (gm.)	Oven dry Weight (gm.)	Water Absorption (%)
00	4069	3850	5.7
05	4043	3819	5.54

10	4007	3798	5.5
15	3955	3742	5.4
20	3904	3715	5.1
25	3865	3672	5.0
30	3805	3638	4.6
35	3785	3602	4.7
40	3759	3585	4.6

#### E. TENSILE SPLITTING TEST

In this test load apply on length side in middle and strength of paver block are

$$Z=0.637 \times k \times \frac{P}{A}$$

Where

Z= tensile strength in mega Pascal

P=apply load

A=Failure plane area

K= correction factor

TABLE VIII

Tensile Splitting strength N/mm<sup>2</sup> for all mixes

Crumb rubber was used to replace fine aggregate (sand) in %	Tensile splitting strength N/mm <sup>2</sup>
00	3.66
05	3.68
10	3.69
15	3.66
20	3.60
25	3.53
30	3.20
35	3.05
40	2.90

## V. CONCLUSION

Based on experimental observations, the following conclusions are drawn:

- Compressive strength is decreasing as the quantity of crumb rubber being increased and sand particle reduces in concrete. According to compressive strength study we can replacing crumb rubber to a limit of 20% in which the specimen achieved suitable strength. Slump value is decreased due to increasing percentage of replacement of crumb rubber. Up to 20% slump value 48mm. this value is appropriate for low traffic flow.
- Crumb rubber in paver block given good result in the abrasion resistance in this performed test wearing depth not exceed 3.5mm for general purpose.
- The tensile strength was almost similar when the crumb rubber used up to 20%.
- Up to the Replacing 20% crumb rubber to sand interlocking paver block meet all characteristic requirement for construction work in light traffic region such paver blocks would be very useful for small street where heavy load vehicle are not allowed.
- This type of paver block is environment friendly, maintenance quickly and helps to increase ground water table. Its maintenance are also quick.

## VI REFERENCES

- [1] Shivradnyi Gaikwad, Sandesh Nalage, Namdev Nazare, Rajendra Joshi(2019), "Use of Waste Rubber Chips for the Production of Concrete Paver Block", International Research Journal of Engineering and Technology (IRJET) Volume:06, Issue: 03.
- [2] P.Kirubagharan, R.Gowtham, Albert Duraisingh, Akshai B Nair(2017), "Experimental study on behaviour of paver block using crushed rubber powder",International Journal of Civil Engineering and Technology (IJCIET)
- [3] Tung-Chai Ling, Hasanan Md Nor(2006), "Granulated Waste Tyres In Concrete Paving Block" 6th Asia-

Pacific Structural Engineering and Construction Conference (APSEC 2006).

- [4] IS 8112:2013 Ordinary portland cement, 43 grade — specification
- [5] IS 383 (1970): Specification for Coarse and Fine Aggregates From Natural Sources For Concrete
- [6] IRC:SP:63-2004 Guidelines for the use of interlocking concrete block pavement
- [7] IS 15658:2006 Precast concrete blocks for paving — SPECIFICATION
- [8] IS 10262:2009 on Indian standard concrete mix proportioning – guidelines(first revision), Bureau of India Standard, New Delhi, India.
- [9] IS 456:2000-Code of practice plain and reinforced concrete (fourth version).