



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 1, January 2022

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

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# Assessment of Strength Characteristics of Titania Blended Rubbercrete

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**ABSTRACT:** Today the number of vehicles and its ratio with the population has become an index of nation's prosperity. This has resulted into paramount generation of scrap tyres and its severe consequences. In the present era, sustainability has appeared as an important aspect of development. One of the most vital sectors for the economic growth of a country is considered to be the construction sector. It provides the basic physical infrastructure needed to initiate and sustain the economic development activities. The natural aggregates are non-renewable sources. Their over exploitation has created lot of environmental hazards. So there is need to preserve the natural resources. The use of alternative materials is a must needed which are waste materials. The use of waste tyre rubber in concrete is also considered to be a best way. Also use of nanomaterials in concrete to enhance the properties of concrete is a new area of study now a days. In this Research work, both the concepts are used together that, the crumb rubber is used as partial replacement of fine aggregate to produce rubbercrete & to use titania powder in rubbercrete. The specimens are casted with replacement of fine aggregate by crumb rubber in the range of 0%, 10%, 25%, 33%, 50%, 66%, 75% by volume of fine aggregate. Also titania is added in percentage 1%, 2% of weight of cement respectively. Thus the cubes of titania based rubberized concrete are casted and the testing is done after curing and atmospheric exposure of concrete for 28 days, 6 months, 1 year, 1.5 year and two years. It has found that the titania blended rubbercrete ages, it loses its structural strength.

**KEYWORDS:** Rubbercrete, compressive strength of rubbercrete, titanium dioxide, nanomaterial

## I. INTRODUCTION

Today the major environmental issue of concern is discarded tyres. It has led to severe environmental degradation. The disposal of these tyres is major problem causing environmental pollution. Owing to their non biodegradable nature they create severe environmental havoc. One of the feasibility was identified as to use them in concrete. Construction sector is growing rapidly, requires large amount of construction materials. The environmental concern is presently growing as a major challenge pertaining to the natural concrete aggregate production. The natural aggregate is the largest component material in concrete comprising 75% of the ingredient of concrete. The growing demand of aggregate for the production of concrete necessitates excessive use of natural stone materials. This may destroy the ecological balance of the environment. The rising population and industrialization will necessitate more construction minerals for infrastructure and building works. The use of waste tyre rubber in some form in concrete is an alternative way to solve the both problems with a single stroke. A great deal of effective research has been done for enhancing the properties of concrete. One of the techniques has been incorporating supplementary cementing materials such as pozzolanas and nanoparticles. Titania and scrap rubber have been used in concrete for different objectives. It also gives



some beneficial properties like reducing density of concrete etc., thereby making it suitable for specific non structural applications.

In this Research work, fine aggregate are partially replaced by crumb rubber in the range of 0%,10%, 25%, 33%,50%,66%,& 75% by volume of fine aggregate.Also titania is added in percentage 1%, 2% of weight of cement respectively. Thus the cubes of titania based rubberized concrete are casted and the testing is done after curing and atmospheric exposure of concrete for 28 days, 6 months, 1 year,1.5year and two years. The present work is an attempt to assess the long term performance of rubbercrete taking compressive strength as a reference parameter.

## II. LITERATURE REVIEW

Desa *et al.*, (2012) has pointed out the need of introducing the concept of recycled aggregates and alternative aggregates in the syllabi of engineering. Also the government must set up standards for these aggregates with rapid pace. The universities, which provide professionals for the construction industry, must be well trained in the aspect of sustainable aggregate technology. Mass media can also be used to enhance awareness amongst the professionals regarding use of alternative materials in construction industry.

The concept of rubbercrete was evolved in early 90s when a good number of research papers outcropped in that duration (Zaher and Fouad 1999; Siddique and Naik 2004).

The global generation of large quantities of scrap tires each year is not only potentially an environmental threat, but also result into fire hazards and serve as breeding grounds for rats, mice, vermin's and mosquitoes (Parveen *et al* 2013). Shuai Tian, Tong Zhang, Ye Li (2011) worked out the optimum proportion of rubber-particles in rubberized concrete to be used for road. Their research indicates that less than 5% rubber proportion (by volume) in rubbercrete is optimum for road concrete mix. This is a low proportion. They tried 12 different modifiers to improve the performance of rubbercrete.

**Chen Bing**, and **Liu Ning** (2014) used higher proportion of tire-rubber particles as a replacement for coarse aggregate in concrete. They replaced the coarse aggregate at content levels of 25, 50, 75, and 100% by volume in concrete. They also used emulsified asphalt for enhancing the mechanical properties of rubberized concrete. An increase in rubber content reduces compressive strength, elasticity modulus, and flexural strength owing to rubber's lower hardness and its inferior bonding with the rest of the concrete matrix.

At first the titania was incorporated in the cement with an objective of preparing white cement. the photocatalytic self-cleaning and disinfection properties of nano sized TiO<sub>2</sub> in cementitious materials have been discussed extensively , Lee and Kurtis (2010) noted that in the process of cement hydration nano-TiO<sub>2</sub> is chemically inert. Yet, it provides crystal nucleuses over which the cement hydration is promoted. This leads to a better completion of reaction and leads to the increase of compressive strength of concrete.

Ali Nazari *et al* (2010) also observed that the nano-TiO<sub>2</sub> particles blended concrete successfully enhances the higher split tensile and flexural strength of concrete. They mentioned that It is found that the 2.0% cement could be beneficially replaced with nano-TiO<sub>2</sub>.

## III. METHIDODOLOGY

### Materials Used

The material used for the work are cement, sand, aggregate ,crumb rubber & Titanium dioxide powder..

The cement used for the work is ordinary Portland cement..

Crumb Rubber: Crumb rubber is obtained from tyre remoulding factory

Locally available coarse &fine aggregates are used.

Concrete mix design: concrete mix design is done..

A nominal concrete mix of proportion 1: 1.5: 3 with water cement ratio 0.5 is prepared. Concrete mix is prepared as per Indian Standards Code10262(2009)

### Specimen Preparation

To prepare rubbercrete ,fine aggregate(sand) is partially replaced by crumb rubber in various proportion as 0%,10%,25%,33%,50%.66% &75%. Various blends of crumb rubber concrete are prepared.The compressive strength of concrete cubes is determined after curing of 28 days and atmospheric exposure for 6 month,12 month,18 month & 24 month. Also in each case titania is added 1%& 2% respectively. Thus the various proportions of titania based rubbercrete is prepared. The compressive strength is determined after curing of 28 days and atmospheric exposure for 6 month,12 month,18 month & 24 month.



**IV. RESULTS & DISCUSSION**

**Test on Fine aggregates (Sand)**

The various characteristics of natural Fine aggregate (Sand) are presented in table.

**Table 1: Tests on Sand (Fine aggregate)**

Parameter	Fineness Modulus	Water absorption	Specific Gravity
Value	2.52	0.72 %	2.64

**Test on Coarse aggregates**

The various characteristics of coarse aggregate are presented in table.

**Table 2: Tests on Gravel (Coarse aggregate)**

Parameter	Specific Gravity	Fineness Modulus	Water absorption
Value	2.78	7.00	0.51%

**Table 3: Tests on crumb Rubber Aggregate**

Parameter	Specific Gravity	Water absorption
Value	1.15	2.67 %

**Test on Ordinary Portland cement:**

The most important ingredient of concrete is cement. Its properties are summarized in table

**Table 4: Tests on Ordinary Portland Cement**

Parameter	Standard Consistency	Soundness	Fineness	Initial Setting Time	Final Setting Time	Compressive Strength After 28 days curing
Value	32%	3mm	3.43%	55 minute	550 minute	53.25N/mm <sup>2</sup>

Table 5 shows Compressive Strength of rubbercrete with replacement of fine aggregate

**Table 5: Compressive Strength of Concrete with Replacement of Fine Aggregate**

Crumb Rubber proportion	Average compressive Strength 28 day (N/mm <sup>2</sup> )	Average compressive Strength, 6 month (N/mm <sup>2</sup> )	Average compressive Strength 12 months (N/mm <sup>2</sup> )	Average compressive Strength 18 months (N/mm <sup>2</sup> )	Average compressive Strength 24 months (N/mm <sup>2</sup> )
0%	38.15	38.3	39.60	37.6	37.31
10%	34.31	34	31.05	30.35	30.18
25%	24.78	24.62	22.85	21.80	20.78
33%	21.96	21.69	19.86	19.57	19.48
50%	15.73	18.15	16.52	15.95	15.52
66%	14.71	13.91	12.13	11.66	11.39
75%	10.00	9.02	7.70	7.02	6.87

#### Addition of Titanium Powder:

Titania is added 1%,& 2% in each blend of rubbercrete respectively. Thus the various proportions of titania based rubbercrete is prepared. The compressive strength is determined after curing of 28 days and atmospheric exposure for 6 month,12 month,18 month & 24 month. Table shows Compressive Strength of titania blended rubbercrete

**Table 6: Compressive Strength of 1% titania blended Rubbercrete**

Crumb Rubber proportion	Average compressive Strength 28 day (N/mm <sup>2</sup> )	Average compressive Strength, 6 month (N/mm <sup>2</sup> )	Average compressive Strength 12 months (N/mm <sup>2</sup> )	Average compressive Strength 18 months (N/mm <sup>2</sup> )	Average compressive Strength 24 months (N/mm <sup>2</sup> )
0%	38.15	39.26	40.8	39.5	38.8
10%	34.31	33.2	31.2	29.8	27.5
25%	24.78	23.2	21.9	20.2	18.8
33%	21.96	19.8	18.2	16.5	15.1
50%	15.73	14	13.2	12.1	11
66%	14.71	12.8	10.7	8.9	8.1
75%	10	8.2	7.2	5.5	4.3

**Table 7: Compressive Strength of 2% titania blended Rubbercrete**

Scrap Tyre Rubber proportion	Average compressive Strength 28 day (N/mm <sup>2</sup> )	Average compressive Strength, 6 month (N/mm <sup>2</sup> )	Average compressive Strength 12 months (N/mm <sup>2</sup> )	Average compressive Strength 18 months (N/mm <sup>2</sup> )	Average compressive Strength 24 months (N/mm <sup>2</sup> )
0%	38.15	38.15	39.6	39.26	39.26
10%	33.4	32.4	29.4	27.9	26.5
25%	24.8	23.9	18.4	17.6	15.7
33%	21.6	22	17.5	16.3	14.1
50%	16.3	15.8	15	13.9	12.5
66%	12.3	12.8	11.1	9.9	8.2
75%	7.7	8.1	7.2	6.4	5.8

## V. CONCLUSION

The use of rubber in concrete is getting popularity owing to both the reasons, the scarcity of natural aggregates and environmental concerns. As the percentage of crumb rubber increases, the compressive strength of concrete decreases. Although the use of Rubber in very small proportion (<10%) can be used in structural concrete. But it can always be used for non structural members like partition walls.

Use of titania to enhance the structural performance of concrete is a well established concept. Sorathiya (2017) have shown that the titania up to 1% is optimum for enhancing the structural strength of concrete. Higher proportion of titania can reduce the structural strength. It is seen that excess titania has detrimental impact on the compressive strength of rubbercrete. Hence titania can be used safely in rubbercrete.

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Impact Factor:  
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