International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

Crumb Rubber Concrete Blocks

P. SARALA[1], E. PAVITHRA[2], E. VANATHI[2], S.S UJITHA[2]

[1]Assistant professor: Civil Engineering Department, Prathyusha Engineering College, Thiruvallur, Tamil Nadu.
[2]U.G Student: Civil Engineering Department, Prathyusha Engineering College, Thiruvallur, Tamil Nadu.

Abstract - *Crumb rubber concrete made up of tire chips, piece elastic and mix of tire chips. Rubber concrete can help to prevent pollution and to overcome the problem of storing used tyres. This reduces crack formation and widening which can withstand much larger tensile loads. These concrete gains importance rapidly due to the increasing demand of superior structural properties. This has the advantage of saving aggregates used in production of concrete which is becoming increasingly scares. Rubber concrete gains a good mechanical properties of concrete when compared to the conventional concrete. Sodium naphthalene formaldehyde is used as a admixture to reduce the water cement ratio. We have added silica fume to increase the compressive strength and tensile strength when 7.5% and 10% of rubber is added to the concrete. The required strength of concrete is attained when silica fume is added.*

Key Words: Crumb rubber concrete, Sodium naphthalene formaldehyde, Silica fume.

1. INTRODUCTION

Concrete is one of the most widely used construction today. More than 90% of the structures ranging from buildings, bridges, roads, dams, retaining walls etc. Utilise the concrete for their construction. The versatility and mould ability of this material, its high compressive strength and discovery of reinforcing and prestressing technique has gained its widespread use. Strength, durability and workability may be considered as the main properties of concrete. In addition good concrete is able to resist wear and corrosion and it should be water-tight and economical. The concrete must be strong enough to withstand without injury all the imposed stresses with the required factor of safety. To develop a given strength lomger time of moisture curing is required at lower temperature than is necessary while curing is done at higher temperature.

Crumb rubber concrete is the concrete made out of piece elastic tire chips and scrap elastic where utilized to supplant mineral today in cement. The common use of waste rubber specifically tire chips have been in highway asphalt mixes. Material characterization experiments have been conducted to determine the practicality of using rubber in concrete. Research has shown that replacement of conventional aggregates with rubber results in a decrease in compressive strength and tensile strength and stiffness. Eldin and senouci (1993) performed tension and compression tests on two types of cylinders, with portions of the coarse or fine aggregate replaced with rubber. They observed tensile strength decreases of 50% and compression strength reduction of up to 85% however noted that the rubberized concrete absorbed a great amount of plastic energy.

Based on the published literature on crumb rubber concrete (CRC) it is apparent that the ductility and energy absorption is enhanced over that of the conventional concrete. These characteristics may prove beneficial for applications where dynamic blast pressure demands are a concern.

1.1 Research scope

The first rubberized concrete was introduced and explored for potential engineering applications in the early 1990s (Kaloush et al. 2005; Allen 2004). Although combining recycled rubber and concrete aggregates for making conventional concrete was an innovative idea, it was found that the resulting rubberized concrete had lower strength (Khatib & Bayomy 1999; Sgobba et al. 2010; Bewick et al 2010; Ling et al. 2009; Khaloo et al. 2008) and this was not preferable especially for structural applications (Ho et al. 2009). However, rubberized concrete has been found to be preferable for paving applications, where lower range of strengths are including in design.

It can be stated that the incorporation of the rubber has two major opposite effects regarding mechanical characteristics of concrete. The negative impact is associated with the reduction of mechanical strengths. In contrast, the positive effect can be an increase of ductility and deformation capability. However, the extent of positive and negative effects are not similar for the different rubber contents. According to the literature size of rubber particles significantly affects the properties of rubberized concrete. Crumb rubber in the particle size range of one to four millimetres was selected for this study. It would be easier to consider usage of crumb rubber on a wider scale for its practical problem. Thus, a variety of rubber content up to 70% and a broad range of water-content ratios from 035 to 0.55 were examined for preparing concrete mix series.

Finally, the effects of using rubber on shrinkage properties of CRC were studied. Although the assessment of generic properties for CRC is the requirement of Australian concrete pavement standard, this research

was not limited to them. Plastic and drying shrinkage of rubberized concrete was studied and based on the results arose from all tests rubber content was optimized for each array of concrete samples.

1.2 Research objectives

Although much research has been conducted thus far on the concept of using recycled rubber in cementitious composites, very limited studies have been performed on the application of crumb rubber concrete (CRC) for pavements. The term of rubberized concrete is a general term, which involves all the types and sizes of recycled rubber. The aim of this research is to extent the knowledge of crumb rubber concrete characteristics used for the pavement application. In this investigation the conducted tests embraced the mechanical and shrinkage properties of rubberized concrete.

a) Providing the required information regarding the use of crumb rubber for concrete pavements and integrating the past and existing studies about rubberized concrete.

b) Quantifying the general mechanical properties of crumb rubber concrete through systematic laboratory tests. In addition, some theoretical studies are performed to provide a deep understanding effects of adding rubber as a low stiffness material in the concrete matrix.

c) The possible advantages and disadvantages of introducing different volumes of crumb rubber into concrete mix are evaluated.

d) Establishing an experimental relationship for predicting the strength properties of CRC by considering the effects of different variables, such as the concrete age, rubber content and the water-cement ratio.

e) Investigating the possibility of adding recycled rubber into the concrete mix in order to improve shrinkage properties and crack-resistance of concrete.

1.3 Research significance

Provides the studies in the field rubberized concrete reviewed and some difficulties associated with the production of rubberized concrete were highlighted. This investigation intends to address these difficulties and provides some solutions to mitigate them. The following points elaborate the significance of this research:

a) Study the challenges associated with the production of concrete mix with crumb rubber and introduction of methods to mitigate the challenges. Those challenges cause difficulties and inaccuracy in the determination of proper content of rubber in the mix, determining the specific gravity of crumb rubber accurately, finding the best method of adding rubber into the mix, and problems regarding vibration and compaction of crumb rubber concrete.

b) Maximize the application of rubber in pavement mixes the environmental problems associated with stockpiling of waste tires can be mitigated. In addition, replacing a portion of natural aggregates with recycled rubber tires saves the Australian natural aggregate resources, also serves sustainability of concrete production in the future.

c) Moreover, local typical cement, sand and coarse aggregates, also local recycled waste tire were used for all test series.

d) Unlike, the other investigations in the field of rubberized concrete, this research assessed various sets of rubberized concrete with multiple variables, such as rubber content, sand content, WC ratio and concrete age on concrete properties.

e) The outcomes of this research may assist in drafting the first concrete specifications for crumb rubber concrete.

1.4 Research innovations

a) Introducing a relationship in order to estimate the strength of rubberized concrete based on influencing factors comprising the WC ratio, concrete age and rubber content.

b) This relationship can assist practicing engineers to select the concrete constituents properly to achieve a specific grade of strength'

c) Only a limited number of studies are available, concerning the plastic shrinkage and cracking of concrete containing rubber particles. This type of concrete shows promise for becoming an additional solution for tire rubber waste management.

2. PROPERTIES

A.CEMENT

Cement is a basic binder substance that is used for construction purpose. It can be also used to bind sand and gravel. Mortar is produced by mixing fine aggregate with the cement. Cement is a widely used as a binding material which is in existence. The most commonly used cement is Portland cement.

B.FINE AGGREGATE

Aggregates are widely used as inert granular materials .They are sand, gravel or crushed stone which is mixed with water and Portland cement to produce concrete. Fine aggregates are passing through 9.5mm and retained on 75micron.They are used to fill the voids in coarse aggregates and act as a good workability agent. This aggregate is an economic factor to reduce cracks and imparts strength to the concrete.

C.COARSE AGGREGATE

Coarse aggregates are important material for construction. Coarse aggregates are obtained from rock quarries or dredging from river beds. They can be characterized as smooth, rounded or angular. Various characteristics that are used to describe the behavior of coarse aggregate includes relative density, bulk density and absorption. Relative density is used to describe the density of coarse aggregates. These particles are retained on 4.75mm sieve and passes through 3-inch screen and are referred to as coarse aggregate.

3. MIX DESIGN

The concrete grade used is M30 which is mixed with high quality of drinking water. This water makes the concrete more efficient. The crumb rubber obtained from the tyre industries is mixed with the concrete during the casting. The rubber is mixed in percentage of 5%, 7.5% and 10% with admixture of sodium naphthalene formaldehyde.

Compressive strength=30Mpa

Size of aggregate =20mm

Specific gravity of cement=3.1

Specific gravity of coarse aggregates=2.67

Specific gravity of fine aggregates=2.53

Specific gravity of crumb rubber=1.15

Bulk modulus of coarse aggregates=1638.7m^3

Bulk modulus of fine aggregates=1676.7m^3

Table1: Mix propotions

Cement	16.18Kg
Coarse aggregate	14.5Kg
Fine aggregate	17.73Kg
Crumb rubber	0.88Kg for 5% 1.32Kg for 7.5% 1.77Kg for 10%
Sodium naphthalene formaldehyde	1.45%

4. RESULTS AND DISCUSSIONS

COMPRESSIVE STRENGTH

Compressive strength is the important property which gives a clear idea about the characteristics of concrete. The factors that affect the compressive strength are water-cement ratio, cement strength and quality of conctrete material. The test results obtained when usage of crumb rubber in concrete.

Table2: Compressive strength of the crumb rubber concrete

S.NO	% OF CRUMB ADDED TO CONCRETE	7DAYS(N/mm^2)	28DAYS(N/mm^2)
1	0	24.3	36.3
2	5	25.3	36.9
3	7.5	27.08	37.2
4	10	27.18	37.8

TENSILE STRENGTH

Tensile strength is an important property of concrete because the concrete is weak in tension. The tensile strength of the concrete is low, when compared to the compressive strength of the concrete. Tensile strength of crumb rubber somewhat higher when compared to the normal concrete. The results obtained when usage of crumb rubber in concrete

Table3: Tensile strength of the crumb rubber concrete

S.NO	% OF CRUMB ADDED TO CONCRETE	7DAYS(N/mm^2)	28DAYS(N/mm^2)
1	0	2.7	3.76
2	5	2.78	3.84
3	7.5	2.8	3.91
4	10	2.85	4.2

5. CONCLUSIONS

According to the test conducted, the following conclusions are made

1. Crumb rubber of 5% is added to the concrete at its initial stage. The compressive and tensile strength of concrete is reduced at the test results of 7^{th} and 28^{th} day. Compressive and tensile strength is less than the conventional concrete.

2. Silica fume is added to increase the tensile and compressive strength of crumb rubber concrete. These crumb rubber concrete blocks can be used in colder regions. This concrete is not much explosed to the freezing and thawing effects. Abrasion resistance and durability is increased in this type of concrete.

REFERENCES

[1] M.S.H. Mohd Sani, F. Muftah, Assessment on Compressive Strength of Waste Rubber Tube Tyre (WRTT) Fiber in Concrete,2012.

[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, 2010.

[3]E Dong , Jiesheng Liu ,"Study in the joint sealants of concrete pavements".

[4] Fochi Wang*, Chengrong Li, Yongjiang Bi, Linjie Zhao"The characteristic of silicon rubber insulators contaminated with concrete".

[5]Jiesheng Liu, Shaopeng Wu, Donglai Li, Chuancheng Zhang"The Research of interaction between the silicon rubber sealant and concrete".