Research Publish Journals, International Journal of ..... , ISSN: XXXX-XXXX
Vol. 1, Issue 9, pp: (1-4), Month-2013, Available at: **www.researchpublish.com**

Benefits of Mixing Waste Tyre Rubber with Concrete

Al-Fadhli Mazyad[1]

[1]The Public Authority for Applied Education and Training, Kuwait.

Abstract: **Robust waste management is highly considered the main issue universally and globally. Particles of tyre-rubber of used tyres and scrap elastic, used to replace element mixture in cement. The particles utilized to replace 11%, 16%, 21%, and 26% of the mixture element total volume. Applying tyre-rubber mixture in these purposes can aid in preventing toxic waste and overcoming the issue of stowing disposed tyres. In general waste tyre rubbers are expensive to store and also hazardous to handle at times. Therefore, couple of the advantages of using rubber aggregates in replacing coarse aggregates are cost reduction and minimization of hazardous incidents.**
Keyword: **Tyre – Rubber – Mixing - minimization**

I. INTRODUCTION

Over the past several decades, concrete is used in asphalt for road paving activities to replace other aggregates. About 20% by volume of shredded rubber or 'rubber crumb' is used in several highway surfacing works [1]. This practice has several advantages and these include safe disposal of scrap rubber types that are non-biodegradable, increase in the water resistance of roads, and considerable savings in use of aggregates [2]. However, the use of shredded rubber as a replacement for aggregates and sand in concrete is not extensively practised. Bearing in mind that construction uses very large amount of silt and gravel in aggregates, successful use of rubber in concrete can not only save the environment but also reduce construction costs [3]. This paper examines the research for using shredded rubber as a partial replacement for aggregates in concrete and the advantages from using rubber.

2. EXPERIMENTAL PROGRAM

Quite a few researchers have conducted revisions in the use of waste tyre rubber in concrete mix. Usage of this mixture of waste tyre rubber with concrete benefits the reduction of drying shrinkage, along with brittleness, while increasing the elastic module, thereby improving the service life of such mixes [5]. Waste tyre rubber mix with concrete should not be used for loading members such as column, bean since strength is critical, and any reduction in the compressive strength can be disastrous. Rather, waste tyre rubber mix with concrete can be used in other extents such as slab work, flooring, parking and driveways, compound construction, etc [6]. It is significant to differentiate between several types of waste tyres since different vehicles have different tyre's compositions. Car tyres have 49% elastomers than trucks that have 45%. Textile components in car tyres are 5% while truck tyres do not have any textile components. However, truck tyres have around 30% more steel fibres than cars that have around 18%. Depending on the size of shredded tyres, three categories are available, chipped rubber has aggregate size of 30 mm and it is used to replace aggregates in concrete. Crumb rubber is in the 3-10 mm size range and it is used to replace sand. Ash rubber has particles of 1 mm and it is used as filler concrete. The shredding of rubber into small particles is extremely vital since larger pieces have less bonding with cement paste, causing the mix to have less strength [7]. Albano et al. [8] present reports from a study where rubber aggregate was used with Portland cement, coarse and fine aggregates, sand and water, super plasticizers and admixtures. These additives have differences in the viscous component, increases the period of workability when heated to 50 degrees centigrade. The mix was cast into eight blocks of 15 x 15 cm with different percentages of rubber and admixtures, and tested for workability, mass density, and compression. Tests were conducted using Abrams slump test and volumetric mass was estimated. Results indicate that the mix has good consistency while the compressive strength decreased when more rubber was added. The report concludes that lower mix of rubber with higher compressive strength can be used for structural applications while mixes with lower compressive strength and volume can be used for non-structural applications. Eldin and Senouci [9] conducted tests on compressive and tensile strength of concrete mix with rubber replacing 25, 50, 75, and 100 of sand and coarse aggregates. Test specimens were subjected to compression and tensile stress. Specimens with 25% rubber had a compressive strength of 19.2 Mega Pascal (MPa) while 40% rubber had 11.6 MPs, 75% had 9.2 MPa and 100 % had 6 MPa. Similarly, results for tensile strength showed that 25% had 2.2 MPa, 50% had 1.5 MPa, 75% had 0.8MPA, and 100% ad 0.8 MPa. The test results indicate that up to 25% of rubber can be used for non-structural construction work. In another set of experiments, Eldin and Senouci [10] repeated the experiment to test the strength of concrete for toughness, dynamic modulus of elasticity, freeze and thaw characteristics, and the compressive and tensile strength of concrete mix with rubber aggregates. Rubber was mixed as 25%, 50%, 75%, and 100% to replace sand and coarse aggregates. The results show that usage of larger rubber chips reduces dynamic modulus. Also specimens showed higher toughness and were less brittle since the energy generated is plastic. In addition, specimens showed a gradual failure of splitting and shearing and sudden, abrupt failure was not seen. Fedroff et al. [11] conducted a series of tests to examine rubber concrete mixes in various proportions. Test was conducted for split cylinder strength, compressive strength, modulus of elasticity, flexural strength, and stress-strain. The results indicate that when compared to standard concrete, strengths of all parameters were reduced, and specimens shrunk in volume. The authors suggest that 'rubcrete' mixes can be used for non-loading work while use for structural loading is not recommended. Additionally, Cahil and Ghali conducted several tests with different sizes of rubber aggregates in concrete with water to cement proportions between 0.47 and 0.61. About 180 trials were tried for compressive strength. Trial results indicate that compressive strength decreases in concrete mixed with rubber by 10-30 percents. Therefore, concrete mixed with rubber cannot be used in construction of serious building components such as columns and slabs. On the other hand, this approach can be utilized in non-load bearing structures, like in transportation constructions such as paving activities for roads and bridges. Concrete used for residential construction needs to have a minimum MPs of 17 MPa [13]. Hernandez-Olivares et al.[14] conducted a series of tests on concrete mixes with 3.5%-5% of rubber by volume along with other ingredients and plastomers. Test results indicate that the compressive strength of rubber plastic was 23 MPa. Other samples without rubber aggregates had a compressive strength of 36 MPa. Using a four point-bending strength and three-point static bending load method, it was seen that rubber filled samples showed a drop in compressive strength, density, and modulus of elasticity. However, rubber concrete did not allow cracks to propagate immediately while plain concrete allowed cracks to progress very quickly. The authors recommend that small proportions of rubber can be used on highways for sound damping and reduction of noise since the mix dampens sound.

3. PROPERTIES OF MATERIALS

The previous sections have reported tests where sand and coarse aggregates were replaced with varying proportions of rubber aggregates. Important properties of material are observed and these are discussed as follows. None of the specimens showed any brittle failure under loading and the failure was gradual with splitting and shearing. Rubber has a very low modulus of elasticity and it functions as weak inclusions in the hardened concrete mix, creating higher internal tensile stress that acts perpendicular to the direction of load [15]. Voids are elliptical shape and the internal stresses formed are equal to the nominal compressive stress. Cement is weak under tensile load than under compressive load. As a result, material is subjected to tensile loads before the compression load limit is reached. These results in tension cracks on the surface, Cracks travel rapidly in the specimen until they reach the rubber aggregate. Since rubber can withstand much larger tensile forces, it acts as a spring and absorbs the load. This reduces crack formation and widening and as a result, rubber specimens can withstand much larger tensile loads. Rubber continues to resist loads until the bond between the cement and rubber chips is overcome. The specimen fails completely at this stage. Overall, the time required for complete failure is much less for rubber concrete than for conventional concrete. Some problems are mentioned in the use of rubber aggregates. Once problem is that old and discarded tyres have impregnated oils, dirt, chemicals, cement and other slag embedded in the surface. Long periods of storage can break down the chemicals, making them to react with other material. While the properties of rubber are not changed, extra efforts must be taken to remove all the dirt and embedded particles. In some cases, shredded tyre aggregates must be washed in special chemicals and with water to remove the impurities. If this precaution is not taken, then quality of cast concrete will degrade.

4. CONCLUSIONS

This paper presents the properties of waste tyre rubber aggregates mixed with concrete where silt and gravel aggregate were replaced by rubber chips. Test results indicate that while the tensile strength is increased, compressive strength is reduced when proportion of rubber aggregates is increased beyond 50%. These findings indicate that it is not advisable to use rubber aggregates in concrete mixes for high strength and load bearing applications. However, rubber aggregate can be used in other applications for non-load bearing components such as road paving, flooring, terrace and other auxiliary construction activities. Using wasted tyre-rubber mixture these purposes will aid in the prevention of pollution and minimize the trouble of packing these wasted tyres. Reusing wasted tyre-rubber mixture to replace rough elements in cement mixture is one of the major benefits; in addition to reducing hazardous incidents of storing these used tyres. Rubber tyres storage requires large areas since about 80% of a tyre is made of voids.

Research Publish Journals, International Journal of ..... , ISSN: XXXX-XXXX
Vol. 1, Issue 9, pp: (1-4), Month-2013, Available at: **www.researchpublish.com**

REFERENCES

[1] Toutanji, H.A., 1996. The use of rubber tire particles in concrete to replace mineral aggregates. Cement Concrete Compos. 18, 135–139.
[2] Siddiquel, R., Naik, T.R., 2004. Properties of concrete containing scrap tire rubber – an overview. Waste Manage. 24, 563–569.
[3] Khatib, Z.K., Bayomy, F.M., 1999. Rubberized Portland cement concrete. ASCE J. Mater. Civil. Eng. 11 (3), 206–213.
[4] Topcu, I.B., 1995. The properties of rubberized concretes. Cement Concrete Res. 25 (2), 304–310.
[5] Segre, N., Joekes, I., 2000. Use for tire rubber particles as addition to cement paste. Cement Concrete Res. 30 (9), 1421–1425.
[6] Neville, A.M., 1995. Properties of Concrete, fourth ed. Longman, London.
[7] Li, G., Garrick, G., Eggers, J., Abadie, C., Stubblefield, M.A., Pang, S., 2004. Waste tire fiber modified concrete. J. Compos. B (35), 305–312.
[8] Albano, C. 2005. Influence of scrap rubber addition to Portland I concrete composites: destructive and non-destructive testing. Compos. Struct. 71, 439–446.
[9] Eldin, N.N., Senouci, A.B., 1993. Rubber–tire particles as concrete aggregate. J. Mater. Civil. Eng. 5 (4), 478–496.
[10] Eldin, N.N., Senouci, A.B., 1994. Measurement and prediction of the strength of rubberized concrete. Cement Concrete Compos. 16, 287–298.
[11] Fedroff, D., Ahmad, S., Savas, B.Z., 1996. Mechanical properties of concrete with ground waste tire rubber, Transportation Research, Record No. 1532, Transportation Research Board, Washington DC.
[12] Ghaly, A.M., Cahill, J.D., 2005. Correlation of strength, rubber content and water: cement ration in rubberized concrete. Canadian Journal of Civil Engineering, Vol. 32, No. 6: pp. 1075-1081.
[13] ASTM, 1988, Concrete and Aggregate, Annual Book of ASTM Standards, vol. 04.02, Philadelphia.
[14] Hernandez-Olivares, F., Barluenga, G., Bollati, M., Witoszek, B., 2002. Static and dynamic behavior of recycled tire rubber-filled concrete. Cement Concrete Res. 32, 1587–1596.
[15] Guneyisi, E., Gesoglu, M., Ozturan, T., 2004. Properties of rubberized concretes containing silica fume. Cement Concrete Res. V 34, 2309– 2317.