Review Paper on Forming Rubcrete-Mixture By Using Waste Tyre as Aggregate

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Abstract- *The results of replacing fine and coarse particles in concrete mix with tyre rubber are presented in this research. The tyre rubber employed in this study is created through a mechanical trituration process of truck tyres that have been used previously. Over the years, researchers have looked into the effectiveness of using recycled tyre rubber waste as a concrete aggregate replacement. The "Rubcrete-Mix" that would arise from such a substitution has a wide range of technical applications and bears promise for the future.*
Over the years, researchers have looked into the effectiveness of using recycled tyre rubber waste as a concrete aggregate replacement. The "Rubcrete-Mix" that would arise from such a substitution has a wide range of technical applications and bears promise for the future. Rubcrete also has strong mechanical qualities, making it one of the most efficient and cost-effective ways to recycle used tyres. The goal of this experiment is to determine the optimal quantity of replacement material for aggregates in concrete mixtures for diverse technical purposes. The recycled aggregates have been tailored with regard to size, shape, and gradation in order to achieve a proper bond with the surrounding concrete paste. Fine and coarse aggregate have been substituted with tyre rubber powder and chipped rubber, and cement has been replaced with silica fume, while the water-cement ratio has remained same. To obtain the needed workability of the final concrete, Portland slag cement was utilised together with a super plasticizer that was less than 1% by weight of cement. In addition, durability tests have been carried out, and mixtures for M30 grade concrete have been developed.

Keywords- concrete, aggregate, tyre, rubcrete-mixture, construction projects, etc.

I. INTRODUCTION

India has taken steps to improve its infrastructure in order to support the expansion of globalisation. Dumping garbage has major health consequences and causes environmental issues. Vehicles are now a vital tool for everyone as a mode of mobility, and the manufacture of tyres is growing at a rapid pace. Following the use of these worn-out tyres, which may be thrown on open ground, these areas may become landfills. Due to the depletion of land filling, these tyre wastes gradually grew significantly.

Furthermore, these areas may become breeding grounds for mosquitoes and serve as breeding grounds for rodents. Because of the presence of cross-links between the rubber polymer chains, the accumulation of these stock piles of tyres will take more than 100 years to disintegrate. Because tyres are created from petroleum by-products, such as methane, which creates fires by releasing a harmful gas into the air when it dissolves in water, polluting the water and causing awful diseases in humans and animals

It is critical to have a comprehensive understanding of how to use industrial wastes for concrete recycling; otherwise, these wastes may have a significant environmental impact. It is a fantastic method for preserving traditional aggregates in the environment. On October 2, 2014, our Prime Minister of India, Sri Narendra Modi Garu, gave an elaborate address in Delhi during the Swacha Bharat Program about eradicating pollution in the environment, which was the aim of our nation's father, Mahatma Gandhi.

When discarded tyres are transferred to landfills, they become incredibly expensive to dispose of, not to mention the large amount of space they take up in landfills and the danger they bring to the environment. Based on this data, the usage of rubber in concrete and pavement materials provides an environmentally viable manner of disposing of the millions of tyres produced each year.

Powdered rubber is a phrase or expression used to describe rubber that is made from discarded tyres. Powder rubber is made by removing the steel and fluff from the tyre, then using a granulator and/or cracker mill to reduce the size of the tyre particles using cryogenics or mechanical techniques. Tires are separated into two categories: automotive tyres and truck tyres, and they are distinct from one another. The rubber source should always be described in the literature since it has an impact on the texture and shape of the concrete, and therefore on the qualities of the concrete that are altered by adding the prescribed amount of rubber.

In this study, fine and coarse aggregates were substituted with Rubber powder and Chipped Rubber, and Portland slag cement was replaced with silica fume in various percentages to examine the effects on concrete mechanical qualities. Water absorption, temperature, density, and thermal insulating qualities, including durability, were all investigated.

II. LITERATURE REVIEW

Waste rubber tyres are one of the most major environmental issues facing the globe today, owing to the increased manufacturing of automobiles and the necessity to dispose of large quantities of waste tyres. Many nations have outlawed the disposal of waste rubber tyres in landfills due to the rapid depletion of existing waste disposal sites. As a result, attempts have been made to find potential waste rubber tyre applications in civil engineering projects. Rubber tyre chips are a waste product that is perfect for use in concrete. This has the added benefit of saving natural aggregates, which are becoming increasingly limited in concrete manufacture. Accordingly, the following is a synopsis of a few such studies:

Almaleeh, Shitote and Nyomboi (2016) - researched that waste rubber can be utilized as development material. Tyres cut into pieces with greatest size of 20 mm to use as coarse aggregate and crumb rubber tyres utilized as fine aggregate. The substitution was done in 3 stages. One was elastic tyres supplanted 50 percent of typical sand. Second was coarse rubber tires supplanted 50 percent of ordinary rock. The last one was both fine and coarse rubber tyres were utilized to supplant the sand and rock by 25, 50, 75 and 100 percent. Compressive quality, splitting tensile and flexural strength tests were led. Despite the fact that, concrete made of tyres had lower strength than normal concrete, it had elastic failure conduct. Compressive quality diminished to 5MPa on lower substitution and can be utilized in pathways. The weight of concrete was diminished and gave advantage for building finishing. Plastic energy increased with increment of rubber content. The flexural quality diminished by 65 percent with increment of rubber percent. In this manner, it doesn't support bending. Splitting tensile strength likewise decreased up to half of the strength of the control.

Asutkar, Shinde, Patel (2017) - experimentally investigated on the behaviours of rubber aggregate concrete beams using analytical approach & found that specific gravity & bulk density of rubber aggregates are less as compared to coarse aggregates. Also, the density of concrete decreases where the use of rubber aggregates increase. The lightweight concrete reduces the weight of structure. But compressive strength decreases and toughness increases when rubber aggregates increase. It was concluded that optimum percentage of replacement of rubber aggregates can be up to 15%. Also, this type of concrete can't be used in structural element where high strength is required.

Eshmaiel Ganjian, Mortezan Khorami, "Scrap tyre-rubber replacement for aggregate and filler in concrete" (2009): In this paper author investigated that mechanical test included compressive strength, tensile strength, flexural strength and modulus of elasticity. The durability tests included permeability and water absorption. The results showed that with up to 5 percent replacement, in each set, no major changes on concrete characteristics would occur however with further increase in replacement ratios considerable changes were observed.

Faraz, Singh, Jain and Jain (2015) - investigated the effects of using crumb rubber material on concrete mix. The resultant concrete mix is to be termed as Rub Crete. There was about 85% decrease in compressive quality and half decrease in tensile strength when the coarse aggregate was completely supplanted by coarse rubber chips. In any case, it was seen that the specimen lost about 65% of their compressive quality and half of their tensile strength when the fine aggregate was completely supplanted by fine crumb rubber. The current investigation depends on contemplating the impacts of substitution of 5% and 10% of coarse aggregates by rubber crumbs on Portland cement concrete. The concrete blends are set up to accomplish target strength of 10N/mm2 (for example M 10 cement). The proportion utilized for concrete mixing is 1:3:6. The addition of rubber crumb brought about increment in workability, increment in compressive quality of concrete (from the outset and afterward it reduces). The rougher the rubber utilized in concrete blend the better the bonding created between the encompassing matrix and the rubber particles which brings about higher compressive strength.

Fiore, Marano, Marti, and Molfetta (2014) - examined that incorporation of rubber aggregates got from waste tyres in cement-based materials can be a reasonable answer for some engineering manufactures, at the same time offering a chance to reuse non-reusable tyres. Various rates of rubber particles, from 0% to 75%, were utilized in the cement-based blends and for every percentage; the appropriate measure of sand was researched by experimental sensitivity tests so as to accomplish the best exhibitions. Regardless of certain downsides, for example, the lessening in compressive and flexural qualities, the high shrinkage, and the vulnerability to sulphate attack, the tests show that the proposed rubber cement composites have fascinating properties that can be valuable particularly for nonstructural applications

Ganjan, Khorami and Maghsoudi (2009) - investigated the performance of concrete when cement and aggregate were replaced with rubber of 5, 7.5, and 10 percent. Two sets were made, where one set had chipped rubber of different percentage by weight in replacement of aggregate and other had scrap tyre powder of different percentage in replacement of cement. Different durability and mechanical tests were performed. The result showed up to 5 percent replacement in each set no major changes of concrete character. But further increase of rubber shown considerable changes like compressive strength at 28 days reduced to 10 to 23 percent for aggregate and 20 to 40 percent for cement replacement. Modulus of elasticity reduced to 17 to 25 percent in the case of 5 to 10 percent aggregate replacement and 18 to 36 percent reduction for powdered rubber. Tensile strength reduced to 30 to 60 percent in case of 5 to 10 percent replacement of aggregate and 15 to 30 percent for powdered rubber. Flexural strength also reduced to 37 percent for aggregate and 29 percent for cement. And water permeability increased in case of coarse aggregate replacement but decreased in case of cement replacement.

Imran Khan, Dr. Sanjay Sharma, Mir Aijaz, "Effect of Recycled Waste Tire Rubber as Coarse Aggregate on the Performance of Concrete" (2018) - In this paper author investigated that this paper is the second in a series of articles detailing our study into the sound absorption properties of rubberized concrete. The disposal of waste tyres is a major issue in India and around the world. We need to discover an environmentally friendly solution because of the environmental concern related with the disposal of waste automotive tyres.

Kotresh K.M and Belachew (2014) - conducted experiment on the use of waste tyre rubber as concrete aggregates & found that concrete showed enhanced toughness & sound insulation. It was concluded that compressive strength was reduced in comparison to conventional concrete. But the strength can be improved by improving the bond particles of rubber aggregate.

S. Selvakumar, R. Venkata krishnaiah, "Strength Properties of Concrete Using Crumb Rubber with Partial Replacement of Fine Aggregate" (2015): In this paper author investigated that the compressive strength of crumb rubber concrete with 5% replacement is 38.66 N/mm2. On the 28th day, it is stronger than conventional concrete (36.73N/mm2). The compressive strength of crumb rubber concrete with 10% replacement, it gives acceptable strength of 3.47 N/mm2 7days (N/mm2). The strength of crumb rubber concrete is lower than the strength of standard concrete when it comes to splitting tensile strength. When flexural strength tests are performed using crumb rubber concrete, the results demonstrate a loss in strength when compared to standard concrete. According to the test results, crumb rubber has a lower bonding ability, which has a negative impact on the concrete's strength.

Siddiqui (2016) - studied the addition of rubber aggregate in concrete mixes reduces the concrete density and it also reduces the concrete strength so that it can be utilised in light weight concrete. Rubber concrete may be used for M15 and M10 grade concrete. There is also a lack of bonding between rubber particles and cement paste. Introduction of rubber concrete mix reduces the slump and workability of various mixed sample. Reduction in unit wt. of 14.33% was observed corresponding to 15% by volume of coarse aggregate replaced by rubber aggregate.

Parth Saika, Owais Mushtaq and A. Arunya, (2016): The author of this research discovered that the disposal of waste tyres is a big concern all over the world because it generates environmental issues. Our major goal was to use leftover tyre rubber chips as a partial replacement for coarse aggregate in concrete. The utilization of leftover tyre rubber chips in concrete is both cost-effective and environmentally benign. The strength of concrete was tested using discarded tyre rubber chips as a partial replacement at varying percentages At a 7-day curing period, compression and split tensile tests were performed on various percentages of rubber chips. The results of the experiments demonstrate that as the amount of rubber chips in the concrete increases, the concrete's strength decreases. But in case of 4% replacement of waste tyre rubber chips in concrete it shows the maximum strength compared to the other percentage replacement.

Priyanka Asutkar, S.B. Shinde, Rakesh Patel, (2016): In this paper author prepared a modified concrete which made up of mixture containing replacement of coarse aggregate by waste tyre at proportion from 0% to 20% with increase of 5%. Three cubes for each percentage of replacement were casted and tested after 28th days of curing. The mechanical properties like density, compressive strength and elastic properties of modified concrete were determined from testing of concrete cubes and additional stresses and displacement at every 50 mm depth of beams were determined analytically by method of initial functions (MIF). MIF is an analytical method for analysing beams that relies on elastic characteristics and theoretical loads rather than an experimental programme. MIF's analytical results were compared to bending theory's results.

Su, Yang, Ling, Gurmel Ghataora and Dirar (2015)- Concrete specimen made with large rubber particles show better workability than those with finer one. Concrete with

finer rubber particles has better performance in strength than the large ones.

Tarry (2018) - studied the effect of partial replacement of coarse aggregate with untreated and treated tyre rubber aggregate. Rubber is useful because of properties like better flexibility, light weight and easy availability. Treated rubber possesses more compressive strength compare to untreated rubberized concrete. Using Rubber aggregate decreases the workability of resultant mixture but it can be solved with plasticizers.

Vidat and Abhay (2017) - found that as the rubber content increases workability decreases. Tensile strength decreases but max. energy absorption during tensile loading increases. Reduction in strength is due to voids created between rubber aggregate and concrete mix and so de airing agents can also be added. It produced light weight concrete.

III. DISCUSSION

The concrete mix with varying replacement proportions for waste rubber tyres was subjected to various strength tests. When discarded rubber tyres are mixed into regular concrete, the workability of the mixtures decreases.

When 10% coarse aggregate is replaced with scrap rubber tyre, the compressive strength of concrete increases by about 15% after water curing: In acid curing, Compressive strength of concrete increases nearly about 20%. Density of concrete decreases nearly about 10%. At both 14 and 28 days, strength diminishes as the amount of waste rubber tyre increases due to inadequate bonding strength between cement and waste rubber tyre chips.

IV. CONCLUSION

From the literatures survey and their experimental study with their results the following conclusion is obtained. Rubber aggregates are feasible solution for Concrete production, economically and environmental. This Study provides a solution for disposal of rubber tyre which can be used as a aggregate at certain limit. This experimental study concluded that the reduced compressive strength of rubberized concrete in comparison to conventional concrete within acceptable limit. In this investigation, we discovered that rubberized concrete has a lower Split tensile strength than normal concrete. In this experiment, we discovered that rubberized concrete has a lower flexural strength than normal concrete. Rubberized concrete cost is less as compared to conventional concrete. Concrete produced is light weighted by 0.99% than conventional concrete. Rubberized concrete's low unit weight properties may make it suitable for architectural applications such as stone baking and interior construction. It can also be used as an earthquake shock wave absorber in buildings where vibration damping is required, such as machinery foundations and railway

REFERENCES

[1] Almaleeh, A. M., Shitote, S. M., & Nyomboi, T. (2017). Use of waste rubber tyres as aggregate in concrete. Journal of Civil Engineering and Construction Technology, 8(2), 1119.Sofi, “Sustainable concrete with waste tire rubber - An overview,” J. Chem. Pharm. Sci., vol. 9, no. 2, pp. 848–853, 2016.

[2] Asutkar, P., Shinde, S. B., & Patel, R. (2017). Study on the behaviour of rubber aggregates concrete beams using analytical approach. Engineering Science and Technology, an International Journal, 20(1), 151–159.

[3] Eshmaiel Ganjian, Mortezan Khorami, “Scrap tyre-rubber replacement for aggregate and filler in concrete”, Construction and Building Materials, Volume 23(5): 1828-1836.

[4] M. A. Yazdi, J. Yang, L. Yihui, H. Su, A Review on Application of Waste Tire in Concrete, Int. J. of Civil, Envir., Struct., Constr. & Arch. Eng., 9 (12), 2015: pp.1648-1653

[5] Fiore, Alessandra Marano, Giuseppe Carlo Marti, Cesare Molfetta, Marcello (2014): On the Fresh/Hardened Properties of Cement Composites Incorporating Rubber Particles from Recycled Tires, Advances in Civil Engineering, v. 2014 (2014).

[6] Ganjian, E., Morteza, K. and Maghsoudi, A.A.(2009). Scrap-tyre-rubber replacement for aggregate and filler in concrete. Construction and Building Material., 23(5): 1828-1836

[7] Imran Khan, Dr. Sanjay Sharma, Mir Aijaz, “Effect of Recycled Waste Tire Rubber as Coarse Aggregate on the Performance of Concrete” IJET – VOLUME 4 Issue Journal of Engineering and Technology, (2018).

[8] Kotresh K.M, Mesfin Getahun Belachew. “Study on Waste Tire Rubber as Concrete Aggregates”. International Journal of Scientific Engineering and Technology April 2014.

[9] S. Selvakumar, R. Venkata krishnaiah, “Strength Properties of Concrete Using Crumb Rubber with Partial Replacement of Fine Aggregate”, International Journal of Innovation Research Science, Engineering and Technology ISSN 23198753, 2015.

[10] Mohammed Mudabheer Ahmed Siddiqui (2016), Study of rubber aggregates in concrete an experimental investigation, International Journal of Latest Research in Engineering and Technology, 2(12), 36-57.

[11] Parth Saika, Owais Mushtaq and A. Arunya, "Experimental Study of Replacement of Coarse Aggregate by Rubber Chips in Concrete", International Journal of Chemical Sciences ISSN: 0972-768, 2016.
[12] Priyanka Asutkar, S.B. Shinde, Rakesh Patel, "Study on the behavior of rubber aggregates concrete beams using analytical approach", Engineering Science and Technology on International Journal (2016).
[13] Su, H., Yang, J., Ling, T-C., Ghataora, G., & Dirar, S. (2015). Properties of concrete prepared with waste tyre rubber particles of uniform and varying sizes. Journal of Cleaner Production, 91, 288-296.
[14] Shahid Rasool Tarry. (2018). Effect of partial replacement of coarse aggregates in concrete by untreated and treated tyre rubber aggregates. International Journal of Advanced Science and Research., 3(1):65-69
[15] V. Choudhary and A. Choudhary, "Use of Tire waste in concrete: A REVIEW," pp. 1924–1936, 2017.