Literature Survey and Study of Waste Tyre Rubber Aggregate and Their Application

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Abstract-Disposal of waste tyre rubber has become a major environmental issue in all parts of the world representinga very serious threat to the ecology. One of the possible solutions for the use of scrap tyre rubber is toincorporate it into concrete, to replace some of the natural aggregate. An estimated 1000 million tyresreach the end of their useful lives every year and 5000 millions more are expected to be discarded in aregular basis by the year 2030. Up to now a small part is recycled and millions of tyres are just stockpiled,landfilled or buried. The search for a new and viable alternative is important for protection of natural resources and reduction in manufacturing cost. Steel slag, coconut shell and over burnt brick have already been tested and used as alternative materials for coarse aggregate. The desolate tyre rubber is a assured material in the building industries as part of coarse aggregate replaced due to its light weight, energy absorption, elasticity and heat insulating properties. This has the other advantage of saving in innate aggregate consumed in the creating of concrete and also this concrete will be light in weight.In this survey, the potential application of waste tyre rubber are being arranged and discussed.

Keywords- Waste tyre rubber, Environmental issue, Alternative materials, Assured material.

1. Introduction :

Countries and cities have been faced with major increasing problems with the disposal of recycled materials, such as rubber, glass, and plastics for several years. The consumption of the world's rubber has nearly reached 24.9 million tons in year 2010. In the U.S. alone, approximately 3.9 million tons of scrap tires are produced every year, out of which 1.36 million tons are recycled and 2.54 million tons are burned or land-filled. In view of the wide and vast market for scrap tires, about a quarter of all scrap tires end-up in landfills numbering to approximately 27 million tires or roughly 6 million tons annually, making-up over 12% of all solid waste. The disposal of the scrap tires materials become very costly once they are sent to landfills; not to mention the wide space that they use in landfills to dispose of, and the hazard that they cause towards theenvironment. Based on this information, the rubber use in concrete and pavement material provides an environmentally sustainable method for disposing of the millions of tires that are annually generated. Powdered rubber is a general term or an expression given to recycled rubber that is generated from scrap tires. The production of powder rubber consists of removing the steel and fluff, then using a granulator and/or cracker mill, with the aid of cryogenics or mechanical means, in order to reduce the size of the tire particles. A well-known fact is that tires can be divided into two major groups: automobile tires and truck tires, and they are different from each other. The description of the rubber source is very important and should always be specified in the literature because it has an influence on the texture and the shape, and consequently, on the characteristics of the concrete that is adjusted by the addition of the specified percentage of the rubber. It is also important to point out that automobile tires and

truck tires vary not only in shape, weight and size, but above all, in the ratio of the components of the base mixture. Researchers have considered three wide categories of discarded tire rubber concrete mix design:Chipped Rubber: This type of rubber has dimensions of about 15–20 mm and used to replace the coarse aggregates in concrete.

On the other hand, and for so many years, material researchers have attempted to make concrete a ductile material. It appears, however, that due to the brittle nature of concrete, the most direct and effective approach in creating damage tolerant concrete structures would be to embed intrinsic tensile ductility into concrete. If concrete behaves like steel in tension (highly ductile), while retaining all other advantages (e.g. high and extreme compressive strength), concrete structures with enhanced serviceability and safety can be readily realized. This research attempts to provide a solution for this worst limitation of concrete, i.e. brittleness and very low tensile strength.Making concrete a ductile material would also improve the impact strength and toughness of the concrete. Another issue would be to seek ways of making the concrete "green" or environmentally friendly through the choice of materials while retaining the core advantages of the concrete. Ductility is a very desirable structural property because it allows the stress re-distribution and allows warning signs of impending failure. The ductile behavior enables the concrete material toHave the capacity to deform and support flexural and tensile loads even after initial cracking. One material that is suggested as a possible replacement of mineral aggregates is rubber from used tires. This research focuses on the effect of replacing the fine aggregates (sand) with powdered rubber. A significant difference between mineral aggregates and tire derived aggregates is that individual particles are much more deformable than those of sand, gravel, or rock. Another significant difference is that the unit weight is much lower; therefore, tire derived aggregates can be considered as lightweight aggregates.

2 LITERATURE SURVEY

ShahidRasool Tarry [1] Effect of partial replacement of coarse aggregates in concrete by untreated and treated tyre rubber aggregates. Rubber has great capability of becoming a permanent member of concrete family because of its wide variety of decent properties like better flexibility, light weight and easy availability. It can be very environmental friendly to use this waste material in construction industry.Treated rubberized concrete possesses more compressive strength as compared to the untreated rubberized concrete. However, even after the surface treatment is given to the rubber, only 92.57% compressive strength ofnormal conventional concrete is regained. Flexural and split tensile strength of almost allreplacement levels of treated rubberized concrete is found to be more than in the normal conventional concretes. 28 day flexural and split tensile strength is found to be highest at NTR-5 and NTR-15 respectively. The purpose of this study was to determine if a waste material like worn out tyres enhance the basic propertiesof concrete. The data presented in this research shows that there is great potential for the utilization of tyres as aggregates. It is considered that used tyres would providemuch greater opportunities for value adding and cost recovery, as it could be used as a replacement for more expensive material such as rock aggregate. Using rubber aggregates decreases the workability of the resultant mix, but this problem can be dealt with the useof the certain plasticizers.

S.F.A.Shah, A. Naseer, A.A.Shah,M. Ashraf.[2] Evaluation of Thermal and Structural Behavior of Concrete
Containing Rubber Aggregate. Thermal behavior for concrete was examined using hotbox technique. No remarkable changes in concrete properties up to 5 % substitution were occurred. Beyond 5 % substitution, concrete properties change appreciably. Compressive strength, flexure strength, workability, stiffness and unit weight of rubberized concrete decreased as
rubber content increased. While impact resistance, air content and water absorption of rubberized concrete increased with increase in rubber content. Thermal performance of concrete containing rubber aggregate was improved, and promising results were obtained. Thus, rubberized concrete could be useful in slabs to improve energy efficiency of building unit.

EshmaielGanjian,MortezaKhorami [3]. Scrap-tyre-rubber replacement for aggregate and filler in concrete. The mechanical tests 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.

Kotresh K.M, MesfinGetahunBelachew [4]
Study On Waste Tyre Rubber As Concrete Aggregates. From the present experimental study, we conclude that despite the reduced compressive strength of rubberized concrete in comparison to conventional concrete, there is a potential large market for concrete products in which inclusionof rubber aggregates would be feasible which will utilize the discarded rubber tyres the disposal of which, is a big problem for environment pollution. Rubberized concrete strength may be improved by improving the bond properties of rubber aggregates. In India, out of 36 tyre manufacturers the tyre recyclers are around 20, the major contribution is only by four or five.. Among these, M/S Gujarat Reclaim has an annual turnover of over Rs.15 Crorefrom its Haridwar (Uttarakhand, India) tyre recycling plants, with a production of 20 tons of reclaim rubber per day. The tyre recycling factories should supply quality rubber aggregates in 20-10mm, 10-4.75mm and 4.75mm down sizes to be used as cement concrete aggregate.

Mr. ChotheOnkar K., Mr. V.S.Kadam, PatilVikram, PatilPravin[5]. Effect Of Replacement Of Course Aggregate By Scrap Tyre Rubber. Solid waste management has most important because tyre rubber waste is increasing at a fast rate. Tyre rubber waste is non biodegradable nature so that its used as a fuel in many industries which is not environment friendly. Concrete has notice asa alternative source of recycling the tyre rubber waste. Aggregate can replaced by tyre rubber waste. In this study, affects on concrete has been observe by experimental results. In this experimental study M20 grade concrete used as reference point. Tyre rubber waste used as a course aggregate in 5% , 10%, 15% replacement for conventional aggregate. As per this percentage cost benefit and strength ratio also identified.

T.Ishwariya [6]. An Experimental Study On Partial Replacement Of Coarse Aggregate By crumb Rubber. Recycle wasted Tyre Rubber is a promising material in the construction industry due to its light weight, elasticity energy absorption, sound and heat insulating properties. In this the density and compressive strength of concrete utilizing waste tyre rubber has been investigated . Recycled waste tyre rubber has been used in this study to replace the coarse aggregate by weight of 20%. The results shows that although, there was a significant reduction in the compressive strength of concrete utilizing waste tyre rubber than normal concrete, concrete utilizing waste tyre rubber demonstrated a ductile, plastic failure rather than brittle failure. In this study we use to find out the compressive strength of concrete by the replacement of coarse aggregate by crumb rubber in normal concrete in grade of M25 and M30.Finally a comparative study is made among the normal conventional beam over to the rubcrete beam.

TanjaKalmanSipos and Kristina Strukar
Robert Busi, c. Ivana Milicevi´c [7]. Recycled Rubber as an Aggregate Replacement in
Self-Compacting Concrete. recycling and reusing waste tire rubber avoids the need for tire landfilling, as one of the major ecological problem of the near future. Replacement of natural aggregate with waste tire rubber can have an undesirable influence on the mechanical properties of self-compacting concrete, i.e., compressive strength, flexural strength, splitting tensile strength, and modulus of elasticity, however. On the other hand, replacing natural
Gravel or sand with waste tire rubber can improve impact resistance, ductility, and fatigue resistance. This paper presents an overview of the literature investigating recycled waste tire rubber used as a fine and/or coarse aggregate replacement in self-compacting concrete and its influence on several essential fresh and hardened self-compacting concrete properties.

YogenderAntil ,Er. VivekVerma, Er. Bhupinder Singh [8]. Rubberized Concrete Made with Crumb Rubber. The test results of this study indicate that there is great potential for the utilization of waste tyres in concrete mixes in several percentages, ranging from 5% to 20%. Based on present study, the following can be concluded: The strength of modified concrete is reduced with an increase in the rubber content; however lower unit weight meets the criteria of light weight concrete that full fill the strength requirements as per given by Neville in 1995. Concrete with higher percentage of

crumb rubber possess high toughness The slump of the modified concrete increases about 1.08%, with the use of 1 to 10% of crumb rubber. Energy generated in the modified concrete is mainly plastic. Concrete with higher percentage of crumb rubber possess high toughness The slump of the modified concrete increases about 1.08%, with the use of 1 to 10% of crumb rubber.

Mazyad Al-Fadhli[9]. Advantages of Concrete Mixing with Tyre Rubber. The paper examines the properties of rubber aggregates mixed in concrete where sand and coarse aggregate are 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 rubber aggregates in such applications can help to prevent pollution and overcome the problem of storing used tyres. Advantages if using rubber aggregates to replace and coarse aggregates is that waste rubber that is expensive to store and is a hazard, can be reused. Rubber tyres storage requires large areas since about 80% of a tyre is made of voids.

Mohd. MohsinKhan[10]. Use Of Crumb Rubber As Replacement Over
Aggregate In Concrete. It can be concluded from this study that fine aggregates can be zeplaced by crumb rubber upto some extent. The higher amount of crumb rubber reduces the strength of concrete which may not be desirable, but, the rubber based concrete has good toughness and deformabilit y. So this kind of concrete may be used in the structures (road foundat ions and bridge barriers) where toughness and deformabilit y is more important than strength. This kind of concrete may also use to decrease the vibrations coming on the base of the structures because rubber based concrete have reversible elasticity property.

Parveen, SachinDass, Ankit Sharma[11]. Rubberized Concrete: Needs of Good Environment**.** The aim of this study is achieved to use of rubber waste as partial replacement of fine aggregate to produce rubberize concrete in M30 mix. Different partial replacements of crumb rubber (0, 5, 10, 15 and 20%) by volume of fine aggregate are cast and test for compressive strength, flexural strength, split tensile strength and stress-strain behavior. The results showed that there is a reduction in all type of strength for crumb rubber mixture, but slump values increase as the crumb rubber content increase from 0% to 20%. Meaning that crumb rubber mixture is more workable compare to normal concrete and also it is useful in making light weight concrete. It is recommended to use the rubberized concrete for non-structural applications.

Ali Raza Khalid, M. HarisHameed[12]. Ubberized Concrete (Rubcrete). This study has two different types of rubber particle samples,crumb rubber & ground rubber which were employ as replacement of coarse and fine aggregates at replacement stages of 5%, 10%, till 40% replacement by weight. This paper examines the fresh and hardens state properties by means of workability, unit weight, air content, toughness and strengthening properties of rubber concrete. Addition of rubber reduced the slump and 40 % replacement lead to zero slump. The concrete mixtures showed lower compressive
quality as compared to normal one. Be that as it may, these blends did not define fragile failure, in any case rather a flexible, plastic failure, and had the ability to assimilate a lot of plastic vitality under tensile and compressive loads. Keeping this in perspective it was concluded that the 5-10%
replacement in concrete could be more viable option to create light weight concrete without significant slump loss & loss of compressive strength.

S.Selvakumar, R.Venkatakrishnaiah[13]. Strength Properties of Concrete Using Crumb Rubber with Partial Replacement of Fine Aggregate. The compressive strength of crumb rubber concrete with 5% replacement is 38.66 N/mm^2 .It is higher than the strength of normal concrete (36.73N/mm^2) on 28^{th} day.The compressive strength of crumb rubber concrete with 10% replacement, it gives acceptable strength of 3.47 N/mm^2 **7days(N/mm^2)**. In splitting tensile strength the strength of crumb rubber concrete is lower than the strength of normal concrete.In the flexural strength test conducted on crumb rubber concrete it shows a decrease in strength when compared to the

strength of normal concrete.From the test results, it is found that the crumb rubber posses less bonding ability which has affected on the strength of the concrete.

Priyanka Asutkar, S.B. Shinde, Rakesh Patel [13]. Study on the behaviour of rubber aggregates concrete beams using analytical approach. A modified concrete is prepared by replacing coarse aggregates in concrete with rubber aggregates by varying the replacement proportion from 0% to 20% with increment of 5%. 3 cubes for each percentage of replacement are casted and tested after 28th days of curing. The physiomechanical properties like density, compressive strength and elastic properties of modified concrete are determined from concrete cubes experimentally and further stresses and displacement at every 50 mm depth of beams are determined analytically by method of initial functions (MIF). MIF is an analytical method in which elastic properties and theoretical loads are used to analyse the beams without conducting any experimental programme. The analytical results by MIF are compared with bending theory.

Gang Xue and Mei-ling Cao[14]. Effect of Modified Rubber Particles Mixing Amount on Properties of Cement Mortar. The surface layer is not a load-bearing part; on the premise of meeting the basic strength requirements, toughness can be considered as the main performance index of mortar. Though rubber particles reduce the compressive strength and the flexural strength of surface mortar, but the ratio of compressive strength to flexural strength is decreased, and this indicates the mortar toughness is improved. Cement mortar mixed with crumb rubber can be used for the surface engineering, which may solve the problem that the crack resistance is poor in traditional surface mortar. According to the tests, the ratio of compressive strength to flexural strength is the smallest when the mixing amount of rubber is 19%; meanwhile impact resistance is high at this moment and drying shrinkage is rational, so the appropriate mixing amount of rubber particles determined by this test is 19%.

K. C. Panda, P. S. ParhiAnd T. Jena [15]. Scrap-Tyre-Rubber Replacement for Aggregate in Cement Concrete: Experimental Study. The reasons for reduction in the strength of concrete when rubber was used are as follows. Lack of proper bonding between rubber particles & the cement Paste. Due to replacement of the aggregates by rubber particles, the weight was reduced. High concentration of rubber particles at the top layer of specimen due to lower specific gravity of the rubber particles. Due to non-uniform distribution of rubber particles in the concrete, non- homogenous samples are produced, which in turn results in reduction in concrete strength. The stiffness of rubber is lower as compared to stiffness of coarse aggregate, the presence of rubber particles in concrete reduces the concrete mass stiffness and also decreases load bearing capacity of concrete.

M. Mavroulidou,J. Figueiredo[16]. Discarded Tyre Rubber As Concrete Aggregate:A Possible Outlet For Used Tyres. An emerging use is the production of concrete, in which tyre rubber particles partially replace natural aggregates. This has the additional advantage of saving in natural aggregates used in the production of concrete which are becoming increasingly scarce. This research investigated a wide range of physical and mechanical properties of concrete containing recycled tyre aggregates, to assess its suitability as a construction material. The influence of factors such as rubber aggregate content and size, as well as curing time was also considered. The results showed that despite a great loss in strength, this type of concrete was acceptable for various applications requiring medium to low compressive strength. The quantities of concrete produced worldwide for such applications could ensure the viability of this product. Therefore, this type of concrete shows promise for becoming an additional sustainable solution for tyre rubber waste management.

Dr J K Dattatreya, S. Suresh Raghu N.E.[17]. Experimental investigation of crumb rubber concrete confined by FRP sheets. Increased its ductility, especially at higher levels of confinement. Therefore, the use of confined CRC in structures subject to seismic loads, where ductility demands are more critical than strength, looks promising. The Confined CRC displayed similar volumetric behavior to the confined conventional concrete. However, the rate of volume expansion for CRC mixes was less than that of conventional concrete. At a given axial stress and confinement thickness, the volumetric strain of CRC is higher than that of conventional concrete. This also

confirms the higher ductility of CRC compared to conventional concrete.

The confined CRC can be used as a promising alternative to the confined conventional concrete in a CFFT segmental column. The CRC can enrich the structure ductility, damping ratio, and the energy dissipation which are the most important parameters in structures resisting earthquakes.

Mohammed Mudabheer Ahmed Siddiqui [18]. Study Of Rubber Aggregates In Concrete An Experimental Investigation. Scrap tyre rubber chips, has been used as coarse aggregate with the replacement of conventional coarse aggregate Concrete is one of the most popular building materials. The construction industry is always increases its uses and applications. Therefore, it is required to find alternative materials to reduce the cost of concrete. On the other hand, Non-biodegradable waste i.e. water bottles, cool drink bottles and disposable glasses, shredded or crumbed rubber etc., is creating a lot of problems in the environment and its disposal becoming a great difficulty. The objective of this paper is to investigate the use of rubber pieces as coarse aggregate in the concrete. Concrete tested with varying percentages of rubber from 0 to 15% of normal aggregates. Compressive strength, of concrete is measured and comparative analysis is made.

Priyanka Asutkar , S.B. Shinde, Rakesh Patel[19]. Study on the behaviour of rubber aggregates concrete beams using
analytical approach. Huge amount of rubber tyres waste is being generated day by day which creates the disposal problem and has many environmental issues. As this scrap rubber waste is an elastic material having less specific gravity, energy absorbent material can be used as areplacement material for obtaining lightweight concrete. In present study an attempt is made to partially replace the rubber aggregates by coarse aggregates in concrete and to study its impact on properties of concrete. A modified concrete is prepared by replacing coarse aggregates in concrete with rubber aggregates by varying the replacement proportion from 0% to 20% with increment of 5%. 3 cubes for each percentage of replacement are casted and tested after 28th days of curing. The physiomechanical properties like density, compressive strength and elastic properties of modified concrete are determined from concrete cubes experimentally and further stresses and displacement at every 50 mm depth of beams are determined analytically by method of initial functions (MIF). MIF is an analytical method in which elastic properties and theoretical loads are used to analyse the beams without conducting any experimental programme. The analytical results by MIF are compared with bending theory.

NajibN.Gerges,CamilleA.Issa,SamerA.Fawaz[20]. Rubber concrete: Mechanical and dynamical properties. Physical properties such as the density, the compressive strength, the fresh concrete properties, the splittension, and the impact load capacity are examined. The results revealed a decrease in the compressive strength Of concrete cylinders containing rubber. The dynamic performance of the rubber concrete is of high importance because of its high resilient nature, as the rubber particles that are included in the concrete have a positive effect on the dynamic Performance. The conclusions that were derived from this research implicate potential applications where rubberized concrete can be efficiently used. Even though rubberized concrete mixture generally has a reduced compressive strength that may limit its use in certain structural applications, it possesses a number of desirable properties, such as lower density, higher toughness, and higher impact resistance compared to conventional concrete.