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Tensile Strength and Toughness Index of Flyash-Lime –Gypsum mixed with Dry/Treated Tire chips

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Abstract

With the alarming growth in vehicle population in world, scrap tires are beginning to pile up. The paper presents an engineering overview of use of shredded scrap tires chips with fly ash, lime and gypsum mix. It has been observed that the tensile load, diametral strain and toughness characteristics of the reference mix mixed with dry tire chips can be increased by providing surface treatment of tire chips with carbon tetra chloride, sodium hydroxide and water. Beside this, it has been observed that curing methods and curing periods has also prominent effect on the tensile and toughness characteristics of reference mix mixed with dry/treated tire chips. As the composite formed by mixing fly ash, lime and gypsum with treated tire chips has shown increased toughness characteristics, hence the composite material find new application in those construction where there is more requirement of toughness characteristics. Utilizing some portion of these wastes like fly ash and tire chips in this way will reduce the quantity of the waste-requiring disposal. Moreover, the disposal in this way will be in an environmental friendly manner.

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Keywords:Treated tire chips, compressive strength, tensile strength, post peak behavior, toughness index, curing period, curing methods;

1. Introduction

With the increased dumping of waste in the environment, most of the researchers are focusing their attention to find out new ways to eliminate the wastes by using them as an alternative resource material. Fly ash and waste tire chips are considered two examples of such wastes. In India the total discarded tires are in the order of 112 million tons. Similarly the production of fly ash in India has also increased to 175 million tons. Thus there is an emerging

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need to use these both wastes to form a composite material so that the same can be brought into useful application. The basic objective of this work is to study the potential use of the new composite material so as to have an application in the improvement of the ground conditions especially for the road pavement. Therefore, the study of properties such as tensile load –strain, post peak behaviour and toughness index of pavement become important. This paper also examines the effect of curing period, curing method and treatment provided on tire chips on the tensile load –strain, post peak behaviour and toughness index of the reference mix containing fly ash-lime-gypsum.

2. Materials

The fly ash (Class F) for the use in the study was procured from Ropar Thermal Power Plant, Punjab, India. It had a specific gravity and dry unit weight of2.07, 9.54kN/m^3 respectively. Commercially available lime and gypsum were used in the study. The chemical composition, *XRD* and *SEM* of lime and gypsum is reported elsewhere (Guleria and Dutta, 2012). The tire chips for the study were derived from waste tires. The tread rubber was first removed from waste tire of passenger car and was cut into strip of 10 mm size. Further, chips of approximately 5 mm irregular size as shown in Fig.1 were derived as per the technique reported by Rao and Dutta (2006).

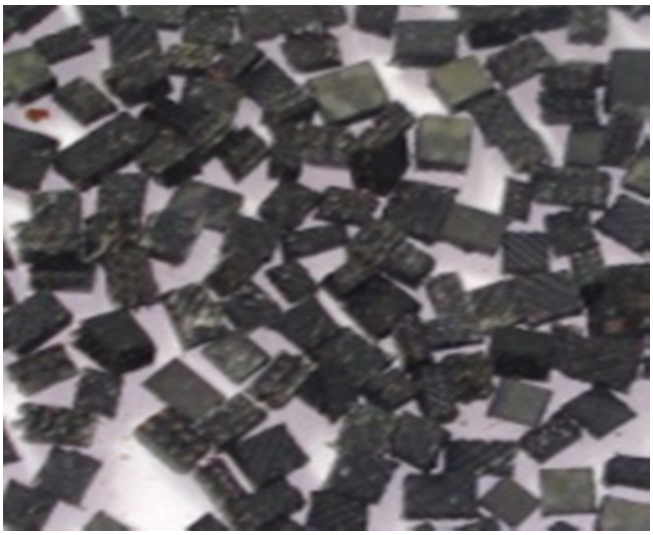

Fig. 1: Photograph of tire chips

The tire chips were found to have specific gravity of 1.12 and the average thickness of 2.7 mm. A reference mix containing fly ash + 8 % lime + 0.9 % gypsum was selected for further experimental work based upon the compaction studies reported elsewhere (Guleria and Dutta, 2012). Further, the quantity of gypsum was restricted to 0.9 % as higher percentage may have deleterious effects (Rollings et al 1999). Ghosh and Subbarao (1998) have also restricted the content of gypsum to 1%. A metallic mould having size 38 mm inner diameter × 19 mm long, with additional detachable collars were used to prepare specimens for tensile strength tests. Further, in order to keep the total volume as constant, fly ash equivalent to the weight of tire chips (10 % corresponding to the dry weight of fly ash) were removed and replaced with dry tire chips. The quantity of 8 % lime and 0.9 % gypsum by reduced dry weight of fly ash was then mixed thoroughly and the required quantity of water (corresponding to optimum moisture content (OMC)) was added to the mix in the first series of experiments (designated as C1). For the subsequent series of experiments the tire chips were dipped for 20 minutes in water (designated as C2), sodium hydroxide (designated as C3) and carbon tetra chloride (designated as C4) solution before adding them to the reference mix. Further, the quantity of water/solution equivalent to the weight of the absorbed water /solution by the tire chips was deducted from the required quantity of water (corresponding to OMC) to facilitate compaction. In order to have the uniform compaction, specimen was compressed statically from both ends till the specimen just reached the dimensions of the mould.