An Investigation on the innovative use of waste tire rubber in concrete

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Abstract:

The production of rubber tire is enormous at global level. It is impossible to get rid of the waste rubber as its decomposition is a long process and also leads to the generation of environment pollutants. Due to such reasons the recycling of rubber is adopted. Certain quality of rubber can be utilized to make recycled rubber product but on case of tire rubber, production of recycled rubber product is costlier. Hence the waste tire rubber is utilized in concrete production by partial replacement of coarse aggregate with rubber chips. It was observed that by using rubber in concrete a number of its properties got enhanced (workability, ductility, crack resistance etc.), but a few properties (compressive strength, tensile strength, flexural strength) got diminished.

Index term:

Rubberized Concrete, Waste Tire, Workability, Slump

Introduction:

Many of the wastes produced today will remain in the environment for several years with larger grows accumulation with a waste disposable crisis, one of the active solution for this problem lies in recycling waste in to useful products with continuous decreasing the number of landfill materials by reusing them again. A large variety of waste materials are considered feasible and even much valuable additives for concrete. Some of these materials include cellulose, fly ash, silica fumes and wood particles. Rubber obtained from scrapped tyres is considered as the most recent waste materials that have been examined because of its vital use in the construction field. Worldwide, the production of rubber increases every year. Different countries of the world has different rate of producing rubber, for instance India produces over 2 million tons of rubber per year, United States produces 3.6 million tons of rubber per year . Iran produces 100,000 tons of rubber per year similarly Malaysia produces 200,000 tons of rubber per year. These numbers increases with the increase in the production of vehicles. Investigations have shown that scrapped rubber tyres contain materials that do not decompose under environmental conditions and cause serious problems. It is very difficult to manage the waste produced by the rubber-tyre industry and to handle the waste. It is not easily biodegradable waste form. According to

Guneyisi et al. 2004 the rubber waste is not easily biodegradable even after a long span passes after the landfill treatment. Siddique and Naik, 2004 stated that the rubber tyre waste has been utilized as fuel for the kilns, as a form of feed for the carbon black and it is also found that the environmental hazardous pollution caused by the combustion of rubber tire in the kilns is greatly reduced as compared to the carbon black fuel. One choice of decomposition is burning, but that would also results in harmful pollutions. Based on these problems, tires can be used as aggregates in concrete.

Methodology:

1. Material used to be recycled:

Crumb Rubber is recycled rubber produced from automotive and truck scrap tires. In order to prevent the environmental problems from growing, recycling tires is an innovative idea or way in this case. Recycling Tire is the processes of recycling vehicles Tires that are no longer suitable for use on vehicles due to the wear or irreparable damage. During the recycling process, steel and tire cord (fluff) are removed, leaving tire rubber with a granular consistency. Continued processing with a granulator or cracker mill, possibly with the aid of cryogenics or by mechanical means, reduces the size of the particles further. The particles are sized and classified based on various criteria including color (black only or black and white). [1]

2. Specimen Preparation:

A concrete mix of M40 is designed as per IS: 10262 having target strength of 48.65 Mega Pascal. The concrete cubes of size 150X150X150 mm were casted and the compressive strength is tested in 7, 14 and 28 days. Further the coarse aggregate is replaced by rubber chips obtained from waste tires and the samples are drawn by partial replacement of 5%, 10%, 15% and 20% of coarse aggregate by rubber chips. Again the cubes of same size are casted and the unit weight and compressive strength of rubberized concrete cubes are obtained. The test results are compared to the results obtained from the conventional mix.

3. Results and discussions:

a. Effect on workability:

By increasing the rubber content in concrete the slump as well as the unit weight decreases. But still gave a workable mix despite of adding rubber to it when compared with the conventional mix concrete.

b. Effect on unit weight:

As the quantity of rubber in concrete increased, the density of concrete decreases. The amount of air entrained or air entrapped, water cement ratio, which in turn depends upon the size of aggregates. Approximately 25-35 percent of rubber content in concrete may cause decrease of about 90% in the density of concrete. However, the effect on the unit weight is negligible under the introduction of rubber content by 10 % or less.

c. Effect on compressive strength:

The compressive strength of concrete decreased with the increase in rubber content. The decrease in the compressive strength up to 15% of rubber content is mild but further a drastic drop occurred in the compressive strength.
Rubber content in concrete decreased the compressive strength. This reduction was due to the presence of entrapped air. Compressive strength can be increased by adding some de-airing agents into rubberized concrete. There is possibility of increasing the compressive strength by using de-airing agents. [2]

Conclusion:

This research leads to several notifications:

1. The compressive strength values of all waste tires rubber concrete mixtures have a tendency to decrease below the values for the reference concrete mixtures with the increasing of waste tires rubber ratio at all curing age. This may be attributed to the decrease in the adhesive strength between the surface of the waste tires rubber and cement paste. At 28 days curing ages the concrete mixtures that made of 20% waste tires rubber has the lowest compressive strength, and the decreasing ratio of this mixture below the referent concrete mixture at the same curing age is 35.25%.

2. The slump values of waste tires rubber concrete mixtures tend to decrease below the slump of the referent concrete mixture, with the increase of this waste ratio. In spite of this declination in the slump of those mixtures, they are easy to work based on the fact that workability has a broad range from very low to high workability for different construction applications.

3. The unit weight of concrete is decreased with respect to the referent concrete mix .Thus made the replaced concrete mix more workable in comparison to the referent concrete mix.

Reference :

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