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COMPARATIVE COMPRESSIVE STRENGTH CONCRETE BY PARTIAL REPLACEMENT OF FINE AGGREGATE BY RUBBER DUST AND COARSE AGGREGATE BY TYRE CHIPS

Engineering

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ABSTRACT

Solid waste management has gained a lot of attention to meet the requirements of globalization in construction of buildings and other structures. Pertaining non-biodegradable nature of waste tyres has become a problem of interest. In the investigation as the substitution of natural river sand to stone dust is taken to 30% replacement of weight of sand in ratio 1:1.66:3.03 of concrete the maximum strength to gain of concrete. In the present investigation as the substitution of natural river sand to Rubber dust is taken to 0.5%to 1.5%replacement of weight of sand of concrete the maximum strength to gain of concrete while the substitution of aggregate to tyre chips is taken 3-6%. It was observed that beyond 5% replacement of rubber dust and tyre chips unable to give acceptable strength to instead leads to subside in strength of concrete.

KEYWORDS:

OPC cement, Coarse aggregate, Rubber Dust, Tyre chips

INTRODUCTION

Concrete is a synthetic construction material made by mixing of cement, fine aggregates, coarse aggregate and water in the proper proportions. Each of these components contribute to the strength their concrete possesses **[Sivakumar 2011].** It is also a well-known heterogeneous mix of cement, water and aggregates. But according to **[Akinwonmi 2012]**, in its simplest form, concrete is a mixture of paste and aggregates. The admixtures may be added in concrete in order to enhance some of the properties desired specially. These materials are very expensive and have hindered the development of shelter and other infrastructural facilities in developing countries. The key to achieving a strong, durable concrete rests in the careful proportioning, mixing and compacting of the ingredients**. [Devi *et al.* 2011],** According to **[El- Gammal, et al 2010],** recycled waste tyre rubber is a promising material in the construction industry due to its lightweight, elasticity, energy absorption, sound and heat insulating properties. Society finds it difficult to management waste-tyre rubber is because of its non-biodegradable nature even after long-period of landfill treatment. However, recycling of waste tyre rubber to be used as aggregates is an alternative to reduce pollution and to reduce expenditures on cement. Quarry dust has been used for different activities in the construction industry such as road construction and manufacture of building materials such as light weight aggregates, bricks, and tiles. Attempts have been made to investigate some property of quarry dust and the suitability of those properties to enable quarry dust **[Celik et. al., 1996]** to be used as partial replacement material for sand in concrete. [**Kashif et al 2015]** investigated that rubber can be used at some extent as a replacement of coarse aggregate. It exhibited lower compressive and tensile strength than of normal concrete but unlike normal concrete, rubberized concrete had the ability to absorb a large amount of plastic energy under compressive and loads. It did not demonstrate the typical brittle failure, but rather ductile, plastic failure mode.

The main objective of the study is to evaluate relative performance of the concrete made by normal fine aggregate and stone dust, aggregate and tyre chips. This study ensures the stone powder or as an appropriate alternative of fine aggregate in concrete manufacturing as a building materials. The advantages of utilization of products or aggregates obtained as waste materials are pronounced in the aspects of reduction in environmental load & waste management cost, reduction of production cost as well as augmenting the quality of concrete.

Mix Proportion-

Mix design pertains to design the quantities of materials that can be used for concrete mixture. Trial mixes for preparing the specimens proportioned by weight. The mix design as per IS 10262:2009 was carried out for concrete grade M20 for getting target mean strength which gives the ratio 1:1.66:3.03 at 7 days and 28 days. The concrete specimens were prepared with partial replacement of fine aggregate with 30% stone dust which is taken as conventional concrete which is compared with rubber dust with replacement level 0.5%, 1%, & 1.5% i.e. substituting natural river sand and crumb rubber of size 4.75 to 10 mm with partial replacement of coarse aggregate at levels 3%, 4% and 5% & 6%.

Preparation Of Specimens

Cube specimens of size 150 mm x 150 mm x 150 mm were cast. All specimens were tested on 7 and 28 days respectively. All concrete mixes in the study were prepared following the procedure prescribed as per IS 456-2000. All the concrete specimens were cast under laboratory conditions, demolded at 24 h after casting, and then fully submerged in water at (25 ± 2) °C until further testing.

Testing Of Specimens

Laboratory tests include compression test as per IS 516-1959, carried out on the concrete mixes at the specified ages.

RESULT AND DISCUSSION

Compressive Strength of Tyre Chips and Rubber Dust Based Concrete- Compression test according to IS 516(1959) was carried out on cubes. The specimens were loaded at constant strain rate until failure. Tyre, and Stone dust are used as alternative materials to aggregate and Natural river sand in concrete now days due to rapid growth in construction activity and consumption of concrete increasing every year. The excessive extraction of natural aggregate and river sand is leading to acute shortage in many areas, availability, cost & environmental concern. Thus, it is becoming inevitable to use these alternative materials in concrete.

The present investigation aims to compare the effect on compressive strength of concrete of 7 days & 28 days in ratios 1:1.66:3.03 when Stone dust, rubber dust and tyre chips is used as a substitution of natural river sand and aggregate for preparation of concrete. Stone dust is replaced at constant levels of 30% to natural river sand.

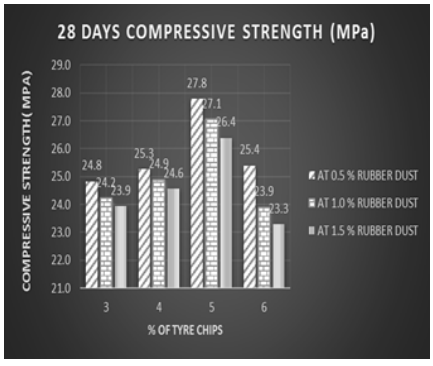

Figure 1 28 days Comparative Compressive Strength With Rubber Dust & Tyre Chips When stone dust mixed at constant level 30% & rubber dust mixed at levels of 0.5% ,1.0%, and 1.5%

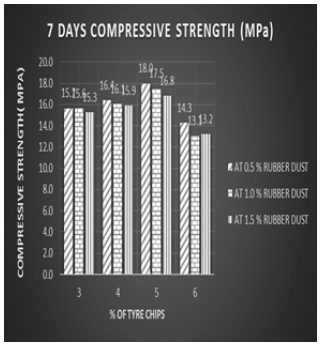

Figure 2 7 days Comparative Compressive Strength Mix With Rubber Dust & Tyre Chips

When Tyre mixed as coarse aggregate in concrete the strength decreases as compare to concrete mix with coarse aggregate so it cannot be used construction of concrete use but it can be used where low strength concrete required. But it reduces more pollution in atmosphere than stone dust.

Conclusion-

Further substitution of rubber dust 1.0% leads to decrease in compressive strength for stone dust respectively. Further substitution of tyre, to replace coarse aggregate, leads to decrease in compressive strength.

Therefore, stone dust & rubber dust is a more relevant substitution to natural river sand. If higher percentage of substitute is required due to lack of natural river sand due to economical or other reason. And tyre substitution to coarse aggregate reduces strength but it can be balanced by other by-products.

So the use of such type of concrete can be done in Non- Structural member as well as structural member.

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