Comparative Assessment of Waste Tyre Rubber in Concrete Properties

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Abstract – Infrastructure is one of the indicators of a country's growth, and India is no exception. In recent years, the Indian government has placed a high priority on infrastructure development. One of the primary contributors in this regard is plastic waste. Waste tyres are also a significant contributor to plastic waste. Many scientists, organizations, and individuals are attempting to solve the problem of plastic waste through trial and error. The paper looks into the use of Waste tyres in concrete as a partial fine aggregate replacement in concrete grades, as a way to reduce tyre waste while also conserving aggregate resources.

Key Words: **Plastic waste, Waste tyre, Aggregate replacement**

1. INTRODUCTION

The increase in construction activities is boosting cement demand significantly; demand for cement from engineering is increasing rapidly as a results of the government's increased investment within the residential and structure sectors, and these factors enable cement manufacturers to supply cement on an outsized scale, thereby increasing consumption volume. India's infrastructure and construction sectors have lots of room for growth, and also the cement industry is probably going to profit greatly from it. Some recent initiatives, like the creation of 98 smart cities, are projected to produce the arena a big boost. Aggregate is one in every of the foremost important components utilized in the manufacture of concrete. Aggregates are the foremost extensively used material after water and soil. As a results of the necessity to preserve natural resources and protect the environment, many other materials are exploited or use as aggregates in concrete. voluminous waste tyres discarded and cultivated throughout a heavy threat to the ecological environment. Management of waste-tyre rubber is difficult to handle because the waste tyre rubber isn't easily biodegradable. Several studies are conducted in recent years on the utilisation of assorted shapes and sizes of discarded tyres in concrete. In scientific literature, a mix of normal concrete and rubber from recycled tyres has been said as "Rubber Concrete" or "Rubber Modified Concrete."

In this study, "Crumb Rubber" was substituted by fine aggregate volume as a percentage of the total volume of "Crumb Rubber," as indicated by different writers in their research papers by different ratios. Many tests for hard concrete (i.e. Compressive strength, Flexural strength test) were conducted by these many authors for various grades of concrete used in everyday life.

2. STUDY ON WASTE TYRE RUBBER FROM PREVIOUS RESEARCH PAPER

A) Waste Tyre Rubber Replaced Concrete

Research has begun to determine the feasibility of incorporating shredded rubber crumbs into Ordinary Portland Cement (OPC) concrete. The workability and strength qualities of concrete including crumb tyre rubber as a partial replacement for fine aggregate will be shown in this study. It is apparent that when rubber substitution rises, the compressive strength of M20 grade concrete diminishes. Rubber-replaced concrete in M20 grade concrete performs admirably, with up to 6% replacements nearly achieving the specified mean compressive strength. With a 2% rubber aggregate substitution, the specimen is nearly identical to the standard specimen. The difference between 4% and 6% replacements is relatively small. In the lot, the 10 percent substitution of crumb rubber achieves a compressive strength of 28 days that is much lower than the 77% performance of the traditional cube. All percentages of substitutions of crumb rubber achieve greater than 80% of conventional specimen strength in M20 grade split tensile strength. In this case, 4% replacement worked remarkably well, achieving better strength than traditional specimens, and 6% replacement equals the strength of a 28-day conventional specimen.

B) Testing of Strength Parameters

In this study, M25 mix concrete is used to complete the test on a weight basis with waste tyre rubber replacing 0%, 3%, 6%, 9%, and 12% of the coarse aggregate. When compared to traditional specimens, the performance of rubber replaced concrete of M25 grade achieves 88% compressive strength with just 6% substitutions. The performance of 10% rubber crumbs replacement is lower than that of others, but it still reaches 76% of the traditional 28-day cube strength. In M25 grade split tensile strength, all replacements except 8% exhibit a result of 80% or more, while 8% shows a result of 75% using a 28-day conventional specimen. According to the aforementioned talks, the performance of 2, 4 and 6% replacements produced improved compressive strength findings on both classes M20 and M25. All of the replacements outperform the originals in terms of flexure strength. According to the graph, a 6 percent substitution of fine aggregate with waste tyre rubber aggregate results in a steady and significant improvement in all of the aforementioned graphs in both grades of concrete in all of the required strengths.

C) Effect of Waste Tyre Rubber on Properties of Concrete

An attempt was made to create concrete of the grades M20, M25, and M30. The mix design for the requested material details has been completed. The cubes and beams are cast and cured according to normal procedures. We chose the water immersion curing method for the curing procedure, and after 14 and 28 days of curing, we performed compressive strength tests on concrete cubes and third point flexural tests on concrete beams. The influence of waste tyre rubber in compressive strength and fexural strength was investigated by adding different percentages of waste tyre rubber. The study's major goal is to determine whether recycled material can be used in concrete to improve its mechanical qualities. As a solid waste, "Crumb Rubber" can be utilized in concrete as a partial replacement for fine aggregate. In this study, the volume of "Crumb Rubber" was replaced by volume of fine aggregate as follows: 15%, 17.5%, 20%, 22.5%, and 25% volume of "Crumb Rubber" replaced fine aggregate, as indicated by several authors in their research papers. These writers conducted several tests on hard concrete. The samples were analysed after seven and twenty-eight days, and the data and findings are shown in graphs. The results of the Compressive strength and Flexural strength tests for concrete are visually examined. The average compressive strength of concrete for 14 days and 28 days has been examined in this section between concrete without WRT and concrete with various amounts of WRT. Similarly, the flexural strength of concrete is graphically contrasted. The fineness of waste tyre rubber is virtually identical to that of local sand. When compared to local sand, waste tyre rubber has a lower specific gravity. Waste tyre rubber has a lower water absorption rate than local sand. At 28 days curing, waste tyre rubber meets the compressive strength requirements for M20, M25, and M30 grade concrete up to 20% replacement. When compared to normal concrete, the compressive strength produced decreases as the amount of waste tyre rubber increases. When compared to ordinary concrete, the product generated utilising waste tyre rubber has a somewhat reduced flexural strength, with the strength decreasing by around 25% at a 20% waste tyre rubber substitution.

D) Study the Strength Properties of Concrete by Using Tire Waste

The usage of tyre rubber particles as a fine aggregate substitute in concrete is studied in this study. Rubber has been used to substitute fine aggregate in concrete at values of 0%, 3%, 6%, 9%, 12%, and 15%. To examine the varied features of rubberized concrete, six distinct series of concrete mixes were created. With an increase in the proportion of rubber aggregates, there was a gradual decrease in compressive strength. It also suggests that up to 3% rubber particles may be used to concrete mixtures without significantly reducing the concrete's strength. As the percentage of rubber aggregate increases, the percentage of water absorption falls. The purpose of this research is to find the best way to use scrap tyre rubber particles as fine aggregate in concrete composites. Based on the literature, it was determined that adding rubber aggregate to concrete decreases its compressive strength, hence M35 was chosen as the reference mix. On the 7th, 14th, and 28th days after curing, the compressive strength of the product was tested in a compression testing machine. The outcomes are displayed. The inclusion of used rubber tyre aggregate resulted in a gradual decline in compressive strength. It may be inferred from this research that up to 3% rubber aggregate can be used to concrete mixtures without causing significant strength loss. Rubber tyre aggregates can be added to concrete for structural structures, primarily stiff constructions, according to this study. Rubber tyre aggregates, which are a waste product, may be used in concrete construction and are both cost-effective and ecologically friendly.

E) Partial Replacement of Fine Aggregate in Concrete

The purpose of this study is to look at the usage of recycled tyre rubber in concrete mixtures. It may make it easier to manufacture concrete that has a lower environmental effect. Curing is the process of keeping the moisture content and temperature of freshly cast concrete at a constant level for a certain amount of time. For this project, tests are carried out on castings that have been cured for 7 days, 14 days, and 28 days. According to investigations, old tyres are made up of elements that do not disintegrate in the environment and cause major pollution. The use of rubber particles in place of fine aggregate may have a substantial impact on the compressive strength of concrete, causing localised stresses and bonding issues between the rubber particles and the cement mix. Scrap tyres can be processed as whole tyres, silt tyres, shredded tyres, ground rubber, or crumb rubber. Crumb rubber is being utilised as a partial replacement for aggregate in this project. Five types of mixes were investigated, with one control mixture (without rubber) created according to Indian Standard Specification IS:10262-2009 to attain a goal strength of 58.25Mpa. Concrete mixes were prepared by substituting fine particles with 5%, 10%, 15%, and 20% for M50 grade concrete. Compressive Strength values of specimens for 7, 14, and 28 days were found to be lowered by 65%, 50%, and 40%, respectively, Tensile Strength values of specimens for 7, 14, and 28 days were found to be lowered by 70%, 65%, and 58%, respectively. Because the specific gravity of rubber employed is lower than that of fine particles, replacing certain fine aggregates in a concrete mix with powdered rubber reduces the density of the finished product. The modulus of elasticity is reduced when powdered rubber is added to the concrete mix. The reduction in elasticity represents the capacity of rubberized concrete to act elastically when loaded under tension, hence improving conventional concrete failure modes.

3. RESULTS AND DISCUSSION

Although inspired by a necessity to dispose of ever-increasing waste tyres, the use of waste tyre rubber particles in concrete has piqued the interest of concrete material experts due to improvements in thermal insulation, acoustic characteristics, and high strain absorption. The brief review demonstrates that rubber particles can be manipulated to achieve desired concrete strengths. However, it is unclear whether the same can be said about the concrete's longevity. The problem with lowering the air content is that it may reduce some of the beneficial effects of using tyre rubber in concrete. Although an increase in air content appears to result in lower carbonation and chloride durability, research does not indicate if this can be reduced in the case of tyre rubber.

4. CONCLUSION

The addition of rubber aggregate to rubberized concrete resulted in a drop in concrete compressive strength when compared to control concrete, according to the test findings. As the percentage of rubber aggregate was increased, the decrease grew. The absence of adhesion at the borders of the rubber aggregate causes the strength to be reduced; soft rubber particles behave like voids in the concrete matrix.
It can be used in constructions when brittle failure is a possibility. The abrasion resistance of the high strength concrete containing crumb rubber is better than the control mix. As a result, it may be used in pavements, floors, and concrete roads, as well as hydraulic structures like tunnels and dam spillways, and other surfaces where moving things provide abrasive pressures during service. This necessitates a more deliberate effort to administer a series of standardized tests in order to establish a baseline for future testing.

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