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"Transforming Waste Tyre into Sustainable Concrete"

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Abstract - Waste tyre disposal is considered an important environmental issue due to the increased rate of vehicle usage. Waste tyres are considered non-biodegradable materials, causing environmental pollution. This study focuses on utilising waste tyres as an alternative material in sustainable concrete by incorporating crumb rubber as an additional component in the concrete mix. Crumb rubber is treated with sodium hydroxide solution to increase the surface roughness. In this study, crumb rubber is incorporated into the mix design as an additional material in different percentages of volume of concrete mix rather than using it as a replacement material for fine aggregates. Concrete mix is designed using cement, sand, coarse aggregates, sodium hydroxide-treated crumb rubber, and water. Concrete mix is cast into cubes and cured at 7, 14, and 28 days to test their properties. It is found that the addition of sodium hydroxide-treated crumb rubber improves the flexibility and crack resistance of the concrete mix while maintaining sufficient strength properties. It is proved that waste tyre rubbers can be effectively utilized as an additional material in the mix design of concrete to produce sustainable and eco-friendly construction materials.

Key Words: Waste tyre, crumb rubber, sustainable concrete, NaOH treatment, rubberised concrete

I. INTRODUCTION

Due to the increased number of vehicles around the world, there has been a considerable accumulation of waste tyres. These tyres are hard to dispose of because they are non-biodegradable and occupy a lot of landfill space. This has the potential to cause environmental problems like soil pollution, fire risks, and the creation of disease-carrying insects. On the other hand, the construction industry requires huge amounts of raw materials like cement, sand, and aggregate materials. Researchers are always seeking more environmentally friendly alternatives that can improve the quality of concrete. One of the alternatives is the use of crumb rubber obtained from waste tyres. The rubber can be used to improve the flexibility and energy absorption of the concrete mixture. However, rubber particles have a smooth surface that causes poor bonding with cement paste. In order to improve bonding with cement paste, rubber particles can be treated with a Sodium Hydroxide (NaOH) solution that increases the roughness of the rubber particles. In this study, crumb rubber is used as an addition to the concrete mixture instead of replacing the fine aggregate material in volume percentages of the total mixture.

Objectives of the study

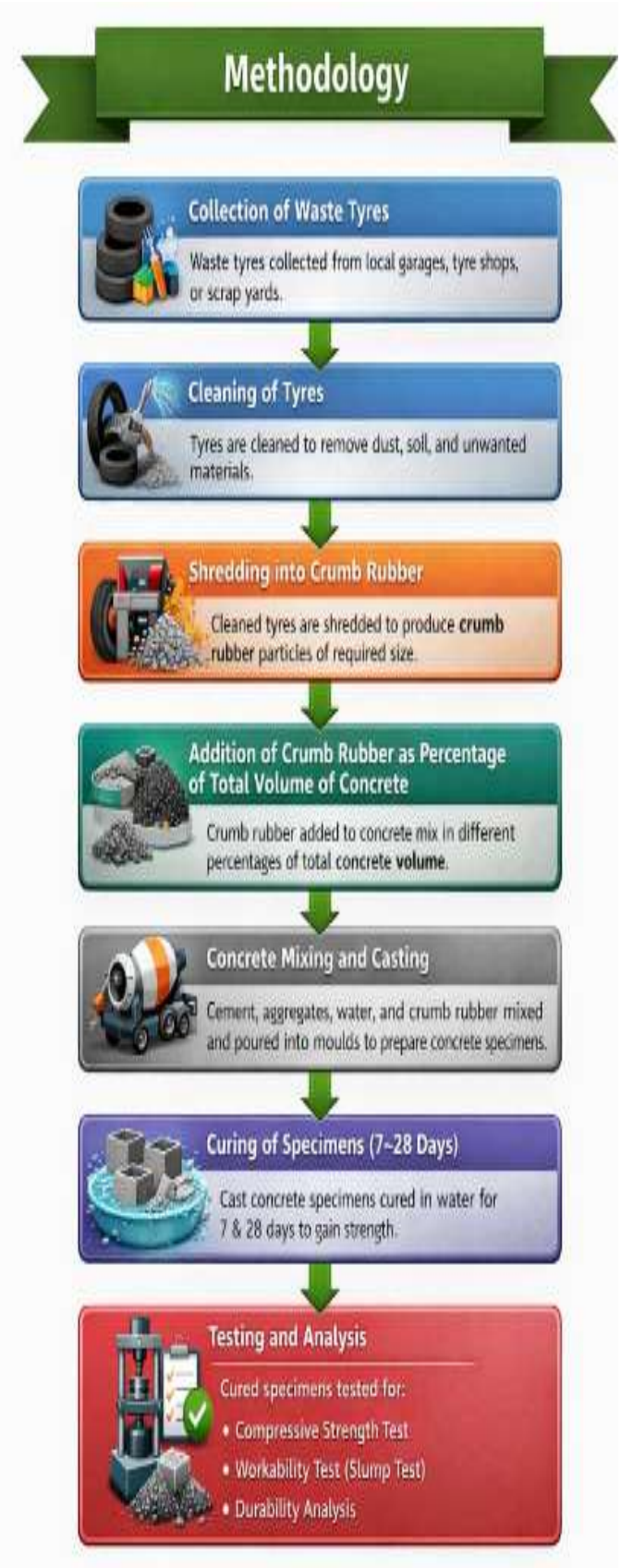
- To use waste tyre rubber for concrete production.
- To use NaOH solution for treating crumb rubber to enhance bonding.
- To use crumb rubber at different volume percentages of concrete as an additional material.
- To test the compressive strength and durability of the concrete.
- To advocate for the use of environmentally-friendly construction practices.

Materials used

- Cement: Ordinary Portland Cement (OPC) is used as the main binding material for the concrete mix.

- Fine Aggregate: M-Sand is used as the fine aggregate for the concrete mix.
- Coarse Aggregate: Crushed stone aggregates are used as the coarse aggregate for the concrete mix.
- Crumb Rubber: Waste tyres are cut into small particles, known as crumb rubber, which are then added to the concrete mix as an additional material, varying in volume percentage.
- Sodium Hydroxide (NaOH): NaOH solution is used to treat the crumb rubber particles before mixing. This helps to improve the bonding capacity of the rubber particles with the cement paste.
- Water: Potable water is used for the mixing and curing of the concrete mix.

II. METHODOLOGY



III. RESULTS

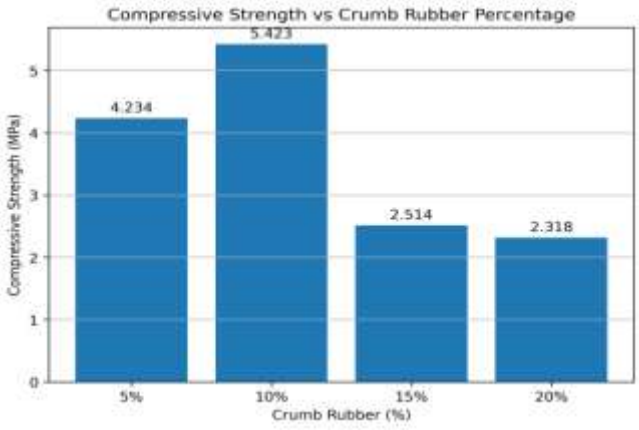


Fig. 3.1Compressive strength after 21 days

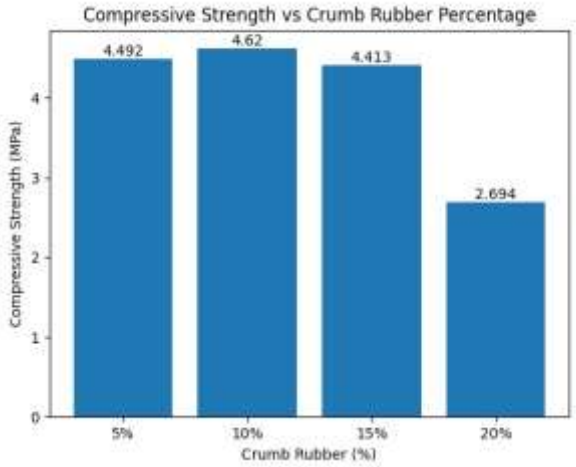


Fig 3.2 Compressive strength after 28 days

From the results, it is observed that:

- The compressive strength increases up to 10% replacement .
- Beyond 10%, strength decreases significantly .
- The reduction in strength is due to weak bonding between rubber and the cement.

However, rubberized concrete shows:

- Better flexibility
- Higher impact resistance
- Improved durability

IV. FUTURE SCOPE

The application of crumb rubber from waste tires in concrete has shown great potential for sustainable construction. For optimum results, it is recommended that crumb rubber is used at an optimum level of 10%, which makes it applicable for construction purposes. In the future, studies can be carried out to enhance bonding and strength using advanced technologies. This type of concrete can be used for pavements, footpaths, sound barriers, and impact resistance due to its flexibility. It can also contribute to waste disposal and environmental protection, hence being an eco-friendly material.

V. CONCLUSION

From the experimental study, it can be concluded that crumb rubber can be used as a substitute material for fine aggregate in the production of concrete. The optimum percentage of crumb rubber is 10%, as it provides the highest compressive strength.

It is observed that the percentage of crumb rubber more than 10% decreases the compressive strength of concrete. However, it can be used for the production of flexible, durable, and impact-resistant rubberized concrete.

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