STUDIES ON USE OF CRUMB RUBBER IN CONCRETE FOR ACOUSTICAL INSULATION PURPOSES

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College ***:*** *B.V.V. Sangha's Basaveshwar Engineering College, Bagalkot*
Branch ***:*** *Department of Civil Engineering*
Guide(s) ***:*** *Dr. Santhosh M Malkapur*
Student(s) ***:*** *Mr. Veeresh Nagappa Hunagund*
Mr. Hebbalappa Hanamant Naik
Mr. Babu Rangappa Kambar
Mr. Gandla Sujith Bhushan

Keywords:
Crumb Rubber, Crumb Rubber Concrete (CRC), Acoustics, Decibels and Strength

Introduction / background:

Solid waste management is one of the major environmental concerns in the world. Waste tyres represent 2% of total annual solid. Waste tyres are extremely durable, not naturally biodegradable and their burning causes environmental pollution. There is a great need to recycle the waste rubber and make value added products out of it and avoid burning to mitigate air pollution. One such method is use of waste rubber as a sound absorbing material in the concrete mix.

Sound absorption is a phenomenon of loss of sound energy when the sound waves come into contact with material. In places like roofs and walls of auditoriums, concert halls, theatres etc, the excessive sound, its prolongation and resonance is highly undesirable. Hence sound absorbing materials are used to avoid sound reflection and reverberation. In the present work, it is proposed to study the sound absorbing characteristics of the concrete mixes incorporated with different dosages of crumb rubber. The crumb rubber is used as a partial replacement to fine aggregates.

Objectives:

1) To test all the ingredients of concrete mixes for their physical and chemical properties.
2) To evaluate the strength properties of concrete mixes made with crumb rubber.
3) To study the acoustical insulation properties of concrete mixes made with crumb rubber and to optimize the mix proportions for maximum insulation with acceptable strength characteristics.

Materials & Methodology:

Materials: Ordinary Portland cement, coarse aggregates, Fine aggregates, Crumb Rubber and Sound Absorbing Materials for Acoustic Insulation Box.

Fig.1. Crumb Rubber

Methodology:

1. Collection of materials i.e. crumb rubber, cement, sand, coarse aggregate.
2. Conducting tests on all the ingredient materials for basic properties.
3. Proportioning the mixes for various dosages of crumb rubber on trial basis.
4. Fabrication of in-house equipment for measuring the acoustical insulation properties of concrete mixes incorporated with crumb rubber.
5. Casting and curing of different specimens (cubes and slabs).
6. Testing of specimens for strength properties.
7. Testing of specimens for acoustical insulation properties.
8. Optimization of the mix proportions for maximum noise insulation and acceptable strength characteristics.

Details of the work carried out:

The Crumb Rubber for the present work is collected from Shree Hanuman Traders, Bagalkot. The basic tests on crumb rubber are carried out. To evaluate the compressive strength the 100×100×100 mm cubes were cast with different percentages of replacement of fine aggregates by crumb rubber. The crumb rubber is replaced up to 50% by volume of the fine aggregates.

For evaluating the acoustic properties, an acoustic insulation box set-up is fabricated in-house by utilizing different sound absorbing materials such as sponge, jute and cotton fibres and cotton waste. Slab moulds of size 250 ×250×100 mm were made using plywood for casting the slabs for testing acoustic properties. The acoustic insulation properties have been evaluated for 7 days and evaluation for 28 days is awaited.

Results and Conclusions:

The results of the 7 days compressive strength of the specimens are presented in Fig.2. The 28days strength results are awaited. Based on these initial results, it is found that with increasing dosage of the crumb rubber, the compressive strength tends to decrease. A maximum of 66% strength reduction is observed for the mix with 50% replacement of crumb rubber. The reduction in strengths was found to be 45.5%, 49.2%, 53%, 64.3%, 66.2% respectively for 10, 20, 30, 40 and 50% crumb rubber.

When tested for acoustic properties, in general it is found that the sound absorption (insulation) capacity is found to increase with increasing dosage of the crumb rubber. A maximum of 39% reduction in sound is observed for the mix with 50% replacement of crumb rubber. The reduction in sound was found to be 3.38%, 5.40%, 13.52%, 30.81%, 39.2% respectively for 10, 20, 30, 40 and 50% crumb rubber.

The 28days results for acoustic properties are awaited.
However with the available initial results it can be said that the crumb rubber can be effectively used as a sound absorbing material in concrete mixes.

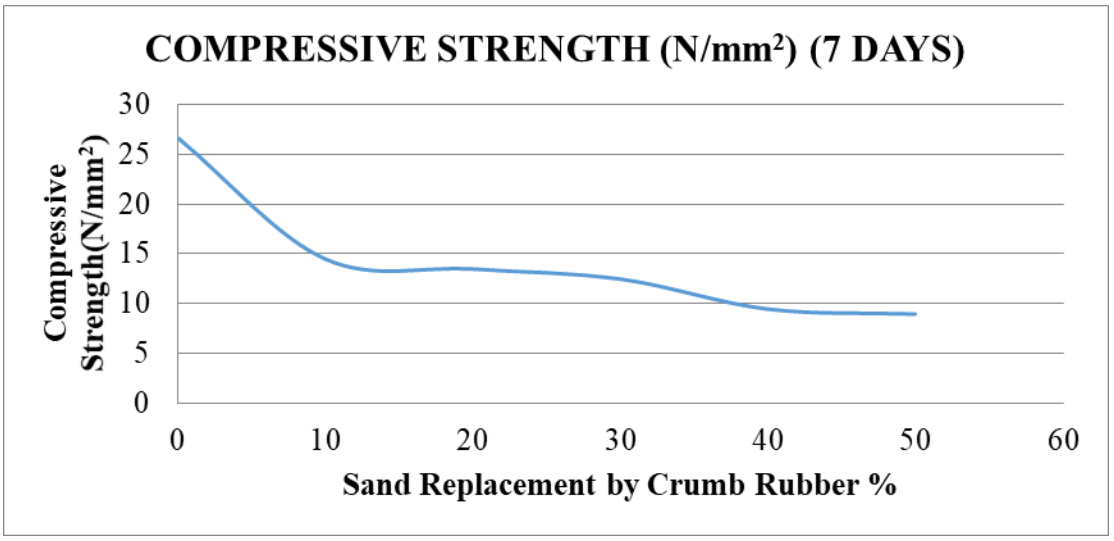

Fig.2 Compressive Strength of Specimens (N/mm^2) (7 Days)

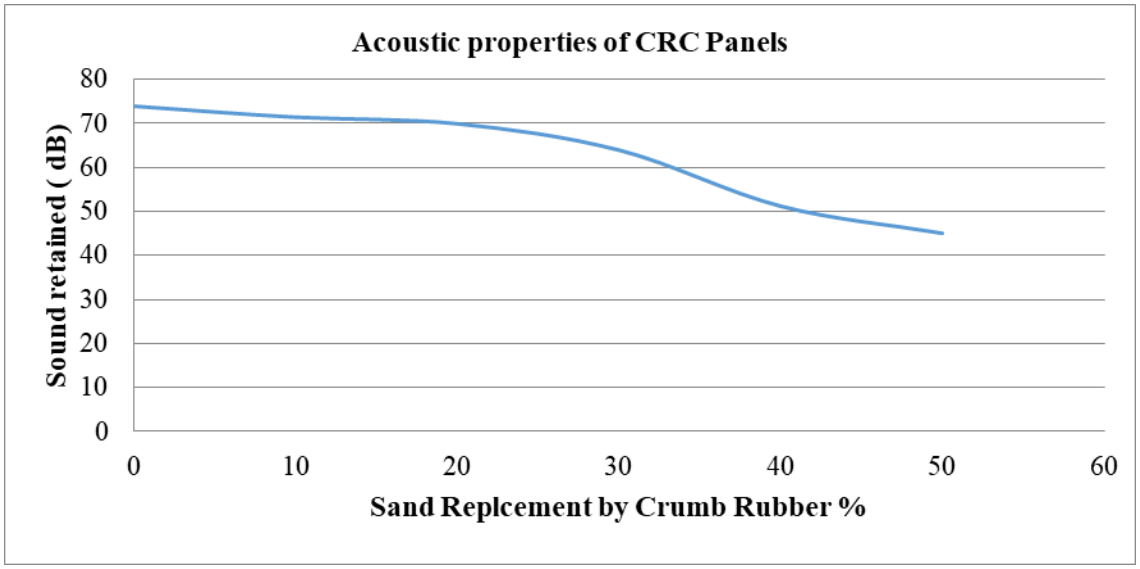

Fig.3 Acoustic properties of CRC Panels

Conclusion:

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Scope for future work:

Waste rubber tyres are adversely affecting the environment so there is a need to make use of the waste tyres. We can use the crumb rubber as partial replacement of fine aggregates. Using crumb rubber in concrete found to be effective in absorbing sound and can be used for acoustical insulation purposes. Panels made with crumb rubber can be used as claddings in auditoriums, concert halls, theatres. Crumb rubber concrete panels can also be used in high traffic areas to reduce disturbance.

The CRC shows that it is slightly more expensive than conventional concrete depending on the availability of shredded tyres and their local price. However, looking at the life cycle cost, a rubberized concrete structure can provide cost effectiveness performance compared to a conventional concrete structure. This is due to the advantages of using rubber in concrete that including lower maintenance cost, providing environmentallyfriendly solutions in structures with high dynamic properties, increasing the structure sustainability, saving energy and natural resources, and reducing/eliminating the adverse effects of dumping end-of-life tyres to land fil.