Concrete using recycled tire rubber promises boost for circular economy

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Concrete mixing using recycled tyre rubber particles for the complete replacement of traditional coarse aggregates. Credit: Mohammad Islam, RMIT

Engineers have discovered a way to replace 100% of conventional aggregates in concrete—such as gravel and crushed rock—with rubber from discarded tires that meets building codes, promising a boost for the circular economy.

The team from RMIT University says the new greener and lighter concrete also promises to reduce manufacturing and transportation costs significantly.

Small amounts of rubber particles from tires are already used to replace these concrete aggregates, but efforts to replace all of the aggregates with rubber have produced weak concretes that failed to meet the required standards—until now.

The study published in the journal*Resources, Conservation and Recycling* reveals a manufacturing process for structural lightweight concrete where the traditional coarse aggregates in the mix were completely replaced by rubber from used car tires.

Lead author and Ph.D. researcher from RMIT University's School of Engineering, Mohammad Momeen Ul Islam, said the findings debunked a popular theory on what could be achieved with recycled rubber particles in concrete.

"We have demonstrated with our precise casting method that this decades-old perceived limitation on using large amounts of coarse rubber particles in concrete can now be overcome," Islam said.

"The technique involves using newly designed casting molds to compress the coarse rubber aggregate in fresh concrete that enhances the building material's performance."

The RMIT team's new casting technique generates structural lightweight concrete from used tyre rubber. Credit: Mohammad Islam, RMIT

Greener, cheaper and lighter building materials

Study co-author and team leader, Professor Jie Li, said this manufacturing process will unlock environmental and economic benefits .

"As a major portion of typical concrete is coarse aggregate, replacing all of this with used tire rubber can significantly reduce the consumption of natural resources and also address the major environmental challenge of what to do with used tires," he said.

Used tires in Australia cannot be exported, making new methods for

recycling and reprocessing them locally increasingly important. About 1.2 billion waste tires will be disposed of annually worldwide by 2030.

The greener and lighter concrete could also greatly reduce manufacturing and transportation costs, Li said.

"This would benefit a range of developments including low-cost housing projects in rural and remote parts of Australia and other countries around the world."

Next steps

The team's manufacturing process could be scaled up cost effectively within a precast concrete industrial setting in Australia and overseas, Islam said.

Following successful testing in the workshop, the team is now looking into reinforcing the concrete to see how it can work in structural elements.

More information: Mohammad Momeen Ul Islam et al, Design and strength optimization method for the production of structural lightweight concrete: An experimental investigation for the complete replacement of conventional coarse aggregates by waste rubber particles, *Resources, Conservation and Recycling* (2022). DOI: 10.1016/j.resconrec.2022.106390

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