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Recycled glass in concrete mixture used to 3D print structure for the first time

The bottles containing recycled glass are grinded down to different sizes ST PHOTO: NG SOR LUAN

Mechanical and Aerospace Engineering (MAE), the principal investigator of the study, said: "Seventy per cent of glass is made up of silicon dioxide... What our research does is to essentially return the silica found in glass to be reused again as sand in our 3D printing concrete mixture."

According to the National Environmental Agency, only 13 per cent of Singapore's 74,000 tonnes of glass waste generated was recycled in 2021.

Most of it finds its way into incinerators before being disposed of in a landfill, with the residual glass remaining intact as it is non-biodegradable, said Prof Tan.

He added that recycling glass in this way allows the built environment sector to participate in the circular economy by creating new uses for waste products, thereby making it more sustainable.

While scientists elsewhere have described the use of glass in concrete mixtures, none of them have been able to successfully 3D-print a structure using a glass-based mixture, said Mr Andrew Ting, the lead author of the study.

This is because glass that is crushed is made up of irregular-sized grains that could be too large or too small to be used with a 3D printer.

As part of the study, the team at NTU separated the glass grains into different sizes to find the optimal formulation for the concrete mixture.

The resulting mixture could be successfully used to 3D print the bench, and the team said on Tuesday that this sustainable mixture could eventually be used to print components for other infrastructure projects, like bridges and modular components for buildings.

The study will be published in the Journal of Building Engineering in June.

Substantial pushes towards a greener built environment are being made in Singapore, where buildings account for over 20 per cent of all Singapore's emissions according to the Building and Construction Authority (BCA).

Part of the Singapore Green Plan 2030, the nationwide sustainability strategy, is to reduce the amount of carbon emissions incorporated into the construction of a building.

Researcher Andrew Ting preparing a mixture with recycled glass that will be used in 3D-printing benches. ST PHOTO: NG SOR LUAN

This can take the form of using sustainable construction materials, like insulation material grown from mushrooms, among other things.

Prof Tan said: "Compared to industries like agriculture and manufacturing that have gone through numerous revolutions, the construction industry is still stuck in the stone age."

He added that the use of sustainable materials and automation through robotics could make construction more humane and productive.