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NTU team 3D-prints bench using recycled glass mixture

Innovation could lead to more glass being recycled for use in building and construction

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Scientists from Nanyang Technological University (NTU) have 3D-printed a bench from a concrete mixture containing recycled glass in a move that could pave the way for more glass to be recycled for use in building and construction.

The specially formulated material used for the 40cm-tall L-shaped bench exceeded the minimum strength required – 30 mega pascals – to be used in construction projects like heavy traffic driveways.

Concrete used in construction is mainly a mixture of cement, aggregates like sand and gravel, and water. The new mixture made by NTU is a combination of crushed glass, water and cement.

The team said the crushed glass in its mixture can fully replace the sand in concrete for 3D printing.

In construction, 3D printing is a recent development that has made the process faster, cheaper and less labour-intensive. Such 3D printing with concrete was used in the construction of landscape furniture, like benches, in the Tengah and Bidadari estates.

Professor Tan Ming Jen from NTU's School of Mechanical and Aerospace Engineering (MAE), the principal investigator of the study, said at a media briefing on Tuesday: "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 last year was recycled.

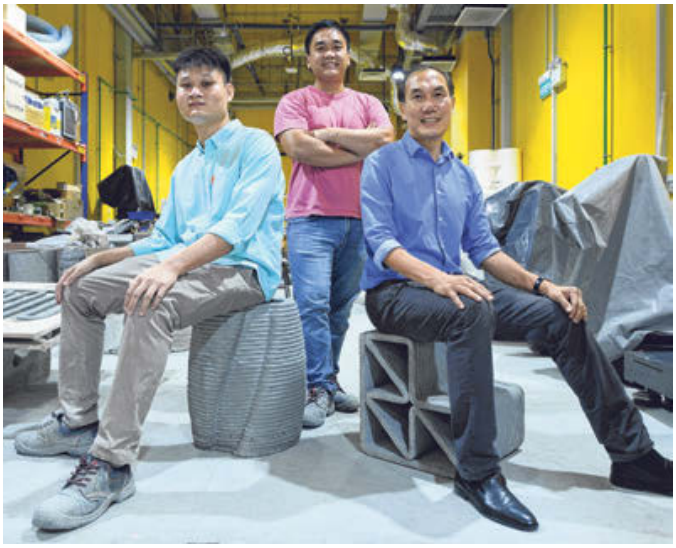
Most of it finds its way into incinerators before being disposed of in a landfill, with the residual glass remaining intact as it is non-biodegradable, said Prof Tan.

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 the sector more sustainable.

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



(From left) Researcher Andrew Ting from the Singapore Centre of 3D Printing at Nanyang Technological University (NTU), research fellow Daniel Tay from NTU's School of Electrical and Electronic Engineering and Professor Tan Ming Jen from NTU's School of Mechanical and Aerospace Engineering, with a 3D-printed vase and bench. ST PHOTO: NG SOR LUAN

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 of Singapore's emissions, according to the Building and Construction Authority.

Part of the Singapore Green Plan 2030, the nationwide sustainability strategy, is to reduce the amount of carbon emissions linked to the construction of a building. This can take the form of using sustainable construction materials, such as insulation material grown from mushrooms, among other things.

Prof Tan said: "Compared with 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.

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