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(From left) Research assistant Manikandan Jayaraj, PhD student Souradeep Gupta, research assistant Chakradha Pedapati and Dr Kua Harn Wei with biochar, a material produced when heat is used to decompose sawdust, and a concrete column containing biochar. Using biochar is also environmentally friendly, by helping to recycle wood waste. ST PHOTO: NG SOR LUAN

New green method to strengthen buildings

NUS team turns wood waste into biochar, which makes concrete stronger and more impermeable

Ervin Tan

Researchers from the National University of Singapore (NUS) have found a way to use wood waste to strengthen building materials.

The new method uses biochar, which is a material produced when heat is used to decompose sawdust.

The researchers from the School of Design and Environment said when biochar in powder form is combined with cement, it increases concrete's strength and impermeability, which refers to the ability to prevent water from passing through.

Dr Kua Harn Wei, one of the four involved in the research, explained how biochar works. The lead researcher said that usually, water is added to powdered concrete to create a wet mix in a process called hydration. The problem is that during the process, water evaporates, weakening the mix.

But the researchers found that when biochar is added, the mix is better at retaining water, which in turn produces stronger concrete.

Biochar in powdered form also plugs gaps that exist within the concrete mix, reducing water seepage through cracks that might form when it is set. The researchers found that adding biochar strengthened the concrete mix by 20 per cent and its impermeability by 50 per cent.

The NUS team conducted experiments and found that a 50mm cube of pure concrete could take about 72.6 kilonewtons (kN) of force before cracking, withstanding the weight of about 119 people whose average weight is 62kg each.

But when biochar was added, it took about 83kN of force, withstanding the weight of about 137 people.

The researchers said using biochar is also environmentally friendly, by helping to recycle wood waste.

In 2016, more than 530,000 tonnes of wood waste was produced in Singapore, mainly from furniture factories, which was previously either incinerated or disposed of.

Dr Kua believes that the new method will help to alleviate some of Singapore's existing structural problems.

For example, Ministry of National Development data shows that more than six out of every 10 cases brought to the Strata Titles Board from 2014 to 2016 involved water leakage issues between unit owners.

"This is a simple and affordable strategy to enhance our building structures," said Dr Kua.

"Particularly in Singapore, this will help to reduce the problems of water leakage from rain and water pipes that could potentially seep through our concrete ceilings."

The team from NUS is currently in discussions with companies and government agencies to commercialise this technique, as well as researching further on cement composites to serve wider applications.

NUS' new technique adds on to Nanyang Technological University's own research on waste management and reuse, as both universities seek to develop greener building materials.

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