

Found: Powerful ways of reusing waste



From left: Dr You Siming, 31, (holding biochar) Mr Ng Wei Cheng, 27, (holding soil sample) Professor Wang Chi-Hwa, 52, (holding horse manure with wood bedding) and Mr Shen Ye, 25 (holding wood chips) from the National University of Singapore's department of chemical and biomolecular engineering have published about 20 papers on the use of gasification to produce synthesis gas, which produces electricity, and biochar, which can improve soil quality. ST PHOTO: JONATHAN CHOO

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NUS team turns animal manure into synthetic gas and biochar

Samantha Boh 

Professor Wang Chi-Hwa is a firm believer in second chances, and breathing life into waste matter.

Inside his laboratory are bags of waste, including animal manure, which he has been experimenting on for the past five years.

Recently, he managed to turn horse and chicken manure into synthesis gas (syngas) to produce electricity, and biochar which can be used to treat water.

He and his team at the National University of Singapore's (NUS) department of chemical and biomolecular engineering have published about 20 papers on the subject.

The horse manure was from Singapore Turf Club, and the chicken manure from local chicken farms.

Instead of being incinerated, the waste went through a process called gasification, where it was converted into a mixture of hydrogen and carbon monoxide - syngas.

Prof Wang explained that animal manure has high ammonia content, which is considered an environmental pollutant.

In his experiment, the ammonia is leached out and turned into fertiliser, while the remaining solid waste is placed in a gasifier, where it reacts with little or no oxygen, and is broken down into smaller molecules which can be converted into syngas.

USEFUL APPLICATION

If I gasify 10kg of animal manure, it will generate 10 kilowatt of electricity. This means burning the waste for an hour will be enough to light a 60-watt light bulb for 167 hours (a week's duration). This is very valid for undeveloped areas where you have no power. If you need to run medical devices, or a fridge to store medicine for instance, you just need some waste and you can have electricity.

PROFESSOR WANG CHI-HWA, on how the gasification process is especially useful for places without ready access to electricity.

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soil quality.

Their eight-week experiment on Adinandra belukar soil - a type of acidic and nutrient-poor soil that can be found in the NUS Kent Ridge campus - discovered that biochar, produced from wood chips, helped to improve the soil quality.

Adding one part of biochar to two parts of the soil, for instance, improved the growth of water spinach. They were four times taller, 10 times heavier and had leaf surfaces which were five times larger compared with those grown in pure Adinandra belukar soil.

He noted that agricultural and horticulture waste and animal manure can also be used, though sewage sludge that contains heavy metals and chemicals should be avoided.

Prof Wang said the next step is to test his findings on a larger scale. The National Parks Board (NParks) and the Agri-Food and Veterinary Authority of Singapore (AVA) have expressed interest in this research.

The AVA said it is in discussions with NUS to explore the use of biochar as a soil conditioner.

Meanwhile, Dr Subhadip Ghosh, senior researcher (urban soils) at NParks' Centre for Urban Greenery and Ecology (Research), said NParks is working with NUS to investigate the potential of different types of biochar generated from different biomass wastes in improving the yield of leafy vegetables. It is also researching the use of biochar to enhance plant growth in Singapore.

He said: "Our short-term research shows biochar has potential to improve urban soil quality and tree growth. Research is in progress to verify and monitor its long-term benefits to our planting practices."

"If I gasify 10kg of animal manure, it will generate 10 kilowatt of electricity. This means burning the waste for an hour will be enough to light a 60-watt light bulb for 167 hours (a week's duration)," he said.

It does not seem like much, but there is a place for this, Prof Wang said. "This is very valid for undeveloped areas where you have no power. If you need to run medical devices, or a fridge to store medicine for instance, you just need some waste and you can have electricity."

The gasification process also produces biochar, a form of charcoal, which can be used in water treatment to remove contaminants such as artificial sweeteners, he said.

Prof Wang noted however, some limitations to the process including the need to dry the waste before it can be gasified. A paper on this research was published in scientific journal Energy in July.

His team has also found that biochar can improve soil quality.