Asian Journal of Scientific Research

ISSN 1992-1454

science alert
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Wake Up and Smell the Willow

More plant matter could be burned in coal-fired power stations if this 'green' fuel was delivered pre-roasted like coffee beans, according to researchers from the University of Leeds, UK.

Many UK power stations are now burning plant matter, or biomass, as well as coal in a bid to cut their carbon footprint. Unlike fossil fuels, plants like willow, Miscanthus and poplar are a virtually carbon-neutral source of energy: the carbon dioxide emitted when they burn is absorbed during photosynthesis by the next batch of 'energy crops' planted in their place.

But the environmental benefits of biomass are countered by some real practical and economic challenges that are forcing power stations to restrict the amount of biomass used. Biomass is moist and bulky, making it relatively expensive to transport and difficult to store for long periods without going mouldy. The fibrous plant matter is also extremely difficult to process in the mills that are used to grind dry lumps of coal into dust before they are burned.

A roasting process known as torrefaction is the answer, according to Professor Jenny Jones and colleagues from the University of Leeds' School of Process, Environmental and Materials Engineering. This process, which sees the plant matter heated to around 300 degrees centigrade in an air-free container, transforms bulky biomass into a dry, energy-rich fuel that is cheaper and easier to move around and has a much longer shelf life.

A study of two common energy crops, willow and Miscanthus, has also shown that when the plant matter is 'torrefied' it can be ground into a powder just as easily as some good quality coals. This makes it far more practical and cost-effective to replace containers of coal with biomass in existing power stations.

Team members are now exploring whether the torrefaction process can be scaled up, with a view to producing a design 'blueprint' for industrial engineers.

"If we can show that torrefaction is feasible on an industrial scale then we would hope to end up with a demonstration plant here in the UK," Professor Jones said. "We already know that many more farmers would be interested in growing energy crops on areas of poorer quality soil, if the economic barriers were lowered and the power companies could use more biomass without losing out financially."

The project will address outstanding questions about the safety, practicality and environmental impact of large-scale torrefaction. For example, researchers will find out what the liquid and gaseous by-products of the roasting process are made up of. They will also assess how likely it is for dust generated by the roasting and milling processes to trigger explosions.

"It is well known that fine powders can cause violent explosions under certain conditions. We will be carrying out experiments to characterise the explosibility of biomass and torrified biomass powder so that appropriate safety features can be designed into industrial-scale powder handling and power generation plants," said University of Leeds Researcher Dr Roth Phylaktou, an Expert on fire and explosion safety engineering and a Co-investigator on the project.

The researchers will work with a range of different materials that could potentially replace coal in future. These include energy crops such as willow and Miscanthus, which are grown specifically for making 'green' fuel, as well as waste plant matter from forestry plantations and farms, such as the branches of harvested pine trees and straw.

"These are all materials that grow well in the UK but not at the expense of food crops," said Professor Jones. "We do not want farmers to have to choose between planting a field of wheat or barley and a field of willow. Ultimately, this is all about providing a secure energy supply for the future and one that is sustainable on all levels."

The project is being funded by the Engineering and Physical Sciences Research Council. The work is being carried out in collaboration with Alstom Power, Drax Power, EON and RWE nPower.

The team of engineering researchers at Leeds includes Professor Jenny Jones, Professor Alan Williams, Professor Gordon Andrews, Dr. Roth Phylaktou and Dr. Leilani Darvell.

Source:
(The above story is reprinted from materials provided by University of Leeds, via EurekAlert!, a service of AAAS).