Agricultural waste could power fuel cells for clean energy

Agricultural waste (such as plant stalks) is an accepted energy source for second-generation biofuels. Recently, Greek scientists have recognised the potential to use biological material, including agricultural waste, for fuel cells. This technology has potential to provide decentralised, renewable heat and power and may become a major technology for power generation in the coming decades because it achieves high efficiencies with low emissions.

Renewable energy sources have an increasingly important role in future sustainable development, with the protection of the environment and security of energy supply the main driving forces in the short term. In the medium to long term, fuel cells have a strong energy saving potential for decentralised co-generation and power production, and could play a major role in future energy supply.

Waste from diverse crops including rice, wheat, cotton, beet and fruit trees can be used to produce electricity by solid oxide fuel cells (SOFC) run on biogas (gas from biological sources). ‘Biomass gasification’ involves heating and adding a combination of oxygen, air or steam to plant waste to convert it into a gas, comprised mainly of hydrogen and carbon monoxide. Fuel cells are an efficient method to turn this chemical energy into electricity. The main waste product is water.

SOFC are a type of fuel cell based on yttrium-stabilized zirconia and a nickel catalyst. SOFC operate at high temperatures (600-1000 degrees C) and do not need pure hydrogen fuel, making them very flexible. Waste heat can also be used for other processes, including the gasification reaction of the agricultural waste to provide the fuel gas.

As well as being efficient and reliable, SOFCs are silent and can use a variety of fuels (including natural gas and coal, as well as biogas), unlike some other types of fuel cell. This is an attractive feature in a scenario where society is shifting its sources of fuel gradually from fossil fuels to biomass. However, they are also expensive and time consuming to install. Combining steam gasification with SOFC technology is one way to cut the cost of the gas reforming stage.

Combining biomass gasification with SOFCs has promise for electricity and heat cogeneration, as well as environmental and socio-economic benefits. Drivers for adopting this technology, particularly in remote rural areas, are both environmental and financial, since connection to the grid can be expensive in such areas and biogas can be produced on site with no significant extra costs.

Despite the benefits of fuel cells, their potential to become a viable option depends primarily on the cost of the system. Fuel cells need to become more cost-competitive compared to conventional power-generation systems before they can be widely adopted.

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