POC-11-wright-C1net-public-summary-report

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Optimizing low cost C1/C2 compound production and fermentation from biomass solid waste

According to the Department for Business, Energy and Industrial Strategy (BEIS), the energy demand in the UK currently is approximately 1600 TWh per year. About 40% of this energy is currently supplied using natural gas as the primary energy source. The use of natural gas as a primary fuel type is attractive as natural gas has the highest fuel efficiency and produces 50% less carbon dioxide emissions when compared to coal. Therefore, increasing use of natural gas as a primary energy type will help the UK move closer to a low carbon economy. However, increased reliance on natural gas as a fuel source is unsustainable as natural gas is a fossil fuel and thus a non-renewable resource. Growing energy consumption in the UK coupled with need for reducing reliance on fossil fuels and reducing greenhouse gas emissions, makes finding sustainable alternatives to natural gas extremely essential.

Biogas is similar to natural gas, given that both of these are predominantly made up of methane. Whilst natural gas is a fossil fuel, biogas is produced by the anaerobic digestion (AD) of lignocellulosic wastes such as agricultural waste, forest waste, municipal solid waste and household waste. Therefore, biogas is a renewable resource and can replace the use of natural gas in energy production.

The UK produces over 100 million tons of lignocellulosic waste per year that can be use in AD. The theoretical yield calculations based on cellulose content of lignocellulosic waste suggests that 90% of bioenergy can be recovered in the form of methane, representing about 225 TWh of energy i.e. approximately 14% of UK's current energy demand. However, in the present scenario, AD alone cannot justify commercial production of value added products such as biogas. Apart from inherent limitations of AD, the major challenge in the commercial development of AD and subsequent production of methane can be mainly attributed by recalcitrant nature of lignocellulosic biomass, particularly the presence of lignin. This necessitates the use of expensive pre-treatments before efficient biogas production by AD. Such expensive pre-treatments make biogas production through AD cost prohibitive.

In this project, we proposed the development of a novel "pre-composter and anaerobic digester" (PCAD) unit for the efficient production of methane with concomitant production of acetic, butyric and propionic acids, which are commonly used as starting materials in many manufacturing processes. We therefore contend that the PCAD technology is commercially viable process for biogas production and will aid the UK in achieving a sustainable, low carbon economy.