Renewable Energy

Feasibility and Viability Study of the Use of Biogas in Fuel Cells for Electricity Generation

A. Introduction:

Fuel cell systems has been an exciting emerging trend in power generation which could offer solutions to the energy crisis in the future.
One of the major impediments to the adoption of renewable energy sources such as wind, wave and solar is that they can not produce power on demand.
Fuel cells offer freedom from these limitations. Their fuel can be pure hydrogen, methane (biogas), methanol, ethanol and bio-diesel.

Fuel cell technology converts chemical energy directly into clean electrical energy, DC power that can be transformed to AC power. It is more environmentally friendly than other power generation methods.

The technology has been developed for both electricity generation and transport.
There are six types of fuel cell currently available. But there are four types that are flexible which can use all types of the above mentioned biofuels. They are Polymer Electrolyte Membrane Fuel Cells (PEMFC), Molten Carbonate (MCFC), Direct Methanol Fuel Cells (DMFC, commercially established), and Solid Oxide Fuel Cells (SOFC). Their system outputs range from 1 kW to 3 MW.

The most efficient one out of the four is the Solid Oxide Fuel Cells considering its running cost and durability etc.

Biogas can be produced in a digester (anaerobic process) from bio-waste such as manure, agricultural waste, food waste (from home or processing plant), sewage (waste water from food processing factory), weeds (freshwater and sea) or directly from landfills, etc.
The gas obtained is mainly methane. Other gases (by-products) are eliminated by the heat in the process thus reducing the cost of purification.

For domestic consumption fuel cells with an output of 5 kW is a viable size. A higher output may be required for farm use, i.e. drier, milking parlour, aeration fan etc, depending on the system output. If Solid Oxide Fuel Cells (SOFC) or Direct Methanol Fuel Cells are used their by-product of high temperature heat can be used directly in a standard steam turbine.

B. Aim
The aim of the project is to study technically and economically the use of biogas in combination with fuel cells.

C. Objectives:
1. Feasibility study and analysis on the use of biogas in fuel cells:
    - To identify types and quantity of organic waste produced in selected areas in Thailand.
    - To assess possible methods to transform this waste into biogas.
    - To establish types of biogas obtained from each method.
    - To assess types of fuel cells most suitable for working with biogas.

- To compile past and current research and studies carried out in Thailand and elsewhere in the world on the use of biogas in fuel cells.

2. Viability study and analysis on the use of biogas in fuel cells.
   -To establish biogas production costs for different waste materials and methods used.
   -To compile fuel cell manufacturers' recommendations or specifications for biogas compatibility to fuel cell types.
   -To establish the costs of selected fuel cells.
   -To design and analyse the overall cost of the entire electricity production system.
   -To evaluate the viability of the project, based on required basic data and comparisons with other countries regarding this promising technology.

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