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The future aspects of power generation through high temperature fuel cells (MCFCs) verses other fuel cells

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Abstract:

In this paper the comparative study of power generation through high temperature fuel cells that is Molten Carbonate fuel cells are presented .The MCFCs is not best power generation source compare to other fuel cells for all conditions and places. But it is the better alternative source of power generation coupling with gasification process. The generating renewable electricity is an important way to reduce carbon dioxide (CO_2) emissions and many countries are installing wind and solar power plants to help meet targets for cutting CO_2. Regarding this direction MCFCs is attractive sources of power generation since in it working no emissions of CO &CO_2. The present aspects of this paper are basic ideas regarding my research works that is Energy modeling and optimization of MCFCs will be appear in next papers.

Key-words: MCFCs, PAFCs, PEMFCs, Clean Energy, Comparative, Development, Applications

1. Introduction:

The Fuel cells are Stationary power generation Device, not having any moving parts Like generators and other engines. Fuel cells are energy conversion devices, they convert stored energy within a fuel into usable energy. A fuel cell uses an electrochemical reaction to extract energy directly in the form of heat and electricity. Molten carbonate fuel cells (MCFCs) are high-temperature fuel cells that operate at temperature of 600°C and above. Since they operate at extremely high temperatures non precious metal can be used as catalysts at the anode and cathode reducing costs. Due to higher efficiency, MCFCs offer significant cost reductions over phosphoric acid fuel cell (PAFCs) approaching 60 percent, considerably higher than the 37-42 percent efficiencies of a phosphoric acid fuel cell . When the waste heat is capture and use, overall fuel efficiencies can be as high as 85 percent. MCFCs don't require an external reformer to convert more energy-dense fuels to hydrogen as require in alkaline phosphoric acid and polymer electrolyte membrane fuel cells. Molten carbonate fuel cells are not prone to poisoning by CO & CO_2

they can even use carbon oxides as fuel making them more attractive for fueling with gases made from coal. The primary disadvantage of current MCFC technology is durability. The high temperatures at which these cells operate and the corrosive electrolyte used accelerate component breakdown and corrosion, decreasing cell life. Scientists are currently exploring corrosion-resistant materials for components as well as fuel cell designs that increase cell life without decreasing performance [1, 2, 3].

2. Historical Developments and application of fuel cells:

The fuel cells is very old direct power generation (devise Sir William Grove 1839). Among the different fuel cells developed so far, molten carbonate fuel cells (MCFC), also referred to as "second generation " cells Kraaij et al.1998 [4].The term fuel cell was first used in 1889 by Charles Langer and Ludwig Mond, who researched fuel cells using coal gas as a fuel. In the late 1950s and early 1960s NASA, in collaboration with industrial partners, began developing fuel cell generators for manned space missions. The Grubb-Niedrach fuel cell was further developed in cooperation with NASA, and was used in the Gemini space programme of the mid-1960s.The 1970s saw the emergence of increasing environmental awareness amongst governments, Substantial technical and commercial development continued in the 1980s, notably in the area of

PAFC [1]. Also in the 1980s, research, development and demonstration work continued into the use of fuel cells for transport applications. In Germany, Japan and the UK, there began to be significant government funding devoted to developing PEMFC and SOFC technology for residential micro-CHP applications. Government policies to promote clean transport also helped drive the development of PEMFC for automotive applications. In 1990, the California Air Resources Board (CARB) introduced the Zero Emission Vehicle (ZEV) Mandate. Fuel cells began to become commercial in a variety of applications in 2007. A large-scale residential CHP programme in Japan helped stimulate commercial stationary PEMFC shipments. These units began to be installed in homes from 2009, and more than 13,000 such units have been installed. However their cost, at around five times that of a diesel bus, plus the cost of hydrogen infrastructure means that they are only used where a city deems the environmental benefit to be worth the extra investment. Fuel cell cars are currently only available for lease; these vehicles are being made available by manufacturers to gain experience ahead of a commercial launch planned from 2015 [1,2].

3. International Status of MCFC:

Molten Carbonate Fuel Cells (MCFC) are currently being demonstrated in several sites around the world. The typical power size is of several hundred KWs, however, a 40-125 kW MCFC system for mid size commercial, industrial and municipal applications was developed by Gen Cell Corporation, and multi-MW systems are going to be demonstrated in Europe [5, 6], USA [7] and Japan [8]. Although there are demonstration programs all around the world, a strong R&D activity is also being undertaken by R&D organizations, industrial companies, and universities. In fact, there are still technical issues to solve before MCFC can penetrate the market and compete with traditional energy systems. In particular, increasing useful service life and reducing costs represent two important priorities upon which R&D is focused. While increasing the stack durability also implies decreasing the system operating and maintenance (O&M) costs, including that of stack replacement, other cost reduction activities are needed. These include increasing power density (to reduce investment cost maintaining equal power yield), and exploring less expensive manufacturing processes. In addition, mass production will contribute substantially to cost reduction [9].The high number of MCFC installations is mainly due to the strong role played by the American company, Fuel Cell Energy (FCE) and the German CFC Solutions (formerly MTU CFC Solutions) in putting their products in operation. CFC Solutions developed its 250 kW system, called *Hot Module*, based on FCE's fuel cell stacks [10]. MCFC technology are considered as the major in the world.FuelCell Energy (FCE, USA),CFC Solutions (Germany) Ansaldo Fuel Cells (AFCo, Italy), Ishikawajima-Harima Heavy Industries (IHI,Japan, POSCO/KEPCO consortium and Doosan Heavy Industries (Korea),Gen Cell Corportation (USA). Ishikawajima-Harima Heavy Industry (IHI) and the Central Research Institute for Electric Power Industry (CRIEPI) in Japan, Ansaldo Fuel Cells in Italy (AFCO) as well as the Korean Institute of Science and Technology (KIST) and the Korean Electric Power Research Institute (KEPRI) in South Korea [11, 12, 13].

4. MCFC Developments in India:

Bharat Heavy Electricals Ltd. (R&D), Hyderabad. They are involved in the development of Phosphoric Acid Fuel Cells (PAFCs) and have developed a 50-kW stack. They have also installed a 200 kW fuel cell bases power plant. The fuel used is LPG and besides generation of electricity, it also produces hot water which is uses in their canteen.

TATA Energy Resources Institute (TERI) has in the past demonstrated the use of digester gas (biogas) for generating electricity from a 2.5-kW PAFC stack imported from ERC (Energy Research Corporation), USA. MNES has funded the import of a 200-kW PAFC system made by the ONSI to evaluate its operation.

SPIC-SF (SPIC Science Foundation) is working on Proton Exchange Membrane (PEM) fuel cells and has developed stacks. They have also demonstrated a fuel-cell battery hybrid vehicle using a 10-kW PEM power plant.

Work on an MCFC stack is underway at TERI and the Central Electrochemical Research Work on an MCFC stack is underway at TERI and the Central Electrochemical Research Institute. TERI has tested the operation of an MCFC mono cell on simulated coal gas. Development of a kW-level stack is currently underway with the aim of integrating it with a coal gasifier.

Work on developing a DMFC (direct methanol fuel cell) is underway at IISc (Indian Institute of Science). In addition, research on SOFC is being done at IISc and CGCRI (Central Glass and Ceramic Research Institute). Research and development on metal hydride storage is ongoing at BHU (Banaras Hindu University) the sources from fuel cell today & fuel cell Energy.

5. MCFC Hybrids System:

Generating renewable electricity is an important way to reduce carbon dioxide (CO2) emissions and many countries are installing wind and solar power plants to help meet targets for cutting CO2. Fuel cell need hydrogen and heat (at starting) & and generate heat as byproduct on the other hand gasifire

required heat to work & generates hydrogen plus other gases , hence the perfect gas and heat flow management between two with carefully assigned operating conditions & design parameters can make combination extremely efficient for producing much clean electric power in industrial application/commercialization of the MCFC. The MCFC and a Braysson heat engine is established, in which multi-irreversibilities resulting from the overpotentials in the electrochemical reaction, heat leak from the MCFC to the environment, non-perfect regeneration in the regenerator, and finite-rate heat transfer in the Braysson heat engine are taken into account [15].

6. Comparative Advantages/ Disadvantages:

The high global efficiency with respect to other electrical energy production systems, De Simon et al. (2003) [14].Fuel choice varies by region with natural gas and LPG dominating in Asia, hydrogen prevalent in the USA, and in Europe some adopters are trialling methanol.Large stationary refers to multi-megawatt units providing primary power. These units are being developed to replace the grid, for areas where there is little or no grid infrastructure, and can also be used to provide grid expansion nodes. The development of energy systems with readily available fuel, high efficiency and minimal environmental impact is required in order to meet increasing energy demands and to respond to environmental concerns [16, 17, 18]. The fuel cells produce electricity directly from hydrogen fuel with an oxidant by electrochemical reaction at high efficiency and offer a clean and pollution-free technology [19]. Among the various fuel cells, the molten carbonate fuel cell (MCFC) is very promising because of its fuel flexibility and highly operating temperature [20-23]. In comparison to the other fuel cells, the MCFC operates with the lowest current densities due to limited zones of effective electrode reactions and low solubilities of oxygen and hydrogen in molten carbonates; also it has a thickest electrodes-electrolyte assembly. In consequence, the applications of MCFC are almost limited to stationary power generators. Although the MCFC stationary power generators have now approached high technological level of pre commercialization, in the future they may face a serious contest from S0FC and PEMFC, for which improvement of operational parameters is believed to be achieved easier [21].

Conclusion:

As in the presently the Indian market rising fossil fuels costs number of times. Majority of peoples hopes from the government to provide them power very low cost as possible as. Also changes in the climate in last few years are to force think about where power is produce locally form e-waste, biomass, sun, water & wind etc., and utilization locally, of these alternative sources of power interest in the biomass is growing all over the world. The Integration of MCFC with gasification system play greater rolls to face the demand of power in the villages & small towns also Internal demands of industries.

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