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Proceeding

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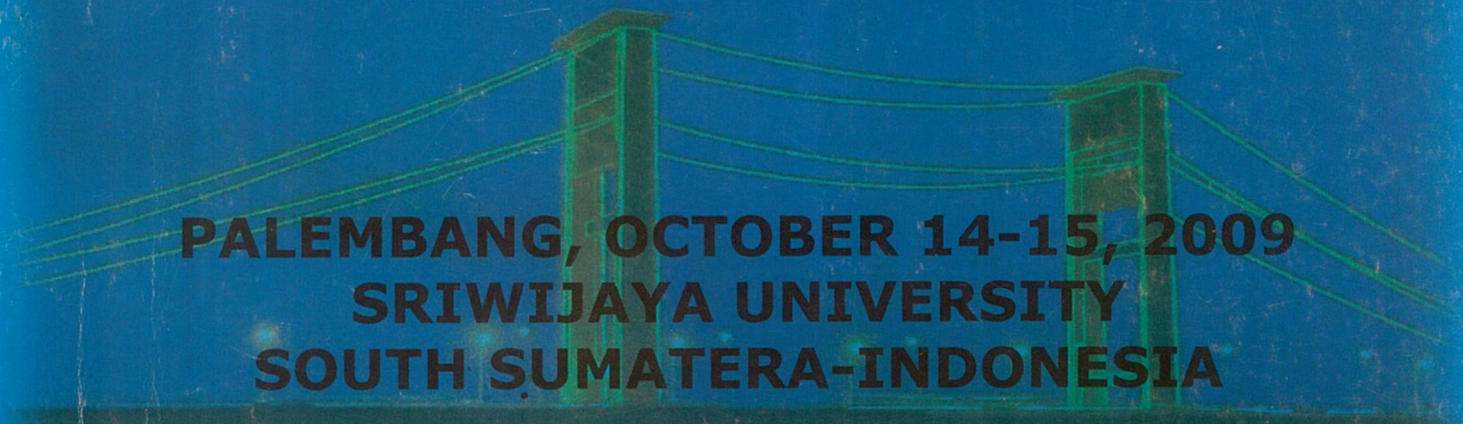
"SAVE OUR WORLD BY SOLVING ENERGY CRISIS"



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CONTENTS

Study of Fuel Cell Hybrid System for Electricity Power Plant

[1]Sri Martini and [2] Lenni Marlinda
[(1,2)]Post Graduate student of Chemical Engineering at Sriwijaya University, South Sumatera
[1]Lecturer of Chemical Engineering Department, University of Muhamaddiyah Palembang
[2]Lecturer of Industrial chemistry Department, University of Jambi

ABSTRACT

Fuel cell is instrument of electrochemical energy conversion that changes hydrogen and oxygen to be water, at the same time, it produces energy of electricity and heat in its process.
As the alternative energy source, fuel cell hybrid system is effective enough because it just produces water vapor as its waste, zero emission and no noise, high conversion and economical energy system.
In this process is used proton exchange membrane fuel cell, for using in remote and hilly area that dont have conventional electricity power plant using fossil fuel, fuel cell hybrid system is good alternative to substitute it. In this study, we also focus on location analysis, technical analysis and economical analysis.

1. INTRODUCTION

Natural energy policy is regulated by government in Perpres No. 5 / 2006 as response to energy crisis that can influence to other sectors. In Indonesia, this policy will be the basic in national energy management. If we refer to blue print in 2006 – 2025, one of the many realization ways in energy management from natural sources is in sub-sector of electricity that is powered by fuel cell as one of the alternative energy sources in 21st century that environmentally friendly. Fuel cell just yield water vapor as its waste. The proof of governmental care to this sector is road map of fuel cell development. Besides thet, day by day, researches in fuel cell development have made by many Researchers such as nano technology.

In nano technology, nano silica is added to the new materials such high temperature polymer and local polymer that can inhance fuel cell effeciency. According to the reseaches, it can be proven that fuel cell is zero emission and no noise. It can be applied in hybrid system with solar electricity power plant to produce continuesly electricity in remote areas such as villages in hilly area and fuel cell can overcome the weaknesses of solar electricity power plant using battery for energy storage, specially at hilly area with low inhabitant denseness, for example in alam city, south sumatera, supply of electricity in this village is from 65 PLTS instalations (Data source are from energy and mining department, 2009) . These villages have clean natural water sources as hydrogen sources to fuel cell.

Fuel cell electricity has high potency in photovoltaic hybrid system and it is influenced by mining sources specially group C so that its difficult to build conventional electricity power plant (www. Pagaralam.go.id)

1.1 Boundary of problem

Based on introduction, this paper is made to find answer about whether the fuel cell instalation planning to fuel cell electrolysis hybrid system is effective and efficient to apply in pagar alam city, in location analysis, technical and economical analysis.

- The explanation in this city is limited just for fuel cell function in PV-FC hybrid technology system choice that is suitable to apply in pagar alam villages.

Types of technology are adopted from many journals after selection with few criteria, such as :

Its application

H_2 source as fuel (by electrolysis process)

cost of fuel cell power plant

1.2 Objective

Knowing of the effeciency of fuel cell instalation planning in PV-FC hybrid system in pagar alam villages, south sumatera province. In effort to supply electricity continuesly, economical and friendly to environment.

Inhancement of people awareness so that they can support fuel cell instalation in order to develop solar energy source and energy diversification.

2. LITERATURE

2.1 Definition of fuel cell

Fuel cell is electrochemical energy conversion equipment that can change hydrogen and oxygen to be water. At the same time, it yields energy of electricity and heat in its process.

Fuel cell is simple technology, its fuel are O_2 and H_2. All of fuel cell have positive and negative electodes, that can be said as cathode nad anode. Chemical reactions cause electric current on electrodes.

Besides electrodes, a unit of fuel cell has electrolyte that will bring electric current from one electode to another electrode and also catalyst that will accelerate reaction on electrodes. Generally, to differ every kind of fuel cells is electrolyte material that is used. Electric current and heat that are caused in every fuel cell are by product of chemical reaction on kathode and anode.

2.2 Development of PV-FC hybrid technology application

These are kinds of application of photovoltaic hybrid- fuel cell technology and fuel cell that are successfull in experiment time.

PV-FC hybrid system has few character (European Commission commitee, 2001), such:

Using proton exchange membrane fuel cell

Having 3 kW of power of photovoltaic module

Having 3 kW of power for electrolizer

Having 5 kW of power of fuel cellwork

The purpose of development on this system is to develop energy power plant system with low power that will use synergy between photovoltaic generator and proton exchange membrane fuel cell.

Hybrid photovoltaic – fuel cell system(Busquet, S.Leroix, 2001). The main aims of Hybrid photovoltaic – fuel cell system development are to optimalize operation by changing conventional system (fossil fuel) to fuel cell, to maintain the benefit of storage system and decrease pollution grade to environment.

On a whole, solar electricity power plant system always use battery with using hybrid system, so that the weaknesses of battery can be controlled. The weaknesses of battery are; easy to be out of order and expensive enough.

Hybrid system has characters such as:

Kind of fuel cell that is used is proton exchange membrane fuel cell(18 cells 900 cm^2, the de Nora's PEMFC)

3,6 kWp of power that can be produced by modul photovoltaic of hybrid application

3,6 kW of power is needed for electrolizer

4,85 kW of power can be yielded by fuel cell

Optimal temperature of fuel cell is 45°C and fuel cell efficiency is 41 %

Generally, battery can safe energy just in short time relatively (70% efficiency), but with using H_2 so it can be energy storage for larger time (stand by)

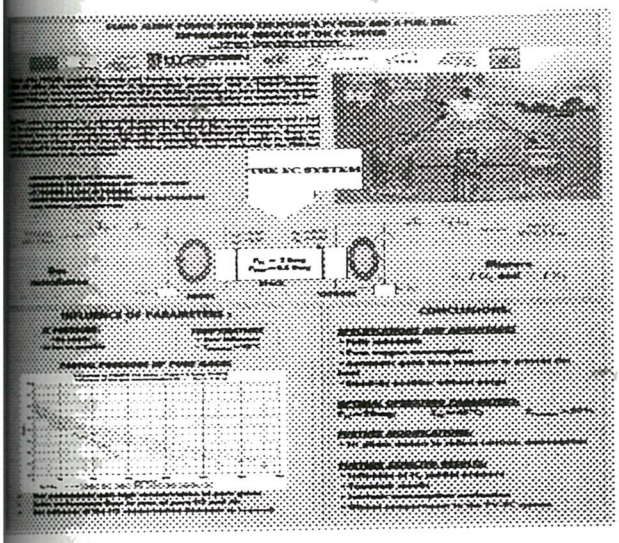

Figure 1 Hibrid System PV-fuel cell

3. RESULT AND EXPLANATION

Based on introduction, we choose pagar alam city as planning lacation of Hybrid photovoltaic – fuel cell system because this location has electric energy from application of electricity power plant using solar energy, started in 2008 about 65 units(south sumatera government, 2009). Besides that, this location doesnt have fossil sources but mining sources in group C such as clay, sand and stone of mountain.

On this location, potential tourism can be developed with environmentally friendly. Although the percentage of villages that are received electric current are about 97,1 % but there are still low in accessibility of electricity for hilli area. So that, planning of hybrid photovoltaic fuel cell is very good to keep sustainability of electrical production.

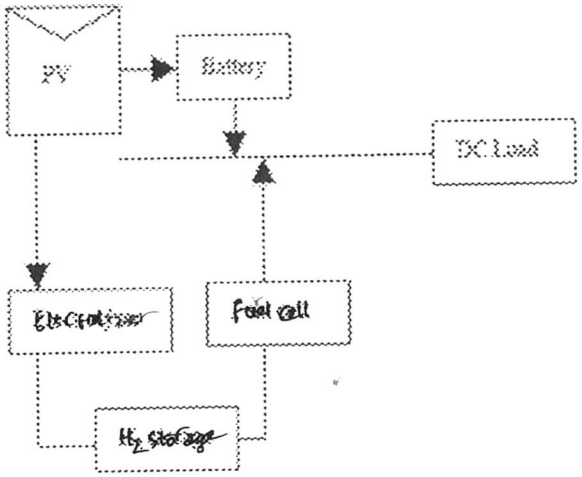

Figure 2 Fuel cell planning

Technically, planning of fuel cel has character such as:

Type is used of fuel cell that is used is polymer of electrolyte membrane fuel cell because its has high density instead of other types

Power that can be produced by photovoltaic module for hybrid application is 3 – 4 kWp

Power that is needed for electrolizer is 3 -4 kW

Power that is produced by fuel cell is 4,85 – 5 kW

3.1 Economical site of Hybrid photovoltaic – fuel cell system

About cost, diesel electricity power plant is about US $ 800 – 1500.

Hybrid photovoltaic – fuel cell system can produce power about 5 Kw with 40 % efficiency. For example, on mid day operation (peak condition + cloudy weather) and nigh operation, we choose operational time 80 %, it means 80 % x 24 hours x 5 kW= 96 kWh/day.

A house has instalation of 100 Wp, so that for fuel cell 5 KW is needed 3 kWp PV, and then, 30 x 100 Wp. We can calculate that 5 K of fuel cell for 30 houses. If a house need 250 watt, so that averge use is about 1,5 – 2 kWh/day.

Totally electrical use for 30 houses = 45 – 60 Kwh/day excess about 36 Kwh/day. At kance diwe village has 65 units of PLTS, so can be made 2 instalations of PV-FC hybrid system. Electrical

excess can be used to supply electrolizer and 5 houses again.
Estimation of electical calculation cost that can be reduced :
Cost of electricity Rp. 500/Kwh, electrical cost for 65 Houses
= (500 /kwh x (2 x 96 kwh/day))
= Rp. 96.000/day

Knowing investment price of fuel cell
= US $ 5000/kw (Tempo interaktif, 15 – 8 – 2003)
Life time instalation that is chosen for PV hybrid electrolizer system 10 years with estimation of investment maintenance cost
= US $ 10.000/instalation (Busquet,Domain, S, 2004)

Electrical cost per 10 years
= 10 x 365 x Rp. 96.000 = 350.400.000 (kurs 1 US $ 10.000)
So that, reduced electrical cost for 10 years is
= Rp. 350.400.000 - (2 x US $ 10.000 x Rp. 10.000)
= Rp. 150.000.000 or Rp. 41.100/day
If we devide it for 65 houses
= Rp. 41.000/day : 65 houses = Rp. 632,3/day can be saved.

4. CONCLUSION

Based on the problem that is written before, we can make conclusion, these are :

1. Application of fuel cell planning in pagar alam effective enough if it is considered by geographical condition, natural resources and long term planning to create tourism villages that environmentay friendly
2. Fuel cell hybrid system can help to overcame the weaknesses of PLTS instalation that depend on weather and battery system that is easy to be out of order
3. fuel cell can maintain the sustainability of electrical production, besides that with complexity of component, it can open the chance for local people to work as local technician in maintenance system.

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