POTENTIAL USE OF LIME AS NITRIC ACID SOURCE FOR ALTERNATIVE ELECTROLYTE FUEL-CELL METHOD

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1. INTRODUCTION

1.1. Background

1.1.1. Despite growing popularity for the use of biofuel and other similar methods to generate renewable energy sources from natural plantation in recent years, there is also growing concern over its disadvantage, i.e. that the energy use of edible plants may cause unwanted effects, because the plantation price tends to increase following the oil price. Therefore an alternative solution to this problem is to find 'natural plantation' which have no direct link to 'food chain' (for basic foods, such as palm oil etc).

1.1.2. Another choice is to use directly natural plants as substitute for components of Fuel Cell systems, such as Electrolyte Fuelcell Systems (EFS). Interestingly EFS methods have been investigated in recent years. This new use of natural plantation in EFS may be considered as potential applications of Green Chemistry [1].

1.1.3. In this regards, possible usage of nitric-acid in EFS (NA-EFS) has been identified and discussed in recent years by some authors. [2][3].

1.1.4. Nonetheless, this new NA-EFS have not been studied in Indonesia, despite plenty of tropical fruits can be found in this country which consists of nitric-acid compounds.

1.1.5. Therefore, in this proposal we will focus on possible use of nitric-acid from natural plants (in particular lime) in EFS. Furthermore, it can be expected that NA-EFS can be proved to be more efficient than other existing biofuel methods, thanks to the fact that NA-EFS does not need to grow plants which normally are parts of basic foods of common people.

1.2. Objectives

1.2.1. Objectives of this proposed research includes:

1.2.1.1. Studying chemical composition of some known source of nitric acid in nature, in order to find out which natural plantation is more suitable from the viewpoint of NA-EFS.

1.2.1.2. Studying (experimentally) which EFS method is the most suitable to be used in conjunction with nitric-acid extracted from Natural Plantation, in particular for tropical countries like Indonesia.

1.3. Expected Output

1.3.1. Result from experiments as well as theoretical studies on how nitric-acid shall be produced and used in EFS methods.

1.3.2. Prototype Design as guidance for practical use or further development.

2. STATE OF THE ART OF THE RESEARCH

2.1. Fuel cell definition: A fuel cell is an energy conversion device that consists essentially of two opposing electrodes, an anode and a cathode, ionically connected together via an interposing electrolyte. Unlike a battery, fuel cell reactants are supplied externally rather than internally. [2] Fuel cells operate by converting fuels, such as hydrogen or a hydrocarbon (e. g., methanol), to electrical power through an electrochemical process rather than by combustion. It does so by harnessing the electrons released from controlled oxidation-reduction reactions occurring on the surface of a catalyst. A fuel cell can produce electricity continuously so long as proper reactants are supplied from an outside source. [2]

2.2. Some known types of ecological power sources [3]:

2.2.1. PEFC (polymer electrolyte membrane fuel cells): With ion-exchange membranes it is possible to create ‘green’ energy source, such as PEFC and RFB. [3]

2.2.2. HOFC (hydrogen-oxygen fuel-cell): In HOFC method, the hydrogen is oxidized at the anode and the protons migrate through a cation-exchange membrane to the anode where they react with oxygen, forming water. [3]

2.2.3. Redox flow battery (RFB): RFB method can be very efficient for large-scale energy storage. In this method, Cr3+/Cr2+ and Fe3+/Fe2+ are circulating through a cell divided by anion-exchange membrane. [3]

2.3. Existing fuel cell systems are typically classified based on one or more criteria: [2]

2.3.1. the type of fuel and/or oxidant used by the system;

2.3.2. the type of electrolyte used in the electrode stack assembly;

2.3.3. the steady-state operating temperature of the electrode stack assembly;

2.3.4. whether the fuel is processed outside (external reforming) or inside (internal reforming) the electrode stack assembly. In general, however, it is perhaps most customary to classify existing fuel cell systems by the type of electrolyte (i. e. , ion conducting media) employed within the electrode stack assembly. Accordingly, most state-of-the-art fuel cell systems have been classified into one of the following known groups: 1. Phosphoric acid fuel cells (e. g., phosphoric acid electrolyte); 2. Alkaline fuel cells (e. g., KOH electrolyte) ; 3. Molten carbonate fuel cells (e. g., Li2CO3/K2CO3 electrolyte); 4. Solid oxide fuel cells (e. g. yttria-stabilized zirconia electrolyte) ; 5. Proton exchange membrane fuel cells (e. g., NAFION electrolyte).

3. METHODS

3.1. The method of research can be described in ‘phases’. Phase A consists doing experimental study on the chemical composition of some of known sources of nitric acid in nature. This phase A also includes studying the nature of ‘nitric acid’ of these tropical fruits, including: lime, lemon, mango, etc. Each of these fruits will be discussed and analyzed, and the results will be summarized.

3.2. Phase B consists of studying and experiments best method to implement EFS in conjunction with nitric-acid extracted from these tropical fruits. Each of these fruits will be tested using particular EFS (not yet determined at present), discussed and analyzed, and the results will be summarized.

3.3. Phase C consists comparing theoretical knowledge in the existing body of knowledge concerning EFS [4], with the findings obtained from Phase B. This will result in new/improved design for better NA_EFS for tropical countries.

4. TIME SCHEDULE

Phase	Feb08	Mar08	Apr08	May08	Jun08	Jul08	Aug08	Sep08	Oct08
A. Chem.	====								
B. Test EFS		====	====	=====	====				
C. Design					====	====	====		
D. Summary							====	====	
E. Final Report								====	====

5. PROPOSED BUDGET

6. PERSONAL INVESTIGATOR AND OTHER RESEARCHER

6.1. Team Leader: V. Christianto

6.2. Research team:

6.2.1. Prof. F. Smarandache (UNM)

6.3. Assistant:

7. REFERENCES

7.1. [1] M. Lancaster, "Green Chemistry," www.chemsoc.org/pdf/LearnNet/rsc/greenss.pdf

7.2. [2] WO/2005/038956) NITRIC ACID REGENERATION FUEL CELL SYSTEMS, http://www.wipo.int/pctdb/en/wo.jsp?wo=2005038956&IA=WO2005038956&DISPLAY=DESC.

7.3. [3] S. Koter & S. Warszawski, "Electromembrane Processes in Environment protection," Polish Journal of Environment Studies, Vol. 9 no. 1(2000) 45-56. URL: http://www.pjoes.com/pdf/9.1/45-56.pdf.

7.4. [4] Fuel Cell Handbook (7th Edition), URL: http://netl.doe.gov/technologies/coalpower/fuelcells/seca/pubs/FCHandbook7.pdf

January 2008
Proposal submitted to Biotrop
www.biotrop.org