HYDROGEN PRODUCTION FROM BLACK SEA WATER BY SULFIDE-DRIVEN FUEL CELL (HYSUFCEL)

Goal of the project

The present proposal is directed to the simultaneous goals: first, remediation of the severe environmental situation in the Black Sea, to produce "carbon-free" energy in the form of hydrogen and to extract valuable compounds from the deep marine water. It is based on the opportunity to recover energy from the hydrogen sulfide in the Black Sea. The thermodynamic analysis shows that the energy recovery of the latter is an energy alternative to the natural gas used in the coastal countries.

Short description of the project

The proposed technology will consist of the following steps: pumping of the water from depths where the sulfide concentration is relatively high; enrichment of the pumped water to attain higher concentrations of sulfide and to enhance the next step: generation of electromotive force in a new designed fuel cell operating by catalytic sulfate oxidation by oxygen; sufficiently high and required for the very hydrogen production by electrolysis. Here other processes for water splitting, alternative to electrolysis will be tested too and the final decision on this step of the technology will be made after the comparison of their feasibility. The final step is hydrogen storage or its utilization as a complementary energy source for electrolysis, used in another traditional fuel cell.

Project implemented by

Laboratory of Electrochemistry, Corrosion and Electrochemical Engineering, Institute for Renewable Energy, University Politehnica of Timişoara – Romania

Implementation period

2011 - 2014

Main activities

2011
1. Technology for hydrogen production.
2. A method for hydrogen storage.
3. Data on the hydrogen clearance overpotential based using solutions of sodium chloride, similar in ionic strength waters in the Black Sea
4. Materials selected to produce the electrodes.

2012
1. Information on the composition of the Black Sea waters.
2. Relations for the determination of kinetic parameters of hydrogen evolution reaction.
3. A method for enhancing the hydrogen evolution reaction.
4. Information on the influence of hydrogen sulfide / sulphide on the catalytic activity of the electrodes and membranes used in fuel cells.
5. A process for extraction of metals from dilute solutions.
6. Hydrogen sulfide / sulphide sensor for usage in sea water and gaseous media.

2013
1. Calculation based on experimental values of energy efficiency for hydrogen production by electrolysis of water containing hydrogen sulfide / sulphide.
2. Electrode material selection.
3. Fuel cell design.
4. Hydrogen storage method suitable for conditions in the Black Sea waters.
5. Design of hydrogen storage system.

2014
Pilot plant.

Results

1.Technology for hydrogen production.
2.A method for hydrogen storage.
3. Data on the hydrogen clearance overpotential based using solutions of sodium chloride, similar in ionic strength waters in the Black Sea
4.Materials selected to produce the electrodes.
6.Information on the composition of the Black Sea waters.
7.Relations for the determination of kinetic parameters of hydrogen evolution reaction.
8.A method for enhancing the hydrogen evolution reaction.
9. Information on the influence of hydrogen sulfide / sulphide on the catalytic activity of the electrodes and membranes used in fuel cells.
10.A process for extraction of metals from dilute solutions.
11.Hydrogen sulfide / sulphide sensor for usage in sea water and gaseous media.
12.Calculation based on experimental values of energy efficiency for hydrogen production by electrolysis of water containing hydrogen sulfide / sulphide.
13. Electrode material selection.
14. Fuel cell design.
15. Hydrogen storage method suitable for conditions in the Black Sea waters.
16. Design of hydrogen storage system.
17. Pilot plant - in progres

Applicability and transferability of the results

Developed technology will be included in a pilot plant used during a cruise in the Black Sea.

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UEFISCDI, UE

Research centre

Research Centre for Environmental Science and Engineering.

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