IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
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Industrial Consultancy & Sponsored Research (IC&SR)

Method and Apparatus Design for Hydrogen Production from Seawater using a Green Route

IITM Technology Available for Licensing

Problem Statement & Unmet Need

- Carbon dioxide is one of the major contributors of the **global warming**. Most of the atmospheric CO2 emission is from the **energy sector industries**.
- Using an **alternative source of energy** can be a significant advantage for controlling Atmospheric CO2 concentration, hence **Clean fuel is needed**.
- **Hydrogen** doesn't leave carbon footprint, making it a **clean' source of energy**. However, the practical use of hydrogen is **limited** due to the facts:

1. Currently, hydrogen is produced mostly from the **steam reformation** of natural gases and the production cost is very high.
2. There is parallel emission of CO2/CO with hydrogen production from natural gas. Hence, this is not an **environment-friendly** method.
3. H2 gas is highly **inflammable** and may cause explosion. Thus, the **transportation** is very difficult.
4. Hydrogen is a very **light gas** and its **storage** in gas phase is challenging. It could be stored as liquid, however liquefaction requires cryogenic storage and boils at **20.268K**. So, a significant loss of energy is associated with its **liquefaction**.

- Hence it is required to address above mentioned issues by introducing an efficient method and an apparatus for safely generating hydrogen without any transporting or handling issues.

Technology Category/ Market

Technology: Hydrogen Production from Seawater using a Green Route;

Industry: Clean Energy, Green Technology, Energy/Infrastructure, Environment Engineering, Manufacturing/Chemical Industries;

Applications: Fuel Cells, Clean Energy, rocket fuel, Haber process for ammonia production, hydrogen fuel cell, Lab purpose, waste management, etc.

Market: The global hydrogen generation market size was valued at USD 155.35B n 2022 and is expected to expand at a (CAGR) of **9.3%** from 2023 to 2030.

Technology

- Present invention describes an **in-situ co-reduction** approach for producing hydrogen at a rate of **610 mL/min** by adding **0.5g** starting material (**aluminum salt** selected from a group of aluminum sulphate) and **0.3g** reducing agent (comprising **sodium borohydride**) to water (seawater, wastewater or tap water) at the room temperature.

Apparatus for in-situ co-reduction method for H2 production, comprises:

A three-compartment housing with a flow controller, bottom air-tight reaction chamber, water inlet, a hydrogen outlet; wherein the housing has two containers with flow controller or three containers with flow controller;

Three containers with flow controller placed in the middle of the compartment to regulate the flow of starting material and reducing agent into the bottom air-tight reaction chamber proportionately to the water supplied through the water inlet or, to the water in the chamber;

Further, the Hydrogen production reaction occurs in the bottom air-tight compartment and the nascent Hydrogen gas is collected from the hydrogen outlet.

Intellectual Property

- **IITM IDF Ref. 1920**
- **IN Patent No. 387060 (Granted)**

Key Features / Value Proposition

- It is a **safely portable apparatus** for hydrogen production from seawater, waste water or tap water in a **sustainable** and **promising manner**.
- Hydrogen, a clean energy source is produced at room temperature **without heat, electricity or sunlight**.
- The **process** and the **volume** of the **apparatus** is **saleable** and **customizable** according to its use in various energy sectors.
- The process overcomes **storage** and **transportation** related safety issues linked with **hydrogen energy**.
- Main reactants of the process are aluminum salt, a reducing agent, and seawater, which can be stored and transported anywhere safely and are of low cost.
- Hydrogen produced in this process can be used in any sectors where hydrogen is required.

TRL (Technology Readiness Level)

TRL- 3/4, Proof of Concept ready, tested and validated in Laboratory

Research Lab

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IMAGES

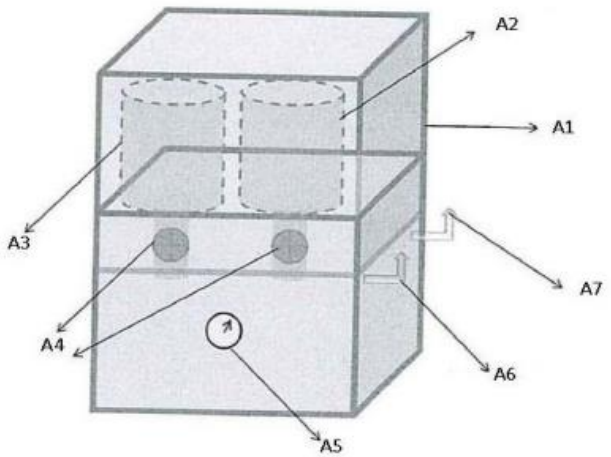

Figure 1
'Model A' of the hydrogen production apparatus with three compartments housing consists of two containers with flow controller. Seawater is added through a water inlet.

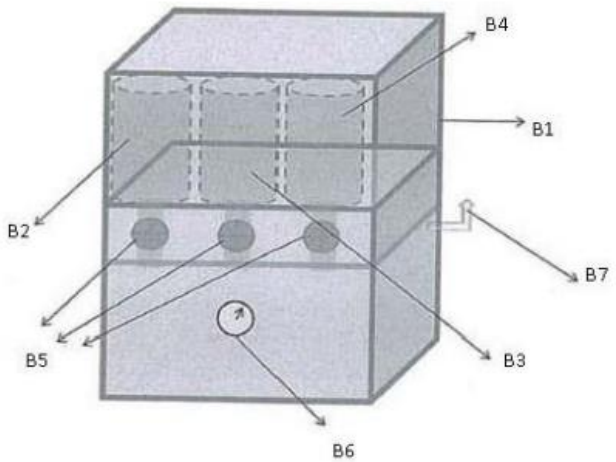

Figure 2
'Model B' of the hydrogen production apparatus with three compartments housing consists of three containers with flow controller. Among these containers, one is for Seawater.

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