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enterprise

H2Upgrade – H2 from industrial waste

BACKGROUND

Waste generation is a common challenge faced by numerous industries, manifesting as waste gases, liquids, or solid residues from processes, reactions, equipment cleaning, or combustion. The safe disposal of such waste is important to prevent environmental contamination and health hazards.

To address this challenge many companies who generate volumes of gaseous/liquid waste utilise waste disposal schemes which typically collect and centrally incinerate the waste due to the variability in composition and toxicity. The disposal of such waste without harnessing its potential represents a missed opportunity for resource recovery and sustainable energy generation, as well as being costly for the company that generates it.

In addition, there is a pressing need for industrial processes to transition to hydrogen fuels as a cleaner and more sustainable energy source to power their operations. By embracing hydrogen, industries can significantly reduce their greenhouse gas emissions, mitigate air pollution, and foster a greener and more resilient future for both the environment and their bottom line.

The technology from Prof Stuart Scott, Dr Ewa Marek, and Abu Fasim from the University of Cambridge in collaboration with Dr Rob Grant from GR2L allows for the conversion of costly and environmentally damaging waste streams to clean hydrogen fuel, allowing industrial partners to clean up their processes and valorise their waste.

TECHNOLOGY OVERVIEW

- The H2Upgrade unit makes use of an integrated thermochemical cycle to

use industrial waste gases

- For this, a stream of waste is used to reduce

- A key feature of the technology is the ability to valorise waste streams (solvents, waste process gases, biomass), using them as the source of the reducing potential. Conversion of the waste not only powers the cycle but also (1) renders the waste harmless and (2) converts carbon-containing wastes to high-grade CO2
- Key to the process are the beds of the chemical looping material and the process integration, which allows separate production of CO2 during the “chemical looping combustion” and pure, un-contaminated H2 during regeneration
- The system can process a wide variety of waste streams and the process can work with a wide variety of streams, regardless of composition, dilution, and impurities

- The process has a flexible capacity and is well-suited to small and medium industrial users

BENEFITS

- Can process gaseous/liquid/gasified-solid as well as dilute/toxic waste streams
- Compact apparatus allowing for industrial waste streams to be dealt with in-house with minimal installation services
- The system is easily coupled to pyrolysis systems and gasifiers but does not require either

- Transformation of no-cost, low-value waste streams into high-value concentrated H_2 (depending on waste source can be ultra-green hydrogen) to be sold or used as hydrogen fuel at the site
- Food-grade carbon dioxide product to be sold or used on site
- An on/off technology realised in medium-scale units
- Mobility and flexibility of the H2Upgrade units offers waste management services compatible with various wastes
- Reliability, maturity, scalability – the 2-step technology can be designed and scaled as modular installations

APPLICATIONS

Could be useful for:

- Waste management companies (to upgrade collected waste streams, producing H2 and pure-CO2, selling both products for profit)
- SME producing waste streams (for example: food and beverage processing, ink/paint production, chemical companies)
- H_2

OPPORTUNITY

Plans to develop a 4 to 40 m^3/hr system and to demonstrate the technology in an industrial setting.

Collaboration with potential partners on developing this technology for commercialisation and a licencing opportunity of:

- Novel metal oxide catalyst which performs at low temperatures and

pressures (patent pending)

- Novel system for converting waste gases into high-value H_2 and food-grade CO_2 (patent pending)
- The know-how and experience in building H2Upgrade units

INVENTORS

Dr Rob Grant

A Cambridge alumni, Dr Rob Grant has been a director of Gas Recycling and Recover Ltd (GR2l) since 2008.

Dr Ewa Marek

Dr Ewa Marek is a lecturer in the department of chemical engineering and biochemistry whose research group focuses on negative and net-zero energy technology and sustainable processes and processing.

Professor Stuart Scott

Prof Stuart Scott is a professor of energy and thermodynamics at the University of Cambridge whose research is focused on carbon capture and other processes for the abatement of CO_2.

Abu Kasim

Abu is a PhD student in the Energy Reactions and Carriers research group.

PATENT

UK Patent Application 2308307.4