POWER TO GAS (PtG) SYSTEM FOR INTEGRATED RENEWABLE ENERGY

Abstract

While the integration of renewable energies into the global energy system decreases greenhouse gas emissions from nonrenewable sources, the unpredictable characteristics of renewable sources like solar or wind pose an obstacle to the integration process. Power-to-gas technology addresses this by converting excess renewable energy into storable chemical forms like hydrogen or methane that can be injected into the gas grid. This project introduces power-to-gas to cut emissions and meet rising energy needs. Literature review identified CO_2 sources and capture methods for methanation, alongside electrolysis and methanation techniques. Suitable technologies were selected based on technical feasibility, economic viability, and environmental impact. Cement production emissions and chemical scrubbing with MEA absorbent were identified as optimal CO_2 sources and capture methods. PEM electrolysis and methanation using a fluidized bed reactor were also chosen. A process flow diagram with material and energy balance calculations were presented, indicating storage or injection of 23 ton/hr of methane into the gas grid. Moreover, the size and the cost of all the equipment needed were calculated, and from that the capital cost of the plant was found to be approximately 1 500 000 000 $. Hazard and Operability (HAZOP) analysis for different process units was done to identify risks and preventative actions. Finally, recommendations for future improvement were also discussed.

Keywords: power-to-gas, CO_2 emissions, renewable energy, hydrogen, methanation.

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