Design and Evaluation of a CO_2 Capture and Purification System from Amine Regenerator Vent Gas at GAIL Vijaipur and Its Conversion to Green Methanol

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Certificate

Certificate of Completion

This is to certify that THATAVARTY SAI HITESH, student of B.Tech in Chemical Engineering at NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR, CHATTISGARH, has successfully completed training in Gas Processing Unit(GPU),Department at GAIL (India) Limited, Vijaipur from 15th May 2025 to 12 June 2025. He has successfully completed the project entitled, "**Design and Evaluation of a CO_2 Capture and Purification System from Amine Regenerator Vent Gas at GAIL Vijaipur and Its Conversion to Green Methanol**" under the guidance of Mr. Abhay Kumar Gupta HOD(GPU-OPS),Mr. Anwar Alam, DGM (GPU-OPS), and Mr. Mayank Garg, Manager, (GPU-OPS), GAIL (India) Ltd. His conduct and behavior during the Vocational training period was found to be exemplary.

Abstract

This project focuses on the sustainable production of methanol by utilizing waste carbon dioxide from the Gas Sweetening Unit (GSU) of GAIL's Vijaipur plant and green hydrogen generated from the plant's newly commissioned 10 MW electrolyzer. The core objective is to reduce carbon emissions by converting captured CO_2 into value-added fuel using renewable hydrogen, thus supporting GAIL's broader decarbonization goals. The chemical process, based on the reaction $CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$, was simulated using Aspen Plus with the Peng-Robinson property method.

The hydrogen generation potential was estimated using an electrolyzer efficiency of 55 kWh/kg, resulting in approximately 4.36 tonnes/day of H_2 available for methanol synthesis. Based on this input, the theoretical methanol yield was calculated to be around 23.1 tonnes/day. The Aspen Plus simulation produced a closely matching result of 22.77 tonnes/day of methanol, alongside 12.81 tonnes/day of water as a byproduct. The hydrogen was completely consumed, while CO_2 conversion was limited to approximately 1.77%, confirming hydrogen as the limiting reactant.

The results validate the feasibility of integrating green hydrogen with industrial CO_2 streams for methanol production at pilot scale. The project also discusses practical future steps such as scaling up hydrogen input, improving carbon capture efficiency, and reusing the water byproduct. Overall, the study demonstrates a viable pathway for clean methanol production that aligns with circular economy principles and GAIL's sustainability roadmap.

Acknowledgement

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