Conference Name: STRA International Conference on Engineering & Technology, 07-08 October 2025, Istanbul
Conference Dates: 07-Oct- 2025 to 08-Oct- 2025
Conference Venue: Nippon Hotel, Taksim, Istanbul, Turkey
Appears in: MATTER: International Journal of Science and Technology (ISSN 2454-5880)
Publication year: 2025

Cherng Chen et. al, 2025

Volume 2025, pp. 31-32

DOI- https://doi.org/10.20319/stra.2025.3132

This paper can be cited as: Cherng Chen, J., Ting Tsai, C. & Jie Lin, Y.(2025). Development of Novel Hybrid Absorbents for Carbon Dioxide Capture. STRA International Conference on Engineering & Technology, 07-08 October 2025, Istanbul. Proceedings of Scientific and Technical Research Association (STRA), 2025, 31-32

DEVELOPMENT OF NOVEL HYBRID ABSORBENTS FOR CARBON DIOXIDE CAPTURE

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Abstract

As the greenhouse effect and climate change become increasingly severe, the development of carbon reduction technology has become a top priority. Chemical absorption technology for post-combustion capture is the most common and mature. For improving the defects of traditional ethanolamine absorbents, this study aims to develop novel absorbents or hybrid absorbents with high efficiency and low energy consumption. The performance of different novel absorbents with tertiary amine 1-dimethylamino-2-propanol (1DMAP) as the primary absorbent mixed with MEA, piperazine (PZ), NaOH, ionic liquid [Emim][Ac], and deep eutectic solvent [Urea+ChCl] (Reline) were evaluated by the carbon capture experiments with 15% CO2 gas to simulate typical combustion flue gas. Experimental

results show that the hybrid absorbents exhibited superior CO2 capture efficiency compared to the individual absorbents and were exceeding 90%. The high viscosity of the ionic liquid [Emim][Ac] and the deep eutectic solvent Urea+ChCl made them less effective for CO2 absorption. Comprehensively considering the results of absorption, and desorption experiments, the optimal hybrid absorbent was 1DMAP+PZ. Its optimal operating conditions were established and it achieved an excellent CO2 absorption efficiency of 99%, an absorption loading of 0.6 mole/mole, CO2 desorption efficiency of 62%, and minimal energy consumption for regeneration. Furthermore, its performance remained stable after three absorption-desorption cycles. Finally, the cost analysis revealed that 1DMAP + MEA (1M+0.5M) achieved the lowest carbon capture cost, making it more economical and feasible than traditional absorbent of 30wt.% MEA.

Keywords:

Carbon Capture, CO2 Absorption, Novel Absorbents, Hybrid Absorbents, Desorption