

Simulation study on efficient decarbonisation of coal-fired power plant flue gas using ionic liquid to capture CO₂

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The carbon dioxide (CO₂) emission reduction technology has the limitation of high energy consumption, and the development of new and efficient capture media is a new way to achieve green and high-value utilisation of CO₂. However, ionic liquids (ILs) have attracted the attention of researchers as a novel capture medium. In this study, Aspen Plus software was used to examine the process of capturing CO₂ from flue gas of coal-fired power plants using ILs. The physical properties of 1-butyl-3-methylimidazolium tetrafluoroborate ([Bmim][BF₄]) were analysed using known experimental data, and a process flow for physical absorption of CO₂ was established. Based on the established full process model, a sensitivity analysis was conducted on the absorption tower and flash tank. The process simulation results showed that increasing the number of absorption tower plates and the lean liquid flow rate benefits CO₂ absorption. The optimised absorption pressure is 3.0 MPa, the number of trays is 15, the lean liquid absorbent flow rate is 500 kmol/hr, the lean liquid feed temperature is 50°C, and the optimal operating conditions for the flash evaporation tank are a recovery pressure of 0.3 MPa and a recovery temperature of 150°C. The calculation of direct equipment investment cost in the process shows that with the increase of lean liquid load, the investment cost of all equipment except for the reboiler increases.

Keywords: Aspen Plus, carbon dioxide, CO₂ capture, ionic liquids, process simulation.

WITH the continuous advancement of science and technology, the demand for energy is increasing. Coal-fired power plants are the main source of energy in China. However, the large amount of CO₂ emissions from coal-fired power plants has become a major problem for the environment. Therefore, the development of efficient CO₂ capture technology is of great significance for reducing CO₂ emissions and achieving green and high-value utilisation of CO₂.