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Abstract

Enhancing Carbon Capture Efficiency in Chemical Looping Combustion Using Fe_2O_3 and Mn_2O_3 Oxygen Carriers: Insights from ASPEN Plus Modeling †

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This study investigates the carbon capture efficiency of a Chemical Looping Combustion (CLC) process employing Fe_2O_3 and Mn_2O_3 as oxygen carriers, modeled within the ASPEN Plus simulation platform. Evaluating various coal compositions characterized by diverse ultimate and proximate analyses, the study focuses on a temperature range spanning 950 to 980 °C. The investigation reveals consistently high carbon capture efficiencies across all coal types, achieving nearly pure CO_2 capture. This exceptional performance highlights the potential of CLC technology as a robust solution for efficient carbon capture in coal combustion processes. The findings underscore its significance in mitigating greenhouse gas emissions, particularly within energy-intensive industries. By leveraging ASPEN Plus simulation, this research contributes to optimizing and refining CLC systems, offering insights crucial for enhancing their performance and scalability. The observed efficiencies underscore the versatility of CLC technology, which can accommodate various coal compositions while maintaining high capture rates. Such capabilities are pivotal in transitioning towards cleaner energy production and realizing climate mitigation goals. Overall, this study underscores the promising role of CLC technology in addressing carbon emissions from coal combustion. As industries strive to reduce their environmental footprint, advancements in carbon capture technologies, as demonstrated by CLC, emerge as indispensable components of sustainable energy strategies. The insights presented in this research provide valuable guidance for further developments in carbon capture technology, facilitating progress towards a more sustainable and environmentally conscious energy landscape.

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