Design and Optimization of a CO_2 Hydrogenation Based Formic Acid Production Process, Including Techno-economic Analysis (TEA)

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With the climate crisis imminent as ever before, various technologies addressing the issue of carbon mitigation are attracting attention. Among these options, carbon capture, utilization, and storage (CCUS) is deemed as a technology that is promptly applicable in large-scale. Formic acid (FA) production is one of the potential applications of CCUS, since FA is utilized in various industries. However, large-scale production of CO_2 hydrogenated FA is yet to be realized, with difficulties lying in its operability and economic feasibility.

In this study, a process model for hydrogenating CO_2 to produce formic acid is designed and optimized, and techno-economic analysis (TEA) is implemented to evaluate the feasibility of the process as a viable carbon mitigation technology. The process is based on the formic acid production patent by BP Chemicals, and novel process configurations are added to improve the operability and economic feasibility. The analysis results show that the proposed process is a viable option for large-scale carbon mitigation in terms of TEA and shows good potential considering LCA as well.