

# Institute of Chemical Engineering

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## The performance of a hybrid VSA-membrane process for the capture of CO<sub>2</sub> from flue gas

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Hybrid techniques, which combine standard separation methods, are being developed in an attempt to overcome some limitations (especially high energy demands) associated with standalone absorptive, adsorptive or membrane processes for CO<sub>2</sub> capture from flue gases. The hybrid system developed in our laboratory, which includes a four-column VSA (vacuum swing adsorption) unit followed by a membrane stage has been theoretically investigated in this paper in order to assess its performance. The adsorbers are packed with ZMS 13X Grace and the membrane stage is based on the Air Products PRISM module with the membrane area of 1575–2250m<sup>2</sup>. It was concluded that such a system is flexible enough to improve the capture of carbon dioxide both in terms of energy consumption and adsorbent productivity in comparison with standalone VSA or membrane systems. At the same time it assures high CO<sub>2</sub> purity (> 95 vol. %) and recovery (85–95 %). It was found that the specific energy consumption in the system analyzed does not exceed 2 MJe kgCO<sub>2</sub><sup>-1</sup> and may be lowered to the level of 1.54–1.56 MJe kgCO<sub>2</sub><sup>-1</sup> by properly choosing the VSA cycle step time and/or the area of the membrane stage. At the same time a possibility to increase the adsorbent productivity in the VSA unit to as high as 1.8 t m<sup>-3</sup> day<sup>-1</sup> along with ways for a simultaneous improvement of the process throughput and the energy usage have been shown while maintaining acceptable carbon dioxide purity and recovery.

## Metryczka

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