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CO_2 Capture using a novel hybrid monolith (H-ZSM5/Activated carbon) as adsorbent by combined Vacuum and Electric Swing Adsorption (VESA)

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Abstract:

Electrical Swing Adsorption (ESA) is an interesting cyclic adsorption technology which relies on rapid Joule heating of the adsorbent to liberate adsorbed molecules such as CO_2. In this study we used a novel hybrid zeolite/activated carbon honeycomb to implement ESA and compared it to conventional vacuum swing adsorption (VSA) for CO_2 capture. We then combined electrical and vacuum swing adsorption (VESA) to assess the merits of this dual regeneration technology for recovering CO_2 from a 15% CO_2/N_2 gas stream at low pressure. With a simple VSA-only cycle, a CO_2 downstream purity of only 17 to 23 % was achievable when the desorption pressures varied from 30 to 10 kPa. This was primarily due to the adsorbent's poor adsorption characteristics which provided little change in CO_2 adsorption capacity over this pressure range. A CO_2 product purity of 15 to 34% and a recovery of 29 to 78% was achieved with ESA as the electrification time was extended from 30 s to 180 s. The combined VESA process provided a CO_2 purity of 33% and recovery of 72% with a short electrification time of 30s at a mild desorption pressure of 10 kPa. Energy