FINAL PROJECT

CO_2 SEPARATION FROM FLUE GAS USING ZEOLITE AND CARBON MOLECULAR SIEVE BY INDIRECT HEATED AND COOLED TSA PROCESS

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ABSTRACT

Since CO_2 is consider as major facilitator of climatic change, carbon capture (CC) is a significant way for sustaining the use of fossil fuels while lowering the amount of CO_2 released into the atmosphere, thereby to achieve zero net carbon emission [1]. Due to high energy consumption and operational cost, carbon capture using adsorption method has been researched from various angle emphasize the sorption materials. Zeolite as famous adsorbent in carbon capture field, exhibits more selective to CO_2, but present challenge deteriotion at wet condition, weak in acidic, and high cost [2]. Furthermore, CMS is less expensive than zeolites [3], and high resistance into acidic and alkaline [2]. This study investigated the CO_2 separation and recovery by using mixing and layer adsorbent packed of CMS and Zeolite. TSA process with indirect heating and cooling was used, to shorting the operating time and low energy consumption. Both dry and wet condition reveal the result, that CO_2 concentration and recovery ratio of CO_2 of mixing adsorbent slightly higher than layer adsorbent, eventhough the total amount CO_2 desorption of mixing and layer adsorbent is not much different. In addition, adding moisture on feed and purge gas at Td=5°C decrease the CO_2 concentration and recovery ratio around 2% than dry condition, it's because adsorbent haven't reached yet the saturation of moisture adsorption before starting the cycle time experiment

Keywords : Mixing adsorbent, Layer adsorbent, CO_2 capture ,CO_2 Separation, TSA

ABSTRAK

Karena CO_2 dianggap sebagai kontributor utama perubahan iklim, penangkapan karbon (CC) menjadi cara penting untuk mempertahankan penggunaan bahan bakar fosil sambil mengurangi jumlah CO_2 yang dilepaskan ke atmosfer, sehingga dapat mencapai emisi karbon nol bersih [1]. Karena konsumsi energi dan biaya operasional yang tinggi, penangkapan karbon menggunakan metode adsorpsi telah diteliti dari berbagai sudut dengan menekankan pada material adsorben. Zeolit, sebagai adsorben terkenal dalam bidang penangkapan karbon, menunjukkan selektivitas yang lebih tinggi terhadap CO_2, namun menghadapi tantangan seperti penurunan kualitas pada kondisi basah, lemah dalam kondisi asam, dan biaya tinggi [2]. Selain itu, CMS lebih murah daripada zeolit [3], serta memiliki ketahanan tinggi terhadap kondisi asam dan basa [2]. Penelitian ini menyelidiki pemisahan dan pemulihan CO_2 dengan menggunakan adsorben campuran dan lapisan CMS dan Zeolit. Proses TSA dengan pemanasan dan pendinginan tidak langsung digunakan untuk memperpendek waktu operasi dan mengurangi konsumsi energi. Hasil pada kondisi kering dan basah menunjukkan bahwa konsentrasi CO_2 dan rasio pemulihan CO_2 dari adsorben campuran sedikit lebih tinggi dibandingkan dengan adsorben berlapis, meskipun jumlah total desorpsi CO_2 dari adsorben campuran dan berlapis tidak banyak berbeda. Selain itu, penambahan kelembaban pada gas umpan dan purga pada Td=5°C menurunkan konsentrasi CO_2 dan rasio pemulihan sekitar 2% dibandingkan dengan kondisi kering, karena adsorben belum mencapai kejenuhan adsorpsi kelembaban sebelum memulai percobaan waktu siklus.

Kata Kunci: Adsorben campuran, Adsorben berlapis, Penangkapan CO_2, Pemisahan CO_2, TSA