

Pengembangan model adsorpsi CO₂ untuk prediksi potensi lapisan batubara Indonesia sebagai media penyimpan gas rumah kaca = CO₂ adsorption model development to predict the potency of Indonesian coal seams for green house gas sequestration

Ramadhania, author

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Abstrak

Informasi mengenai kapasitas adsorpsi batubara Indonesia dalam berbagai kondisi operasi sangat diperlukan guna mengoptimalkan penerapan teknologi injeksi CO₂ pada coalbed. Untuk mendapatkan informasi tersebut, diperlukan suatu model adsorpsi CO₂ yang dapat mengkorelasikan antara kapasitas adsorpsi dengan karakteristik batubara Indonesia secara akurat.

Oleh karena itu, dalam penelitian ini akan dibuat suatu pengembangan model adsorpsi CO₂ pada batubara Indonesia dengan melakukan uji adsorpsi CO₂ pada tekanan tinggi, dengan variasi jenis batubara, temperatur, tekanan, dan kandungan air. Pada penelitian ini, digunakan 2 variasi batubara (batubara Barito dan batubara Ombilin), 3 variasi temperatur (25°C, 40°C, dan 60°C), 6 variasi tekanan (150 psia, 300 psia, 450 psia, 600 psia, 750 psia, dan 900 psia), serta 2 jenis kandungan air (batubara kering dan batubara basah).

Uji daya adsorpsi batubara terhadap CO₂ dilakukan dengan menggunakan prinsip adsorpsi isoterms Gibbs, sedangkan model yang digunakan adalah model adsorpsi Ono-Kondo. Pengembangan model yang akan dilakukan dalam penelitian ini hanya meliputi perhitungan dua parameter, yaitu nilai energi interaksi antara adsorbat dengan adsorben ($\Delta H/k$) dan nilai kapasitas adsorpsi maksimum adsorben (C).

Dari hasil penelitian didapat bahwa kapasitas adsorpsi batubara Barito lebih besar daripada batubara Ombilin, kapasitas adsorpsi batubara kering lebih besar daripada batubara basah, kenaikan temperatur mengakibatkan penurunan daya adsorpsi, dan kenaikan tekanan menyebabkan peningkatan daya adsorpsi batubara terhadap CO₂. Kondisi adsorpsi maksimum terdapat pada batubara Barito kering, dengan temperatur 25°C dan tekanan 900 psia sebesar 0,8794 mmol/gram.

Pengembangan model Ono-Kondo menghasilkan nilai $\Delta H/k$ terbesar pada batubara Barito kering dan nilai C terbesar pada batubara Barito kering dengan temperature 25°C, yaitu sebesar -1300 K dan 0,741 mmol/gram. Penyimpangan antara model dengan hasil percobaan adalah sebesar 0,7%., sehingga dapat disimpulkan bahwa penggunaan model Ono-Kondo untuk memprediksi kapasitas adsorpsi CO₂ pada batubara Indonesia cukup akurat.

.....Information of Indonesian coals' capacity in various operating conditions is important in order to optimize the application of CO₂ injection into coalbed. To get that kind of information, the accurate CO₂ adsorption model that able to correlate Indonesian coals' capacity with their characteristic is needed. So that, this research will develop CO₂ adsorption model on Indonesian coals by testing CO₂ adsorption in high pressure condition, in various types of coal, temperature, pressure, and moisture content. This research utilized 2 types of coal (Barito coal and Ombilin coal), 3 variation of temperature (25_C, 40_C, dan 60_C), 6 variation of pressure (150 psia, 300 psia, 450 psia, 600 psia, 750 psia, dan 900 psia), and 2 kind of moisture content (dry coal and wet coal).

Test of CO₂ adsorption on coals was done by applied Gibbs isotherm adsorption principal and the used model

is Ono-Kondo adsorption model. Model development that will be carried out in this research was focussed on two parameters, which are fluid ' solid interaction energy parameter (ϵ_{fs}/k) and maximum adsorption capacity (C).

Results of this research point out that Barito coal's adsorption capacity is higher than Ombilin coal's, dry coal's adsorption capacity is higher than wet coal's, increasing of temperature affect decreasing of adsorption capacity, and increasing of pressure affect increasing of adsorption capacity. Maximum adsorption condition is reached on dry Barito coal, in 25°C and 900 psia in the amount of 0,8794 mmol/gram.

Development of Ono-Kondo model produced that the highest value of ϵ_{fs}/k is on dry Barito coal and the highest C value is on dry Barito coal in 25°C, which are -1300 K and 0,741 mmol/gram. Deviation between the model and the result of this research is 0,7%, so it can be concluded that application of Ono-Kondo model to predict CO₂ adsorption capacity in Indonesian coals' is accurate.