

Adsorpsi Gas CO₂ pada Tekanan Tinggi menggunakan Biomolekul Metal-Organic Framework Berbasis Ligan Asam Sitrat = High Pressure CO₂ Capture using Biomolecule Metal-Organic Framework Based on Citric Acid Ligand

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Abstrak

Bio Metal-organic Framework (MOF) adalah bahan berpori yang terbentuk dari kombinasi ion logam dan ligan organik. Asam sitrat adalah senyawa organik lemah yang dapat ditemukan dalam daun dan buah jeruk. MOF memiliki banyak fungsi, salah satunya bertindak sebagai bahan adsorben. Kami telah mensintesis dan mengkarakterisasi MOF berdasarkan ligan logam kromium nitrat dan asam sitrat. Sintesis dilakukan melalui metode reaksi hidrotermal menggunakan KOH dan Etanol serta dengan rasio logam terhadap ligan 0.6:1; 1:2; 1:2.5 dan 1:3. Sintesis dilakukan pada suhu puncak 120 °C selama 30 menit dan ditahan pada suhu tersebut selama 48 jam. Karakterisasi MOF dilakukan dengan Brunauer-EmmettTeller (BET), X-ray difraksi (XRD), scanning electron microscope (SEM), analisis termogravimetri (TGA), dan analisis Fourier transform infrared spectroscopy (FTIR). Dalam percobaan ini diperoleh luas permukaan paling besar 49 m²/g. Pengujian adsorpsi dilakukan pada suhu 27 °C, 40 °C dan 55 °C dengan variasi tekanan 5, 10, 15, 20, 30, dan 40 bar. Hasil adsorpsi paling besar terjadi pada suhu 27°C pada tekanan 40bar. Korelasi adsorpsi dilakukan dengan menggunakan persamaan Langmuir, Toth, dan Dubinin-Astakhov. Persamaan Dubinin-Astakhov dengan nilai deviasi paling rendah (8.9%) digunakan untuk perhitungannya panas adsorpsi. Semakin tinggi suhu adsorpsi, semakin tinggi panas adsorpsi yang dihasilkan. Semakin besar jumlah adsorbat yang terserap, panas adsorpsi yang dihasilkan semakin rendah. Dengan semakin rendahnya nilai panas adsorpsi, maka semakin rendah juga biaya regenerasi material tersebut dan semakin tinggi nilai penghematan energi pada proses adsorpsi.

.....Bio Metal-organic framework (MOF) is a porous material formed from a combination of metal ions and organic ligands. Citric acid is a weak organic compound that can be found in citrus leaves and fruit. MOF has many functions, one of which acts as an adsorbent material. We have synthesized and characterized MOF based on metal chromium nitrate and citric acid ligands. Synthesis is carried out through the hydrothermal reaction method using KOH and Ethanol as well as with a ratio of metals to ligands of 0.6:1; 1:2; 1:2.5 dan 1:3. Synthesis was carried out at a peak temperature of 120 °C for 30 minutes and held at that temperature for 48 hours (Material B). MOF characterization was carried out with Brunauer-Emmett Teller (BET), X-ray diffraction (XRD), scanning electron microscope (SEM), thermogravimetric analysis (TGA), and Fourier transform infrared spectroscopy (FTIR) analysis. In this experiment the maximum surface area of 49 m²/g was obtained. Adsorption testing was carried out at temperatures of 27 °C, 40 °C and 55 °C with pressure variations of 5, 10, 15, 20, 30, and 40 bar. The highest adsorption results occur at 27°C at a pressure of 40bar. The adsorption correlation was performed using the Langmuir, Toth, and Dubinin-Astakhov equations. The Dubinin-Astakhov equation with the lowest deviation (8.9%) is used to calculate the heat of adsorption. The higher the adsorption temperature, the higher the adsorption heat produced. The greater the amount of adsorbate absorbed, the lower the heat of adsorption produced. The lower isosteric heat adsorption value, the

lower regeneration cost and high efficiency energy in adsorption process.