THE EFFECT OF ROTATION IN CO_2 ADSORPTION

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ABSTRACT

In the context of mitigating climate change, the adsorption of gases onto activated carbon (AC) is considered a promising method, particularly regarding the adsorption of CO_2 emissions of industrial and anthropogenic activities. This study investigates the potential impact of rotation on enhancing the adsorption capacity of activated carbon further. Two sets of experiments were carried out: (a) CO_2 adsorption isotherms on AC at 25°C, with and without rotation, and (b) adsorption kinetics experiments. A specially designed sample cell facilitating adsorption with rotation was employed, with detailed specifications provided elsewhere. The AC in use was characterized by N_2 porosimetry giving a Brunauer–Emmett–Teller (BET) surface area of 1150 m^2/g and an average pore size of 2 nm. Rotation took place at 5000 rpm lasting 1 min and repeated at each pressure increment of the isotherm (up to 10 bar).

The experimental data of the adsorption isotherms revealed that, without rotation, the equilibrium amount (q_e) is 0.016 kg/kg while with rotation it increases to 0.035 kg/kg. However, Langmuir's adsorption constant (K_L), decreases. Although the latter indicates a weaker adsorption, the increase of q_e indicates a higher concentration of gas molecules over the solid surface. Rotation increases the strikes of the adsorbed molecules onto the surface and also pushes some of them to previously inaccessible sites, following a deep-adsorption. Adsorption kkinetics experiments lasted 90 min for both cases (with and without rotation). Both curves are showing good fits on the pseudo-second-order (PSO) kinetic model. During rotation there is a desorption process which corresponds to a pressure peak at the 45^{th} minute of the recording, followed by an increase in the amount adsorbed - more than it does in the case without rotation.

KEYWORDS: CO_2 adsorption, adsorption under rotation, adsorption isotherms, adsorption kinetics, climate change

REFERNCES

[1] R. I. Kosheleva, *et al.*, (2023) *J. Non-Equilib. Thermodyn. to be published.*
[2] R. I. Kosheleva, *et al.,* (2021) *Rev. Sci. Instrum. 92, 045106*.
[3] K. S. W. Sing, *et al*., (1985) *Pure Appl. Chem. 57, 603.*
[4] Pure Appl. Chem. 57, 603 Pure Appl. Chem. 57, 603 I. Langmuir, (1916) *Phys. Rev. 8, 149.*
[5] V. I. Geyko, *et al*., (2013) *Phys. Rev. Lett. 110, 150604.*
[6] S. Lagergren, (1898) *Handl. 24, 1*