EXPERIMENTAL AND MODELLING OF BREAKTHROUGH CURVES OF CO_2 ADSORPTION BY PALM SHELL ACTIVATED CARBON FUNCTIONALIZED WITH NATURAL AMINO ACIDS

Nur Syahirah Mohamed Hatta [1], Farihahusnah Hussin [1,2], Lai Ti Gew [2,3] and Mohamed Kheireddine Aroua [1,2*]

[1]*Research Centre for Carbon Dioxide Capture and Utilisation (CCDCU), School of Engineering and Technology, No. 5 Jalan Universiti, Bandar Sunway, 47500 Petaling Jaya, Selangor, Malaysia*
[2]*School, Lancaster University, Lancaster LA1 4YW, UK*
[3]*Department of Biological Sciences, School of Medical and Life Sciences, Sunway University, No. 5 Jalan Universiti, Bandar Sunway, 47500 Petaling Jaya, Selangor, Malaysia*

Abstract

Carbon capture by adsorption is one of the technologies used to reduce carbon dioxide (CO_2) emissions. However, this technology has to be economically viable to widen the adoption of this method across various industries. The development of a low-cost adsorbent could reduce the total cost of materials and production of adsorbent to some extent. In this work we propose the use of activated carbon derived from waste biomass (Palm Shell Waste) as adsorbent. To further enhance its CO_2 adsorption performance, the Palm Shell Activated Carbon (PSAC) is functionalized with natural amino acids sourced from egg white. The adsorption performance of this novel material is evaluated using dynamic CO_2 adsorption process in a continuous packed-bed column. The carbon impregnated with diluted egg white (ACEW-10) demonstrated considerably high adsorption capacities at breakthrough point (18.25 mg/g) and exhaustion point (25.17 mg/g) when operated at room temperature and atmospheric pressure. In comparison to the untreated activated carbon, the adsorption capacities were enhanced by 2.61 and 1.76 times at breakthrough and exhaustion points, respectively. The effects of gas flow rate (200, 300 and 400 mL/min) and bed depth (9, 14 and 21 cm) are also studied and the breakthrough were modelled using 4 models to predict the adsorption kinetic constant (k_{AB}) and maximum allowable saturation concentration (N_0). Overall, the model-predicted breakthrough curves were in good agreement with the experimental data. In the case of bed depth service time (BDST) analysis, the predicted breakthrough times were in concordance with the measured values.

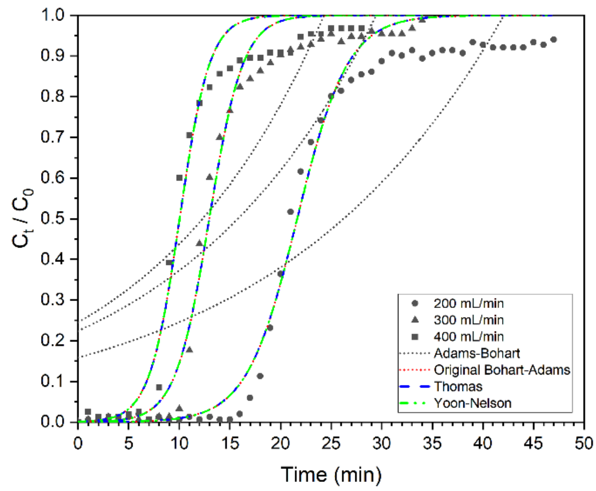

Figure 1: Experimental and Modelled Breakthrough Curves at Different Gas Flow Rates. Temperature 30 °C and Co 15 %.

Acknowledgement

This project is funded by Ministry of Higher Education Malaysia for funding the project under Fundamental Research Grant Scheme (FRGS/1/2020/TK0/SYUC/01/2)

Biography

Head, Centre for Carbon Dioxide Capture and Utilization(CCDCU), Sunway University, Malaysia

Distinguished Professor Mohamed Kheireddine Aroua completed his PhD in 1992 at the University of Nancy 1, France. He worked at University of Malaya for 23 years before joining Sunway University in 2017. His research addresses the fundamental and technical issues related to water, energy and environment. He has supervised to completion 35 PhD and 25 Master's students. His research has generated more than 250 articles in ISI-ranked journals and over 24,000 citations, and his h-index is 76 according to Google Scholar database. He was listed by Clarivate Analytics as top 1% highly cited researcher in 2018 and 2019. He is also recognized in Stanford University list as top 2% world scientist for career long as well as single year impacts in 2019,2020, 2021, and 2022. In 2018 he was the recipient of the IChemE Global Award in Water Category. Recently his water project won the 1st Place in the Innovative R&D Award (International Institutions award) at the 3rd Cycle of the Mohammed bin Rashid Al Maktoum Global Water Award. Know more about University of Malaya and Sunway - YouTube

Email: kheiredddinea@sunway.edu.my