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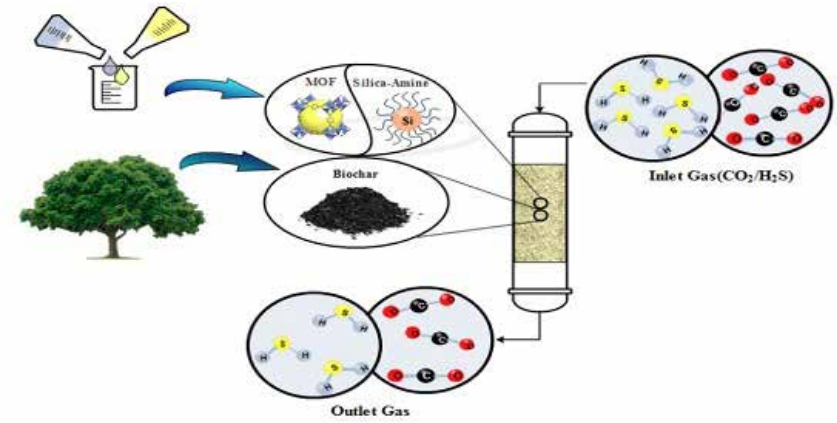
Experimental and theoretical analysis of CO_2 adsorption process for optimization of carbon based (Biochar) adsorbent

Hanieh Bamdad[1], **Kelly Hawboldt**[1] and **Stephanie MacQuarrie**[2]
[1]Memorial University, Canada
[2]Cape Breton University, Canada

Biochar, a product of pyrolysis of biomass, represents an attractive alternative and, depending on the biomass source, sustainable adsorbent material for treating gaseous effluents. In this study, biochar sourced from three different woody biomasses (i.e. softwood shavings, softwood bark, and hardwood sawdust) were produced via fast pyrolysis at different pyrolysis temperature (400-500°C) in a 2-4 kg/h auger reactor. The produced biochars were characterized for elemental composition, surface area, morphology, proximate analysis, and thermal properties. The CO_2 adsorption capacity of produced biochars was determined in a fixed-bed adsorption unit. Response surface methodology (RSM) coupled with a central composite design (CCD) was used to investigate the impact of significant process factors on the adsorption capacity of biochar. Three variables were investigated including temperature (20-80°C), the inlet flow rate (60-200 mL/min.g), and volume fraction of CO_2 (20-100% (v/v)). The optimum CO_2 capture capacity of biochar was obtained at an adsorption temperature of 20°C, CO_2 volume fraction of 100%, and inlet flow rate of 60 ml/min. The ANOVA analysis illustrated that the quadratic model fitted the experimental data well. In addition, the effect of different biochars obtained from fast pyrolysis of softwood shavings and hardwood sawdust pyrolyzed at different pyrolysis temperatures were investigated at optimum conditions. Softwood shavings pyrolyzed at 500°C showed the highest CO_2 uptake as it has the highest surface area (95.58 m^2/g).



Biography

Hanieh Bamdad is a PhD candidate with particular interests in Process Engineering, Waste Management, and Simulation. She holds a Master's and BA degree in Chemical Engineering from her home country, Iran. She is an active volunteer in academic societies.

hb3154@mun.ca

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