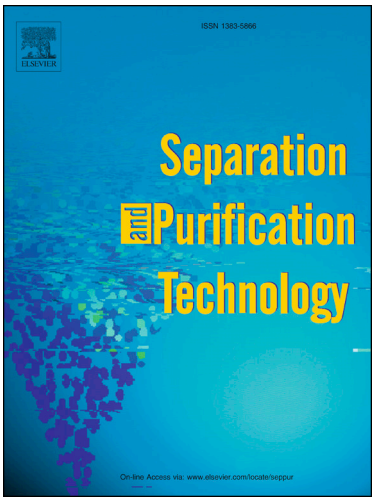

Experimental benchmark data of CH_4, CO_2 and N_2 binary and ternary mixtures adsorption on MOF-5

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PII: S1383-5866(17)31556-3
DOI: https://doi.org/10.1016/j.seppur.2018.01.013
Reference: SEPPUR 14307

To appear in: *Separation and Purification Technology*

Received Date: 23 May 2017
Revised Date: 29 December 2017
Accepted Date: 5 January 2018

Please cite this article as: F.A Kloutse, A. Hourri, S. Natarajan, P. Benard, R. Chahine, Experimental benchmark data of CH_4, CO_2 and N_2 binary and ternary mixtures adsorption on MOF-5, *Separation and Purification Technology* (2018), doi: https://doi.org/10.1016/j.seppur.2018.01.013

Experimental benchmark data of CH_4, CO_2 and N_2 binary and ternary mixtures adsorption on MOF-5

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Abstract

We present benchmark adsorption data of CH_4, CO_2 and N_2 binary and ternary mixtures on MOF-5 at 297 K and pressures up to 1500 kPa obtained via the isotope exchange technique (IET) and a predictive volumetric method. The ternary mixtures data are organized in two different domains: constant composition and constant pressure planes. The constant composition data show quasi-constant selectivity in the entire pressure range. The constant pressure data showed the existence of azeotrope-like crossover for CH_4 along the N_2 and CO_2 paths. However, these crossovers do not correspond to a reversal in the adsorbent's affinity for CH_4. The obtained experimental data is in accord with ideal adsorption solution theory (IAST).

Keywords

Isotope exchange technique; multicomponent; Adsorption; Thermodynamic consistency; Azeotrope; MOF-5.

1 Introduction

The main advantage of adsorption over traditional technologies in catalysis, separation and purification industry is the high selectivity attainable by the adsorbents[1]. Adsorption applications include separation of a wide range of industrial gases, purification of air, purification of hydrogen from steam methane reformers, production of olefins from olefin and paraffin mixtures, and recovery of biomethane from biogas [2-4]. Other applications can be found in environmental and electronic gas industry [5]. Since adsorption is a material-driven technology, there is a need to develop more and better adsorbents at commercial scale [6]. On the other hand, the design of adsorption processes like pressure swing adsorption (PSA) requires the accurate knowledge of the multicomponent adsorption equilibria, kinetics and heats. One of the most challenging problem in adsorption process design is the prediction of multicomponent adsorption equilibria from the pure-component isotherms. Unfortunately, there is still a need of thermodynamically consistent data to improve the understanding of multicomponent adsorption mechanisms, to test the existing multicomponent adsorption models and ultimately to enhance the development of