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PII: S1385-8947(17)31704-7
DOI: https://doi.org/10.1016/j.cej.2017.09.197
Reference: CEJ 17782

To appear in: *Chemical Engineering Journal*

Received Date: 7 August 2017
Revised Date: 29 September 2017
Accepted Date: 30 September 2017

Please cite this article as: N. Al-Janabi, V. Martis, NektariaServi, F.R. Siperstein, X. Fan, Cyclic adsorption of water vapour on CuBTC MOF: Sustaining the hydrothermal stability under non-equilibrium conditions, *Chemical Engineering Journal* (2017), doi: https://doi.org/10.1016/j.cej.2017.09.197

Cyclic adsorption of water vapour on CuBTC MOF: Sustaining the hydrothermal stability under non-equilibrium conditions

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Abstract

Metal organic frameworks (MOFs) based adsorption processes for gas separation from humid streams are limited by the hydrothermal stability of MOFs. This work presents a comprehensive study of the hydrothermal stability of CuBTC MOF when exposed to humid streams in cyclic operations. We show that water uptake is slow, and that adsorption processes will most likely operate under non-equilibrium conditions. CuBTC MOF does not show signs of decomposition when exposed to low water concentration and room temperature (up to water partial pressures of 6 mbar and 25 °C) for up to 48 h of cyclic operation. Nevertheless, short cycles (of less than 15 min per pressure stage) are required when exposed to high water vapour content (up to 70 mbar, 50 °C). This work demonstrates the need of tailoring the length of water exposure to avoid the equilibrium adsorption of water vapour on CuBTC and maintain the adsorbent integrity.

Keywords

Metal-organic frameworks (MOFs); CuBTC; Water vapour adsorption; Non-equilibrium adsorption; Hydrothermal stability; Cyclic adsorption.

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