

Accepted Manuscript

Intensified Carbon Capture using Adsorption: Heat Transfer Challenges and Potential Solutions

Jonathan R. McDonough, Richard Law, David A. Reay, Vladimir Zivkovic

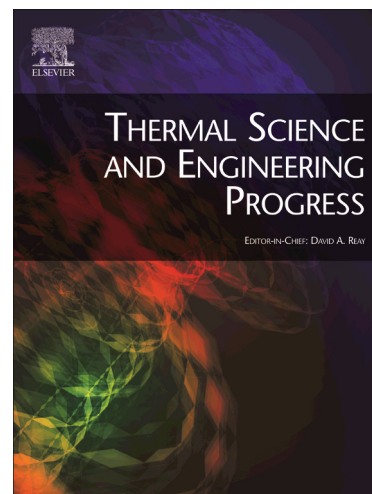
PII: S2451-9049(18)30101-X
DOI: <https://doi.org/10.1016/j.tsep.2018.07.012>
Reference: TSEP 206

To appear in: *Thermal Science and Engineering Progress*

Received Date: 17 February 2018
Revised Date: 17 July 2018
Accepted Date: 24 July 2018

Please cite this article as: J.R. McDonough, R. Law, D.A. Reay, V. Zivkovic, Intensified Carbon Capture using Adsorption: Heat Transfer Challenges and Potential Solutions, *Thermal Science and Engineering Progress* (2018), doi: <https://doi.org/10.1016/j.tsep.2018.07.012>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Intensified Carbon Capture using Adsorption: Heat Transfer Challenges and Potential Solutions

Jonathan R. McDONOUGH, Richard LAW, David A. REAY*, Vladimir ZIVKOVIC

*Corresponding author: Tel.: +44 (0)191 208 5604; Email: david.reay@newcastle.ac.uk
School of Engineering, Newcastle University, Newcastle upon Tyne NE1 7RU, UK

Abstract

Up to 25% of the total European Union (EU) CO₂ emissions that contribute to global warming are from industry, and while improved energy efficiency and process integration continues to play a role in minimizing these, it is carbon capture (CC) that in future will contribute most to mitigation, until nuclear energy and renewable technologies take over from fossil fuels. One of several CC methods is to use gas-solid adsorption, where the CO₂ is adsorbed ~~into~~ onto a solid. As with the more common absorption process, regeneration is required, and typically a single bed is employed to adsorb CO₂ while regeneration and removal of the CO₂ takes place in the second bed – carried out by pressure swing adsorption (PSA) or temperature swing adsorption (TSA). Collaborating in an EPSRC-funded project with Heriot-Watt University, where hydrotalcite-based adsorbents are being synthesised, and Sheffield University, where modelling is being undertaken, Newcastle University is examining the intensification of CC using a TSA-based process involving swirling or toroidal fluidized beds. As well as improving adsorption, it is believed that recovered waste heat could be used for desorption using a similar intensified technology. This paper discusses the potential sources of CO₂ that are being addressed, and how they will be integrated with the capture and desorption processes where fluidization will be used for the adsorption process. It also describes preliminary work on fluidization of the particles using additive-manufactured miniaturized fluid beds.

Keywords: Heat transfer, Carbon Capture, Adsorption, Fluidization, Additive Manufacture

Nomenclature

d_p Average diameter of adsorbent particle (m)
 h_{max} Maximum heat transfer coefficient ($W \cdot m^{-2} \cdot K^{-1}$)
 k_g Thermal conductivity of fluidizing gas ($W \cdot m^{-1} \cdot K^{-1}$)

Greek Letters

ρ_p Adsorbent particle density ($kg \cdot m^{-3}$)
 ρ_{sb} Bulk density of the adsorbent particle bed ($kg \cdot m^{-3}$)

Download English Version:

<https://daneshyari.com/en/article/8918631>

Download Persian Version:

<https://daneshyari.com/article/8918631>

[Daneshyari.com](https://daneshyari.com)