Developing Pressure Swing Adsorption Process for Biogas Upgrading using Shaped MIL-160(Al)

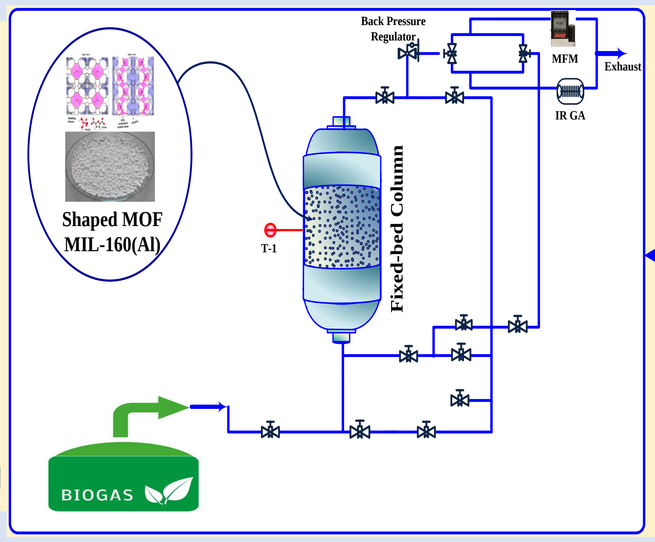
M. Karimi[1,2,3], A. E. Rodrigues[1,2], A. Ferreira[1,2], F. Nouar[4], K.H. Cho[5], U.H. Lee[5], C. Serre[4], , J. A. Silva[3]

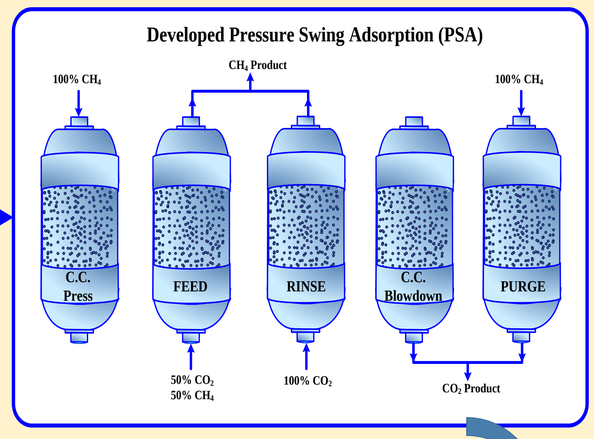
1. LSRE-LCM - Laboratory of Separation and Reaction Engineering – Laboratory of Catalysis and Materials, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
2. ALiCE – Associate Laboratory in Chemical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
3. Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal.
4. Institut des Matériaux Poreux de Paris, ESPCI Paris, Ecole Normale Supérieure, CNRS, PSL University, Paris, France.
5. Research Center for Nanocatalysts, Korea Research Institute of Chemical Technology (KRICT), 141 Gajeong-ro, Yuesong-gu, Daejeon 305-600, Republic of Korea.

Motivations and Objectives:

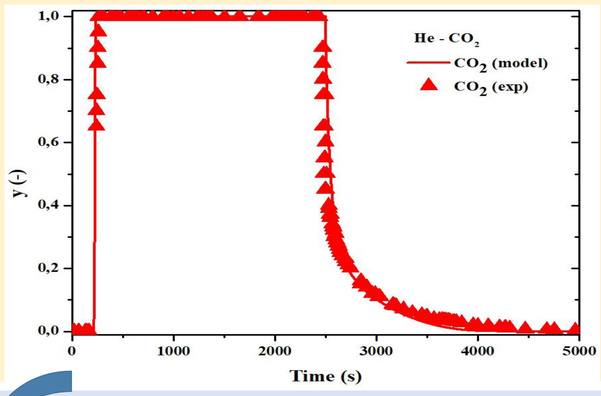
In this study, regarding the increasing interest on renewable sources of energy as well as considering the challenges of climate changes, the potential of shaped MOF MIL-160 (Al) for biogas upgrading has been evaluated. Accordingly, firstly the breakthrough assessments of CO_2 and CH_4 adsorption onto this sorbents were studied. Afterwards, a pressure swing adsorption (PSA) process to this end was designed and developed. The results showed MIL-160(Al) has an excellent potential for biogas upgrading concerning CO_2 and CH_4 separation.

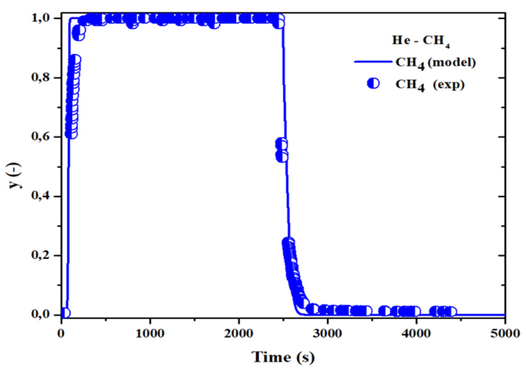
Materials & Methods:

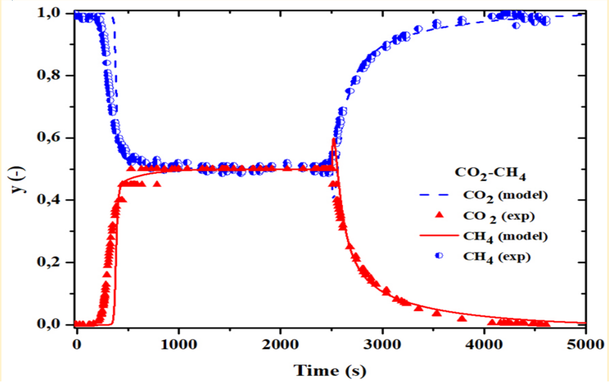


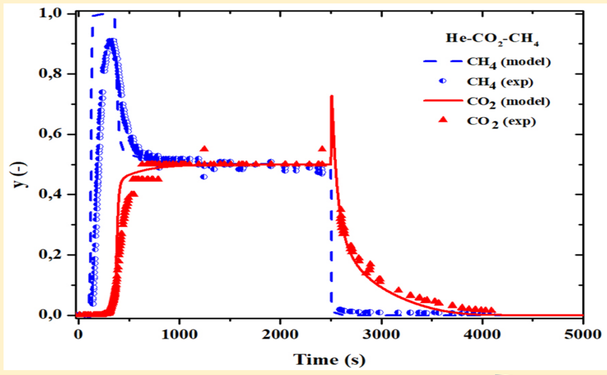


Breakthrough Results:

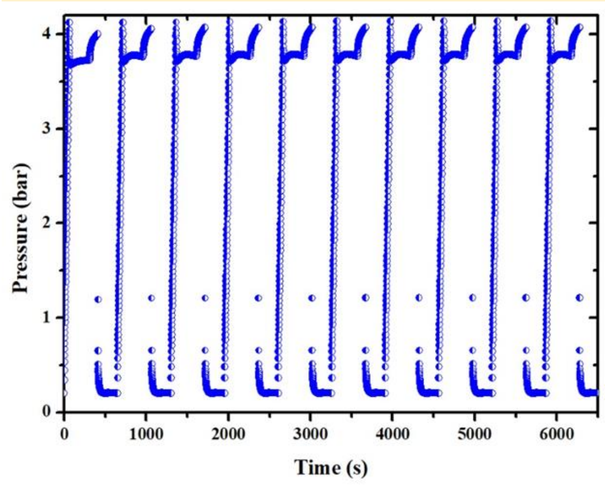


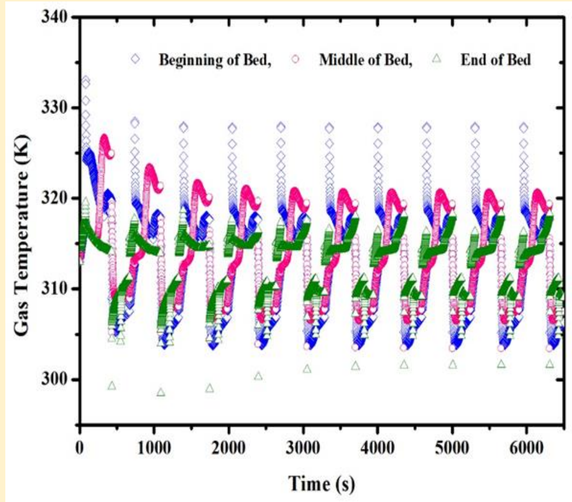


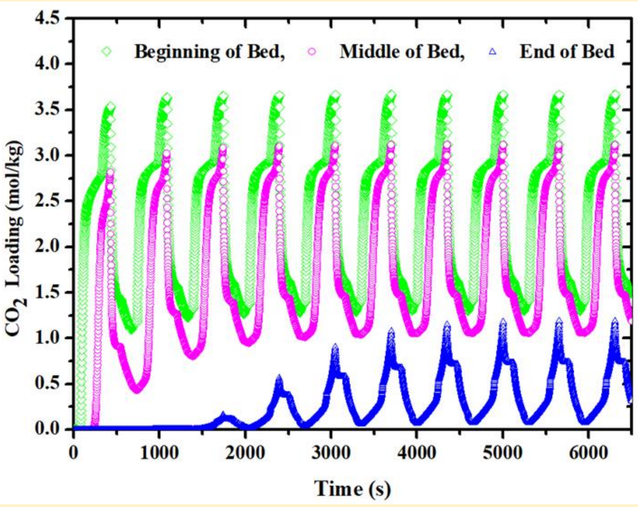


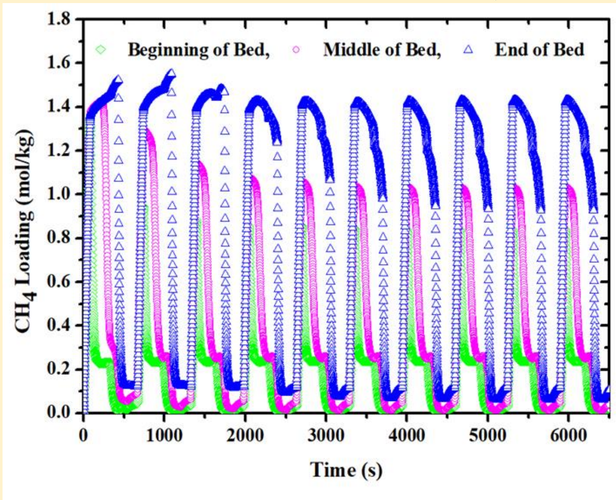


PSA Results:









Remarkable outcomes:

Evaluation of Developed PSA		
	Purity (%)	Recovery (%)
CO_2	81%	100%
CH_4	99%	68%

Sustainable Development

Conclusion:

- ✓ **Breakthrough experiments were properly simulated with ASPEN ADSIM.**
- ✓ **Cyclic steady state were developed after 10 cycles.**
- ✓ **Shaped MOF MIL-160(Al) showed and excellent capacity of Biogas upgrading.**
- ✓ **Life cycle assessment (LCA) of MIL-160 for biogas upgrading can be considered as a future direction.**

Acknowledgements

This work was financially supported by: LA/P/0045/2020 (ALiCE) and UIDB/50020/2020 - UIDP/50020/2020 (LSRE-LCM) funded by national funds through FCT/MCTES (PIDDAC);