

# CHARACTERIZATION OF MATERIALS FOR METHANE CAPTURE IN CATTLE BARN AND DEPLOYMENT OF A PILOT PLANT

Gramegna A<sup>a,b</sup>, Tommasi M<sup>b</sup>, Lovarelli D<sup>c</sup>, Stucchi M<sup>b</sup>, Ortenzi M<sup>b</sup>, Prati L<sup>b</sup>, Rossetti I<sup>a,b</sup>, Guarino M<sup>c</sup>

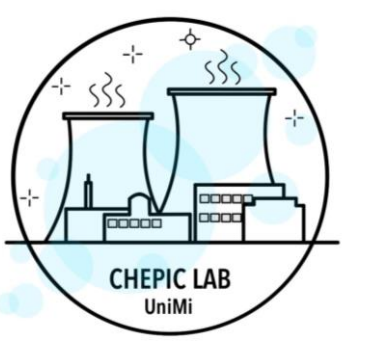
<sup>a</sup> INSTM consortium, Unit Milano-Università, via Golgi 19, 20133, Milano, Italy

<sup>b</sup> Department of Chemistry, Università degli Studi di Milano, via Golgi 19, 20133, Milano, Italy

<sup>c</sup> Department of Environmental Science and Policy, Università degli Studi di Milano, via Celoria 2, 20133, Milano, Italy



UNIVERSITÀ DEGLI STUDI DI MILANO



E-mail:  
ilenia.rossetti@unimi.it  
marcella.guarino@unimi.it

alice.gramegna@unimi.it  
daniela.lovarelli@unimi.it

## SPOKE 8, WP 3, TASK 8.3.2 & TASK 8.4.1

500 L of CH<sub>4</sub>/ day cattle

Potent greenhouse gas  
Unexploited methane source

Adsorption

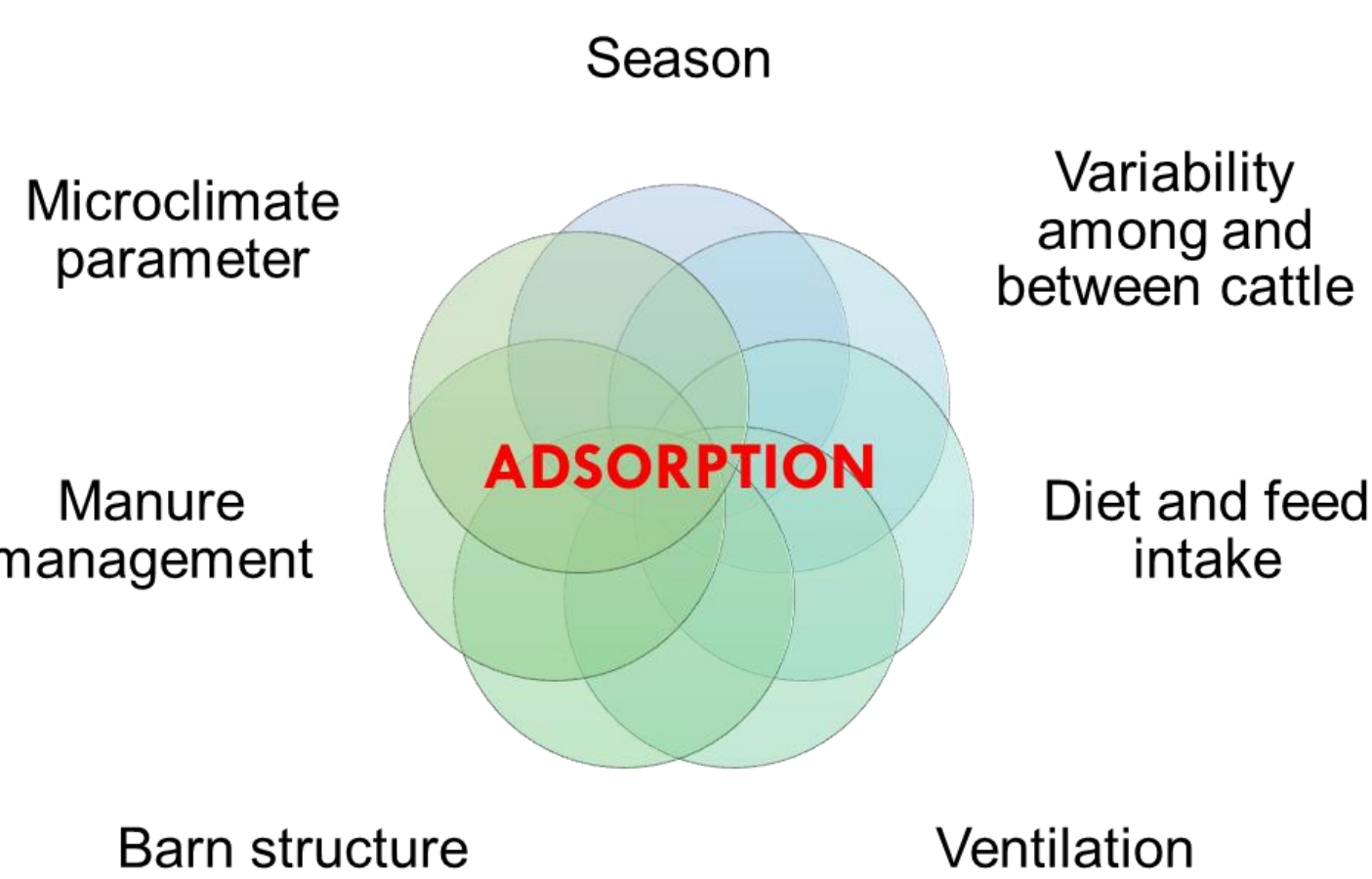
- Easily scalable
- Abundant adsorbent materials

• Techno-economically viable

Biogas upgrading

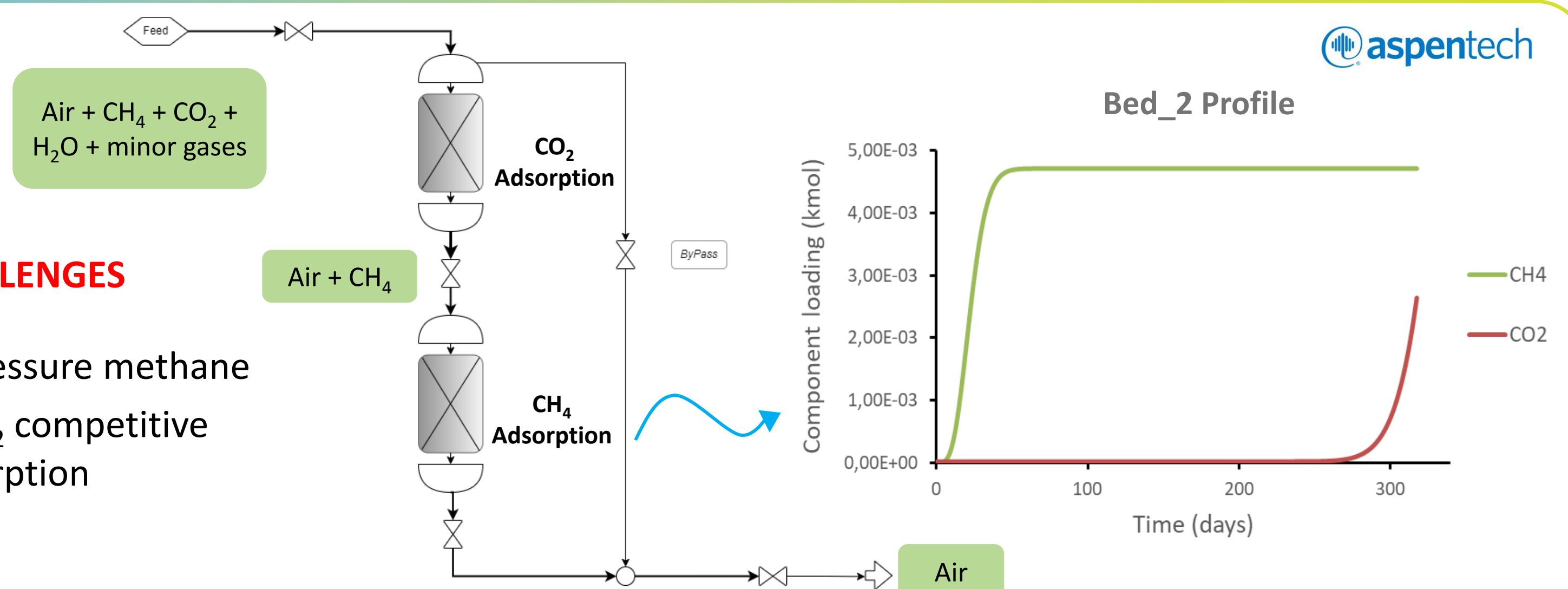
Anaerobic digester

## BACKGROUND AND PROCESS SIMULATION



### KEY CHALLENGES

- Low partial pressure methane
- CH<sub>4</sub> and CO<sub>2</sub> competitive adsorption

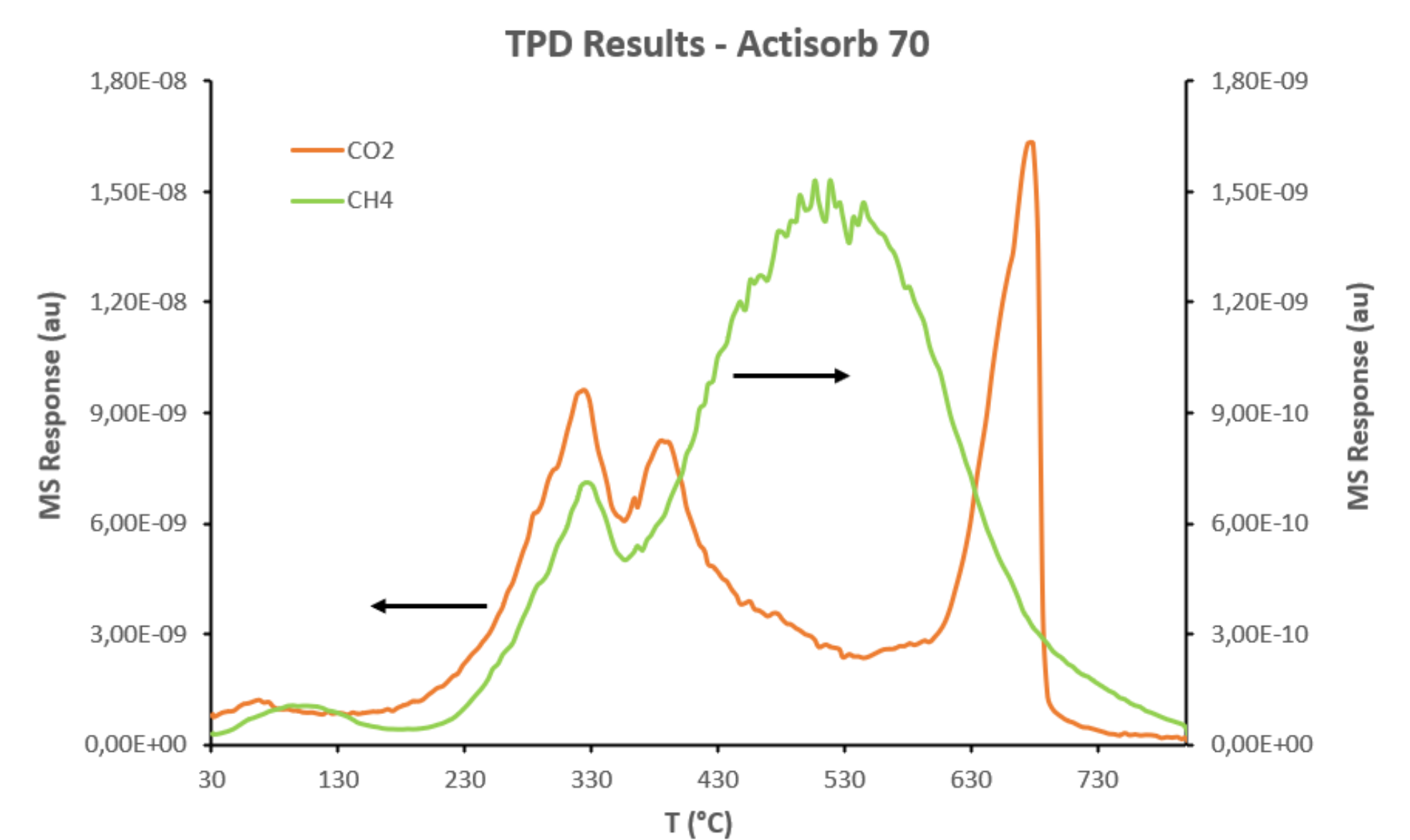
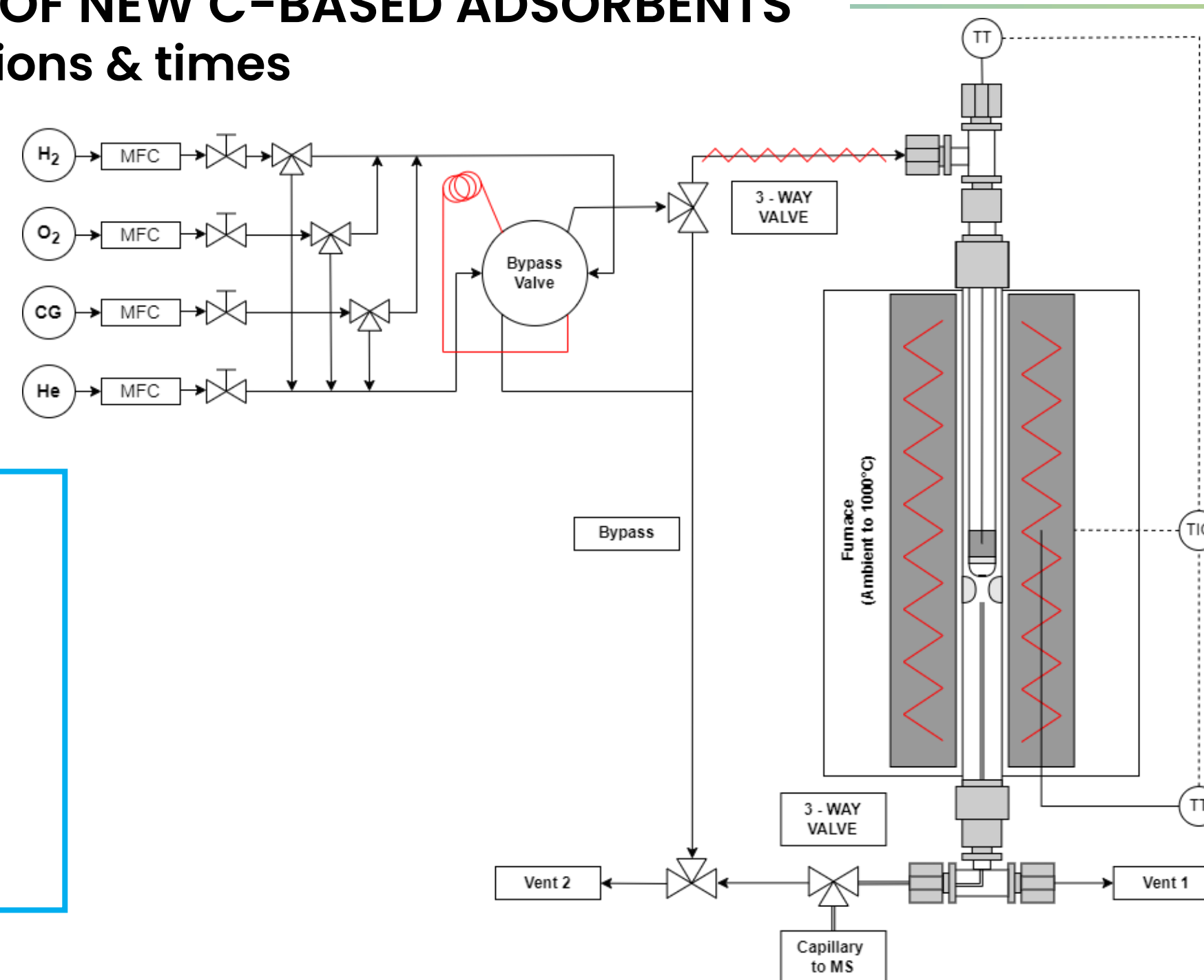


## TEST AND CHARACTERIZATION OF NEW C-BASED ADSORBENTS Exposed in stables various locations & times

CATLAB Microreactor equipped with a MS module

### TPD Analysis

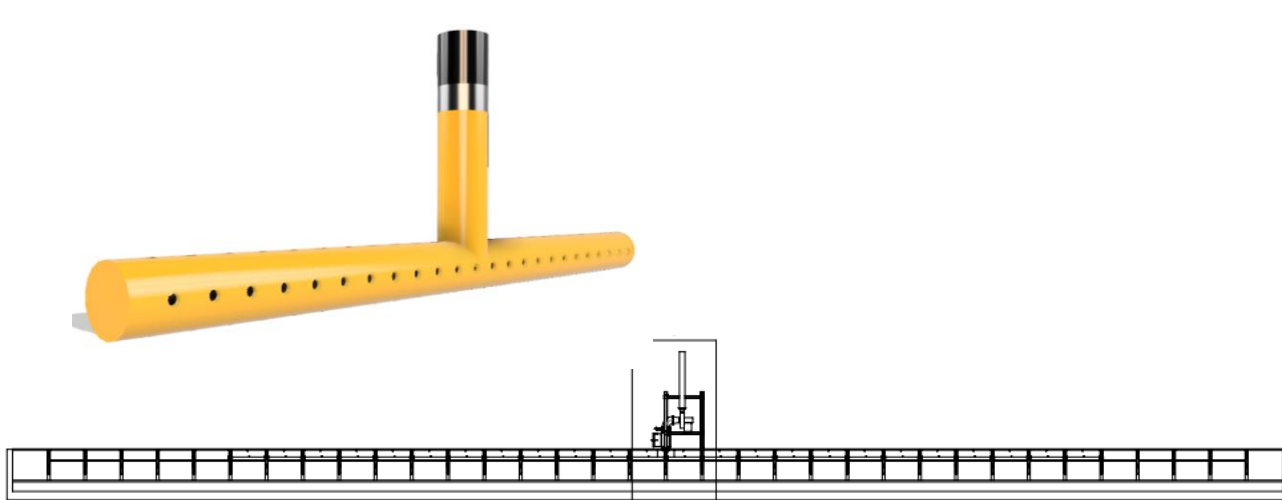
- P = 1 atm
- T range = 30-800 °C
- Heating ramp = 3°C/min
- Quartz reactor → Int. Diam. = 6 mm
- He flux = 25 mL/min
- Sample mass = 60 mg



## PILOT PLANT

### Scaled adsorption system

- Volumetric flowrate = 36 m<sup>3</sup>/h
- Perforated tube design:
  - D = 20 cm, L = 30 m
  - Number of perforation sections = 24, with 4 holes per section



### Experimental Part

- Materials development → focus on CH<sub>4</sub> uptake
- Materials testing → Isotherm collection



### Pilot Plant

Design of a plant for the direct «air» capture → CO<sub>2</sub> + CH<sub>4</sub>

Scale-up

### Real plant



## REFERENCE

[1] Johnson, K. A., & Johnson, D. E.. Methane emissions from cattle. *Journal of Animal Science*, 1995, 73(8), 2483–2492, doi:10.2527/1995.7382483x